The Effects of Exercise-Induced Heart Rate Arousal on Stimulation Seeking and Aggression in College Students

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ABSTRACT

The current study aimed to test sensation seeking as a mediator in the relationship between arousal and aggression. In addition, an experimental design was used to test whether arousal can be manipulated to alter levels of sensation seeking and aggression, both measured behaviorally. A sample of 128 undergraduate students completed state and trait measures of sensation seeking and aggression, and baseline measures of physiology. It was hypothesized that trait sensation seeking would mediate the relationship between baseline physiology and trait aggression. Also, state sensation seeking would mediate the relationship between an arousal manipulation and state aggression. The results failed to support the proposed mediation models. Furthermore, the arousal manipulation was insufficient to result in sustained heart rate differences, and therefore the malleability of state sensation seeking and aggression could not truly be tested. Exploratory analyses supported an interaction between arousal and sensation seeking, such that in individuals low on experience seeking, disinhibition and boredom susceptibility, low heart rate was associated with greater aggression. These findings suggest that arousal and sensation seeking may conjointly predict aggression through moderation rather than mediation, though future studies with improved experimental designs are needed.

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Introduction

Sensation seeking has been offered as one of the potential outcomes of low resting heart rate (HR) that make an individual more likely to become aggressive (e.g., Eysenck, 1997; Quay, 1965; Raine, Venables, & Mednick, 1997). Although this is a frequently cited premise in the literature, there is still an overall lack of strong empirical evidence. Several studies have provided longitudinal, albeit correlational, findings supporting a link between low resting HR, sensation seeking and aggression (e.g., Raine, et al., 1997). At least three meta-analyses address this research question by examining pieces of this pathway (i.e., Lorber, 2004; Ortiz & Raine, 2004; Wilson & Scarpa, 2011). Ortiz and Raine (2004) and Lorber (2004) demonstrated a significant inverse relationship between HR and aggression. Wilson and Scarpa (2011) found a significant positive relationship between sensation seeking and aggression. Additionally, an experimental study supported an inverse causal link between HR arousal and aggression; however, this study did not examine the role of sensation seeking (Ward et al., 2008). One recent longitudinal study found partial support for sensation seeking as a mediator in the relationship between HR level and antisocial behaviors, but again, this study was correlational in nature (Sijtsema et al., 2010). Overall, there is empirical evidence suggesting that individuals with low resting HR have sensation seeking tendencies, which may be expressed through aggression; however, no studies have used a strong experimental design to examine the interplay between all three variables of interest.

Heart Rate Level and Aggression

Of the numerous psychophysiological processes which have been examined in relation to aggression, HR underarousal has been the most consistently replicated in child, adolescent, and adult samples. Furthermore, it has been replicated in studies with both sexes, across various

research designs (Ortiz & Raine, 2004; Raine, 2002), including at least five prospective research studies (i.e., Farrington, 1997; Moffitt & Caspi, 2001; Raine, Venables, & Williams, 1990; Raine et al., 1997; Wadsworth, 1976), and in six different countries (e.g., England, Germany, New Zealand, Mauritius, Canada and the United States; Raine, 2002). The findings suggest that HR underarousal predicts aggression, rather than being a consequence of aggression. Low resting HR has also been linked to aggressive and dominant behaviors in animals, such as rabbits, macaques, baboons and tree-shrews (Eisermann, 1992).

A meta-analysis of 40 studies including 5,868 child and adolescent participants found significant effect sizes for resting HR (d = -0.44, $p < .0001$) and HR during a stressor (d = -0.76, $p < .0001$), in relation to antisocial behavior (Ortiz & Raine, 2004). Furthermore, the results suggested that participant characteristics (e.g., age) and research design (e.g., inclusion of a control group) did not moderate the effect. Thus, the results supported low resting HR as a robust correlate of antisocial behavior and demonstrated that this relationship was homogenous across numerous moderating factors.

Lorber (2004) also conducted a relevant meta-analysis consisting of 95 studies. This meta-analysis included children, adolescent and adult samples, and assessed three behavioral outcomes: aggression, psychopathy/sociopathy and conduct disorder (CD). The results revealed mean effect sizes of -0.38 (95% Confidence Interval of -0.50 to -0.26) for the relationship between resting HR and aggression and -0.33 (95% Confidence Interval of -0.43 to -0.23) for the relationship between resting HR and CD. Conversely, the mean effect size for the relationship between resting HR and psychopathy/sociopathy was 0.06 (95% Confidence Interval of -0.08 to 0.21). Overall, the results of Lorber's meta-analysis demonstrated that lower resting HR was associated with greater aggression and CD, but not significantly related to

psychopathy/sociopathy. Thus, HR underarousal may only be related to specific types of behavioral problems.

To further explore low resting HR in aggressive individuals, substantial research has ruled out potential artifacts, such as height, weight, muscle tone, substance use, intelligence, hyperactivity, inattention, participation in physical exercise, and psychosocial risk factors, including low social class, teen pregnancy, attachment to parents, self-control and parental divorce (Armstrong, Keller, Franklin, & MacMillan, 2009; Farrington, 1997; Raine et al., 1997). In addition, low resting HR is diagnostically specific to disorders that involve aggression, and not simply a reflection of psychopathology (Ortiz & Raine, 2004). For example, Rogeness and colleagues (1990) compared the HR of children and adolescents diagnosed with CD, major depressive disorder and separation anxiety disorder. The results suggested that participants diagnosed with CD had lower resting HR compared to those with mood or anxiety disorders. Although other biological markers of aggression, such as low serotonin levels, have been linked to other psychiatric disorders, research suggests that low resting HR is diagnostically specific to disorders associated with aggression (e.g., CD; Raine, 2002).

A study conducted by Cauffman, Steinberg, and Piquero (2005) found that juvenile delinquents incarcerated for serious crimes (e.g., rape, murder) evidenced significantly lower resting HR than a control sample of non-offending high school students. Furthermore, lower resting HR was an independent predictor of whether the teen was a serious offender or non-offender, above and beyond self-control, which has been suggested by Hirschi and Gottfredson (1995) as another key variable in predicting antisocial behaviors in adolescents. Conversely, Cauffman and colleagues (2005) found that HR level was unrelated to minor delinquent acts within the sample of high school students. Therefore, the results support that lower resting HR is

related to more serious behavioral problems, such as rape and assault, and not a correlate of minor acts of rule-breaking behavior (e.g., school truancy).

Due to the relationship between low resting HR and aggression, it has been suggested that high HR arousal (i.e., high HR reactivity) may function as a protective mechanism against aggressive tendencies (Brennan et al., 1997). Specifically, Brennan and colleagues (1997) found that skin conductance and HR reactivity were significantly higher in noncriminal men with criminal fathers than in criminal men with criminal fathers, criminal men with noncriminal fathers, and noncriminal men with noncriminal fathers. Therefore, these findings suggest that in men who are at high risk of becoming criminals, high HR and skin conductance reactivity are associated with a noncriminal outcome.

Two additional studies have also offered evidence of the protective nature of high HR arousal. In a sample of 23 children (ages 7-12) diagnosed with disruptive behavior disorder, resting HR was collected before and after the completion of an intensive 12-week program aimed at reducing antisocial behaviors (Stadler et al., 2008). The results showed a significantly greater reduction of aggression following treatment in children with high HR compared to those with low HR, and HR level was the only significant predictor of treatment outcome. Additionally, in a sample of 85 male college students, Ward and colleagues (2008) used a stair-climber to induce either high or low HR arousal, and also placed the participants in either an aggression promoting or inhibiting group. The findings showed that participants in the high HR arousal group had significantly lower scores on a competitive reaction-time task than the low arousal group, when they were in an aggression-inhibiting group. Understanding the mechanisms behind the link between HR and aggression may have implications for the treatment of psychological disorders associated with aggression given that increased HR has been linked to reduced aggression, even

in individuals at high-risk of violent tendencies.

Researchers have proposed that certain personality traits may help explain the association between HR underarousal and aggression (e.g., Eysenck, 1967). For example, a recent longitudinal study conducted on participants at the ages of 11, 13.5 and 16, examined if personality traits, such as fun seeking, mediated the relationship between HR level and antisocial behaviors (Sijtsema et al., 2010). In this study, fun seeking was used as an age-appropriate measure of sensation seeking. In boys and girls, HR was negatively associated with fun seeking at age 13.5, and fun seeking at age 13.5 was positively associated with rule breaking at age 16. Furthermore, in boys, fun seeking at age 13.5 mediated the relationship between HR and rule breaking. Sijtsema and colleagues (2010) also found that although HR at age 13.5 was negatively associated with aggression at age 16 in boys, this relationship was not mediated by personality traits. Moreover, in girls, HR was not significantly associated with aggression. However, the mean and standard deviation of the aggression measure was much lower than the rule breaking measure, therefore the non-significant findings may reflect a restricted range of variance. Overall, the findings of Sijtsema and colleagues (2010) partially support the role of the personality trait fun seeking (i.e., sensation seeking) in explaining the link between HR underarousal and antisocial behaviors.

Although a substantial amount of research has supported a significant inverse relationship between HR and aggression, and has even demonstrated the protective role of high HR reactivity, a limited amount of research has directly examined the role of sensation seeking in the relationship between HR and aggression. Furthermore, the majority of the existing research has relied on self-report measures of sensation seeking and aggression, and has been correlational. While Ward et al. (2008) experimentally manipulated HR arousal to examine its effect on

competitive aggressive behaviors, no studies have used an experimental design to test the effect of manipulated HR on sensation seeking and proactive aggression.

Sensation Seeking

The construct of sensation seeking originated in Zuckerman's research exploring individual differences in reactions to sensory deprivation (1964; 1967; 1969). Through these experiments, Zuckerman deprived individuals of visual and auditory sensory input in order to identify person-variables that predicted their responses to the experimental situation (e.g., boredom, anxiety, hallucinations). To aid in the creation of a questionnaire assessing such personality traits, Zuckerman, Kolin, Price and Zoob (1964) used the optimal level of stimulation and optimal level of arousal theories as bases for understanding the wide range of participant reactions. These theories propose that there is a continuum of stimulation/arousal on which there is an optimal level at which stimulation and/or arousal is perceived as pleasurable by an individual, and any stimulation/arousal above or below that level is unpleasant (Wundt, 1893). Accordingly, Eysenck (1967) hypothesized that individuals high on sensation seeking are chronically underaroused and therefore need greater stimulation to achieve and maintain their optimal level of arousal.

Zuckerman et al. (1964) then developed an experimental form (i.e., Form I) of the questionnaire based on the notion that different levels of sensation seeking behaviors would explain differences in the reactions of people. To do so, they created prototypes of individuals they perceived as high sensation seekers, and identified the thoughts and behaviors that characterized these individuals. The items assessed behavioral experiences, intentions, desires, and attitudes related to sensation seeking tendencies. Once a specific behavior or thought had been identified, an item was written in forced-choice format. A forced-choice format was used to

write the items using similar wording and content to attenuate the impact of social desirability (Zuckerman et al. 1964). After generating a collection of forced-choice items, Zuckerman and colleagues (1964) administered the questionnaire to a sample of male and female undergraduate students. Following data collection, Zuckerman et al. (1964) conducted a factor analysis, which provided evidence of a general factor among most of the items. After selecting the items that best represented the single factor, Zuckerman et al. (1964) created the Sensation Seeking Scale II (SSS-II).

The SSS-II was created with narrow construct validity because the primary purpose was to predict participants' responses, such as boredom or anxiety, to Zuckerman's sensory deprivation condition (Zuckerman et al., 1964). However, contrary to Zuckerman's hypothesis that sensory deprivation experiences would be more aversive to high sensation seekers, he found that a greater number of high than low sensation seekers volunteered to participate in the experiment (Zuckerman et al., 1964). Upon inquiry, the researchers found that the high sensation seeking participants were under the impression that the experimental condition could induce a temporary state of insanity, which they viewed as a novel experience that would outweigh the possible risks of the experiment. It was through this discovery that Zuckerman and colleagues recognized that the phenomenon of sensation seeking had applicability in predicting a more diverse set of behaviors than simply participants' reactions to the sensory deprivation study.

Since its introduction, the SSS has been the standard instrument for assessing sensation seeking behavior; however, it has gone through several revisions (Zuckerman, 1971; Zuckerman, Eysenck, & Eysenck, 1978). At the time of the scale's first development, Zuckerman and colleagues were not interested in examining factors other than the single general factor that best captured all of the items. However, a subsequent factor analysis of the SSS-II revealed evidence

of additional subfactors after rotation, and thus additional items that were thought to represent these factors were added. Factor analyses revealed four factors: (i) thrill and adventure seeking (i.e., engaging in physical activities that provide novel sensations; e.g., skydiving), (ii) experience seeking (i.e., seeking novel experiences through the mind or senses; e.g., music), (iii) disinhibition (i.e., a hedonistic lifestyle; e.g., sexual variety), and (iv) boredom susceptibility (i.e., a tendency to find monotonous situations aversive; e.g., restlessness; Zuckerman, 1971). The SSS-IV (Zuckerman, 1971) is a 72-item version of the instrument that assesses the aforementioned factors (i.e., four subscales), as well as the original SSS-II General Scale factor. However, the most commonly used version, the SSS-V (Zuckerman et al., 1978), is an abbreviated 40-item instrument that contains the ten items that load the highest on each of the four subscales from the SSS-IV. The measure was originally developed in a study conducted by Zuckerman et al. (1978), but more recently has been referenced as Zuckerman (1994).

The SSS has been translated into many languages and factor analyses have confirmed the four-factor structure in several countries (Zuckerman, 1990). The construct of sensation seeking thus originated from Zuckerman and colleagues' (1964, 1967) work involving the measurement of individual differences in the perception of optimal levels of stimulation and arousal in response to sensory deprivation; however, its applicability to a wider range of contexts quickly became apparent.

Heart Rate Level and Sensation Seeking

Because the study of sensation seeking is partly based on arousal theory, it is not surprising that research has demonstrated a link between psychophysiological measures of arousal and sensation seeking. Research conducted from 1975 to 1980 revealed an association between questionnaire measures of sensation seeking (e.g., various versions of the SSS) and

psychophysiological measures of arousal (e.g., electroencephalography; EEG), and thus further supported claims of a biological model for this personality trait (Zuckerman, 1979a, 1979b; Zuckerman, Buchsbaum, & Murphy, 1980).

Relevant to the present study, low HR, which is influenced by both sympathetic and parasympathetic (i.e., vagal) activity, is thought to reflect a low level of cardiovascular arousal (Dietrich et al., 2009). As previously stated, according to arousal theory, a low level of arousal is believed to be physiologically unpleasant, thus leading individuals to engage in stimulating behaviors to increase their arousal to an optimal and more comfortable level (Eysenck, 1997). Thus, arousal theory is the basis for the relationship between low resting HR and high sensation seeking behavior.

Despite the influential theoretical assumptions that identify sensation seeking as a potential explanation for low resting HR in aggressive individuals, only a small number of studies have examined the relationship between baseline HR and sensation seeking as their primary research aim. De Pascalis, Valerio, Santoro and Cacace (2007) examined the autonomic responses of individuals that were identified as high or low on the dimensions of neuroticism-anxiety and impulsive-sensation seeking. Results indicated that pre-stimulus HR levels were significantly lower in those with high levels of impulsive-sensation seeking tendencies. Furthermore, the study conducted by Sijtsema and colleagues (2010) found a significant negative association between HR level and fun seeking behavior. Thus, there is some preliminary evidence suggesting that low resting HR is linked to high sensation seeking, which predisposes individuals towards aggression. Overall, the relationship between HR and sensation seeking has been the focus of fewer studies than the relationships between HR and aggression, and sensation seeking and aggression.

Sensation Seeking and Aggression

Substantial research has supported sensation seeking as a primary explanatory construct for a wide range of risky behaviors, including promiscuous sex, smoking, parachuting, and gambling (Zuckerman, 1979a, 1979b, 1994, 2007). One domain of behavior that has received a considerable amount of empirical attention is aggression, as well as numerous aggression-related constructs, such as psychopathy, conduct problems and antisocial personality traits (Zuckerman, 2007). In fact, the relationship between antisocial behaviors and sensation seeking has been studied in children as young as six years old (Zuckerman, 2007). For example, Kafry (1982) found that child participants' (ages 6-10) scores on a SSS-child form were positively correlated with the number of age-relevant antisocial activities. Sensation seeking has been empirically linked to a greater need for stimulation across the lifespan, which often includes socially deviant behaviors (e.g., conduct problems, preference for violent stimuli; Zuckerman, 2007).

Not only have sensation seeking and aggression been linked through empirical findings, but they also correlate in development. Arnett (2000) identified a period of development he coined "emerging adulthood," during which time individuals tend to forfeit childhood norms, values and expectations, but delay accepting the norms and responsibilities associated with adulthood. Research suggests that risky behaviors (e.g., unprotected sex, drug use) and violent crimes (e.g., rape, assault) peak during this developmental stage (Arnett, 1992), and diminish in adulthood (Slater, Henry, Swaim, & Anderson, 2003). In addition, research has demonstrated that sensation seeking behaviors also peak during this "emerging adulthood" period of development (Steinberg et al., 2008) and then decrease (Slater et al., 2003). Therefore, the relationship between aggressive behaviors and sensation seeking tendencies has even been revealed in developmental trends.

A recent meta-analysis was conducted on 43 independent effect sizes, from studies with a total of 32,217 participants, to test the hypothesis that sensation seeking would be positively related to aggression across studies (Wilson & Scarpa, 2011). A significant overall effect size of $d = .19$ ($p < .001$) was found, supporting the hypothesis. Therefore, across studies, the overall mean effect size was small, but significant, and therefore supported the notion that greater sensation seeking is associated with greater levels of aggression.

Wilson and Scarpa (2011) conducted moderator analyses that revealed that the relationship differed based on participant and methodological characteristics. For example, the results supported a significant positive linear relationship between participant age and the magnitude of the effect size. The authors suggested that this finding may reflect heterotypic continuity, meaning that an underlying vulnerability may manifest differently across the lifespan (Costello, Mustillo, Erkanli, Keller, & Angold, 2003). The majority of the adult participants in the meta-analysis were college students (i.e., ages 18-22) and the positive linear trend may also support the role of Arnett's (2000) "emerging adulthood" period, during which sensation seeking and aggression peak. Because this meta-analysis suggests that the effect size representing the relationship between sensation seeking and aggression may be of greater magnitude in a young adult population, the proposed study will use college students as participants in an attempt to increase power.

Wilson and Scarpa (2011) also found that studies that measured multiple aspects of aggression (e.g., behavior, affect, cognition) yielded significantly larger effect sizes than studies that only measured behavioral aspects of aggression. These findings are consistent with Joireman and colleagues (2003) who found that hostile cognitions and negative affect play an important role when examining the relationship between sensation seeking and aggression. Hence, the

proposed study will use a laboratory measure of aggression and two self-report questionnaires of aggression.

Constructs of Interest

The variables of interest will be clearly defined because there is wide variability in their use in the literature.

Arousal. It is important to note that arousal is not a unitary construct, but rather reflects an interconnection between systems (e.g., central and peripheral nervous systems), as measured through variables such as HR, skin conductance activity and EEG. Therefore, in the current project, underarousal will be defined as a state of low activation in the autonomic nervous system, as measured by HR and heart rate variability (HRV).

HR and HRV were chosen as the physiological measures of choice for the current study because substantial evidence supports low resting HR as the most replicated psychophysiological correlate of aggression (Ortiz & Raine, 2004) and HR level as a significant biological correlate of sensation seeking (De Pascalis et al., 2007). Specifically, low HR, which is influenced by both sympathetic and parasympathetic (i.e., vagal) activity, is thought to reflect a low level of cardiovascular arousal (Dietrich et al., 2009). That is, cardiovascular arousal is jointly determined by the sympathetic and parasympathetic branches of the autonomic nervous system, where sympathetic activation is thought to increase HR and parasympathetic activation decrease HR. According to arousal theory, a low level of arousal is believed to be physiologically unpleasant and lead individuals to engage in stimulating behaviors to increase their arousal to an optimal level (Eysenck, 1997), which in some individuals may be exhibited through forms of aggression. Thus, the proposed hypotheses are based on relationships between low resting HR, high sensation seeking and high levels of aggression.

HRV, or the beat-to-beat alterations in HR, will be included as an additional measure of arousal to clarify the findings. Because resting HR is influenced by both the sympathetic and parasympathetic branches, it is necessary to include HRV as a way to elucidate the parasympathetic influences because it is widely accepted that HRV is an indicator of parasympathetic activity (Berntson, Cacippo, Quigley, & Fabro, 1994). Therefore, HR is the primary arousal measure of interest; however, HRV will be used to clarify and interpret the results.

Sensation seeking. "A trait defined by the seeking of varied, novel, complex and intense sensations and experiences, and the willingness to take physical, social, legal and financial risk for the sake of such experience" (Zuckerman, 1994, p. 27). In the current study, to help clarify, "trait sensation seeking" will be used to refer to relatively stable individual differences in sensation seeking tendencies and will be measured with the SSS-V (Zuckerman, 1994). Because one of the primary research aims is to examine whether or not exercise-induced HR arousal results in changes in sensation seeking behavior, it will be necessary to obtain a more transitory measure of sensation seeking. Sensation seeking may be thought of as a personality disposition that leads individuals to make risky decisions because of the sensation and thrill the experiences may provide. Indeed, by definition, a high sensation seeker is an individual who is willing to make high risk decisions without regard for the consequences, for the sake of novel, varied, complex, or intense experiences. Therefore, in the current study a measure of risky decision-making will be used to measure sensation seeking tendencies post-intervention. The term "state sensation seeking" will be used throughout the paper to refer to the post-task measure of risky decision-making, which may vary from moment-to-moment and is malleable. This process of decision-making will be measured via the Risky Behavior Driving Task.

Aggression. Aggression is a multidimensional construct that involves cognitive (e.g., cynicism), affective (e.g., anger) and behavioral (e.g., inflicting physical harm) elements (Ziherl, Travnik, Plesnicar, Tomori, & Zalar, 2007). Thus, aggression will be defined as an amalgamation of several components: (i) negative beliefs about others, (ii) anger and hostility, and (iii) actual, attempted or threatened physical or verbal acts against another individual in which the intent is to inflict harm.

In this area of the literature, it is important to distinguish between proactive (i.e., premeditated) and reactive (i.e., impulsive) aggression. This distinction is important because high sensation seekers have a tendency to expect positive outcomes as a result of their risk-taking behaviors (Zuckerman, 1979a), which is a characteristic of proactive aggression (Smithmyer, Hubbard, & Simons, 2000). For example, Scarpa, Haden and Tanaka (2010) found that proactive aggression, which is defined as non-emotional aggression used to obtain a goal, was significantly associated with increased HRV, hyperactivity/impulsivity, and delinquent behaviors. Conversely, reactive aggression, or responding to a perceived threat with aggression, was significantly associated with decreased HRV, internalizing problems and attention deficits. Therefore, for the purposes of the current study, the term "aggression" will be specific to proactive aggression, unless otherwise specified.

Similar to sensation seeking, the term "state aggression" will be used to refer to transitory aggression following the arousal intervention and will be measured using the Hot Sauce Paradigm (Lieberman, Solomon, Greenberg, & McGregor, 1999), also called the Hot Sauce Allocation Test. The Hot Sauce Paradigm will be considered a state measure of the affective, cognitive and behavioral elements of proactive aggression because the participants will be given an opportunity to aggress towards a stranger in an unprovoked situation. "Trait aggression" will

be used to refer to relatively stable individual differences in aggression and will be measured using the Aggression Questionnaire (Buss & Perry, 1992) and Impulsive/Premeditated Scale of Aggression (Stanford, Houston, Mathias, Villemarette-Pittman, Helfritz, & Conkilin, 2003). Both measures were included because the Aggression Questionnaire assesses the form (e.g., physical) and traits (e.g., hostility) of aggression, whereas the Impulsive/Premeditated Scale of Aggression assesses the function of the aggressive behavior (e.g., premeditated).

The Current Study

Collectively, previous research provides a strong argument for the hypothesis that HR underarousal increases the likelihood that an individual will engage in sensation seeking, which increases the probability that an individual will engage in aggressive acts. However, few studies have examined the complex relationships between HR, sensation seeking and aggression in a single study. Furthermore, studies that have been conducted in this area frequently fail to include behavioral measures of sensation seeking and aggression, and no studies have experimentally manipulated HR to examine the effects on both sensation seeking and aggression. This limitation of previous research is largely due to the fact that sensation seeking is a personality trait, and therefore by definition cannot be experimentally manipulated. The current study will contribute to the literature by using a behavioral measure of risky decision-making to serve as a state measure of sensation seeking behaviors, therefore allowing the researcher to examine the effects of exercise-induced HR arousal on sensation seeking and aggression. Additionally, the current study will contribute by using an experimental design to manipulate HR arousal and include multi-modal measures of sensation seeking and aggression. In sum, the current study will experimentally manipulate HR arousal to examine whether high HR arousal is in fact a protective factor against aggression via decreased sensation seeking tendencies.

Hypotheses

The hypotheses for the current study will be presented in two sections: (i) trait measures and (ii) state measures.

Hypotheses Part I (Trait Measures)

It is predicted that trait sensation seeking will mediate the relationship between resting HR/HRV and trait aggression. Two sets of analyses will be conducted to examine HR and HRV separately. To explain the first set of hypotheses, the causal steps of Baron and Kenny (1986) will be presented to theoretically outline the predicted results. First, to demonstrate mediation, baseline HR will be negatively associated with trait aggression, as measured by the Aggression Questionnaire and Impulsive/Premeditated Scale of Aggression. Next, baseline HR will be negatively associated with trait sensation seeking, as measured by the SSS-V. Third, once controlling for baseline HR, trait sensation seeking will remain positively related to trait aggression. To demonstrate mediation, the relationship between baseline HR and trait aggression, after controlling for trait sensation seeking, will become non-significant or be substantially reduced.

The same theoretical steps apply for outlining the hypotheses related to HRV as the predictor. First, baseline HRV will be positively associated with trait aggression, as measured by the Aggression Questionnaire and Impulsive/Premeditated Scale of Aggression. Next, HRV will be positively associated with trait sensation seeking, as measured by the SSS-V. Third, once controlling for baseline HRV, trait sensation seeking will remain positively related to trait aggression. To demonstrate mediation, the relationship between baseline HRV and trait aggression, after controlling for trait sensation seeking, will become non-significant or be substantially reduced.

Hypotheses Part II (State Measures)

It is predicted that state sensation seeking, as measured by the Risky Driving Behavior Task, will mediate the relationship between HR arousal groups and state aggression, as measured by the Hot Sauce Paradigm. To explain the second set of hypotheses, the causal steps of Baron and Kenny (1986) will be presented to theoretically outline the predicted results. First, the HR arousal experimental groups will significantly differ on state aggression, such that the 'exercised-induced arousal' group will score significantly lower on state aggression (i.e., Hot Sauce Paradigm) than the 'no arousal' group. Second, the HR arousal experimental groups will significantly differ on state sensation seeking, such that the 'exercised-induced arousal' group will score significantly lower on state sensation seeking (i.e., Risky Behavior Driving Task) than the 'no arousal' group. Third, once controlling for the arousal groups, state sensation seeking will remain positively related to state aggression. To demonstrate mediation, the relationship between arousal group and state aggression, after controlling for state sensation seeking, will become non-significant or substantially reduced.

Method

Participants

The total sample included 146 undergraduate and graduate students between the ages of 18 and 25 (M = 19.47, SD = 1.22). Of the 146 students who completed both Phase I and II of the study, 18 are excluded from the analyses presented here. The reasons for excluding each participant is discussed in the preliminary analyses section of the results. Therefore, the final sample included 128 students (26.6% male, 73.4% female). The sample consisted of 82% Caucasian, 6.3% Asian American/Asian Origin/Pacific Islander, 3.9% African American, 3.9% Hispanic/Latino/Latina, 2.3% biracial/multiracial, and 1.6% American Indian/Alaska Native.

The sample was predominantly undergraduate students (98.4%). The majority of the participants indicated that the annual income of the household they grew-up in was more than $75,001 (67.2%). See Tables 1 and 2 for a more complete list of the descriptive statistics.

To be included, the participants had to be undergraduate or graduate students, physically healthy and confident enough to engage in 30 minutes of moderate exercise, report no major medical problems (e.g., asthma, heart condition), and have no allergies to the ingredients of the hot sauce that was used in the study (i.e., Hot Sauce Paradigm). The participants were recruited through flyers posted on campus, verbal announcements in classes at Virginia Tech, and Virginia Tech's SONA online experiment management system.

The inclusion and exclusion criteria were selected because they are relevant to the proposed research questions. The participants had to be an undergraduate or graduate student because Wilson and Scarpa (2011) found that the relationship between sensation seeking and aggression may differ for non-student adults compared to college-age adults. That is, the meta-analysis suggested that the effect size representing the relationship between sensation seeking and aggression may be of greater magnitude in a young adult population and therefore the proposed study used college students as participants in an attempt to increase power.

The participants had to be healthy and confident enough to engage in 30 minutes of moderate exercise because participants were asked to walk on a treadmill to manipulate their physiological arousal. Additionally, the participants had to have no food allergies to any of the ingredients in the hot sauce because they were asked to handle the hot sauce. Therefore, the inclusion criteria were to ensure the safety of the participants and to properly examine the research questions.

The number of participants included should be adequate to detect an effect for the mediation analysis according to Fritz and MacKinnon (2007). The average effect size between HR and aggression was *d* = -.44 in Ortiz and Raine (2004) and *d* = -.33 in Lorber (2004). Furthermore, Wilson and Scarpa (2011) found that the average effect size between sensation seeking and aggression was *d* = .19. However, the average effect size was much larger in college samples (*d* = .33). No meta-analyses have examined the relationship between HR and sensation seeking. Based on McNamara and Ballard (1999), however, the mean effect size calculated from the correlations between resting HR and the four subscales of the SSS-IV was *d* = -.28. Fritz and MacKinnon (2007) found that for the PRODCLIN program, a sample size of 126 would be adequate for an α path (i.e., predictor and mediator) of .26 and a β path (i.e., mediator and outcome) of .39, which are comparable to the effect sizes reported here. Therefore, the current sample of 128 should be adequate for the analyses.

Phase I Self-Report Measures (See Table 1)

Demographic Questionnaire (Appendix A). Participants completed a demographic questionnaire that included questions about their background, such as age, gender, race, income, and socioeconomic status (SES). The participants had to be between the ages of 18 and 25 in order to be invited to participate in Phase II of the study. Several of the demographic variables, such as income, will be entered as covariates in the proposed analyses. Identifying information was collected on the Demographic Questionnaire to ensure there was enough information for the participants to receive their incentives, and to match their Phase I and Phase II responses. However, the identifying information was stored separately from the questionnaire responses.

Health Questionnaire (Appendix B). Participants completed a self-report questionnaire to screen for significant medical problems (e.g., dizziness, chest discomfort, asthma) that may

interfere with their ability to safely complete the arousal task in Phase II of the study. The Health Questionnaire was also used as a screener to ensure that all participants were physically healthy and confident enough to engage in 30 minutes of moderate exercise. Participants were asked questions that inquired whether they were allergic to any food items and the researcher was particularly interested in allergies to the ingredients in the hot sauce. The Health Questionnaire was based on the AHA/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire (Balady et al., 1998). If participants reported any medical concerns, difficulties related physical exertion, or allergies to ingredients in the hot sauce, then he or she was not invited to participate in Phase II of the study.

Cardiorespiratory Fitness (VO_{2max}; George, Stone, & Burkett 1997; Appendices C and D). Previous research (e.g., Armstrong et al., 2009) suggests that fitness level does not affect the relationship between arousal level and aggression. However, the current study is the first known experimental design to test the relationship between arousal, sensation seeking, and aggression. Therefore, because an exercise task will be used to manipulate arousal level, it is necessary to obtain information related to cardiorespiratory fitness levels, which will be entered as a covariate in the proposed analyses.

The American College of Sports Medicine (2006) suggests the best way to measure cardiorespiratory fitness is to use a fitness test to estimate $VO_{2max.}$ However, most of these tests require that the participants obtain medical clearance prior to participation, may be dangerous if an individual is not healthy enough, and many of the tests are time-consuming and strenuous. Instead, the current study used a non-exercise VO_{2max} estimate that is based on questionnaire responses and participant characteristics. This non-exercise estimate has been empirically

supported as providing results comparable to a fitness test estimate in a similar sample (George et al., 1997).

George et al. (1997) created a regression equation that estimates VO_{2max} based on the participants' perceived functional ability to walk, jog or run a specified distance (i.e., Perceived Functional Ability; PFA; Appendix C; George et al., 1997), information about the participants' physical activity during the previous 6 months (i.e., Physical Activity Rating; PA-R; Appendix D; George et al., 1997), body mass index (BMI), and gender. The PFA asks the participants to rate from 1 to 13 the pace they would use to complete one mile on a track and how fast they could cover a distance of three miles. The PA-R is a modified version that originally appeared in Jackson, Blair, Mahar, Weir, Ross, and Stuteville (1990). The PA-R asks the participants to rate from 0 to 10 the overall level of physical activity they have achieved in the previous 6 months. The equation used is VO_{2max} = 43.513 + (6.513 * gender) – (0.749 * BMI) + (0.724 * PFA) + (0.788 * PA-R). In the equation, gender is coded as 0 = male and 1 = female. This equation has been validated for a physically active college sample and provides estimates of VO_{2max} comparable to fitness measures of VO_{2max}. Higher scores reflect greater cardiorespiratory fitness levels.

In a sample of 100 physically active male and female college students ages 18 to 29 years old, George and colleagues (1997) found an average VO_{2max} of 44.05 (*SD* = 6.60). In a similar study of college students, Dolgener, Hensley, Marsh and Fjelstul (1994) found an average VO_{2max} of 42.40 (*SD* = 12.90). As seen in (Table 1), the average VO_{2max} of the current sample was 47.56 (*SD* = 5.88). Therefore, the current sample evidenced high cardiovascular respiratory fitness levels, even for a physically active college student sample.

Zuckerman Sensation Seeking Scale (SSS-V; Zuckerman, 1994; Appendix E). The participants completed the SSS-V (Zuckerman, 1994), which is currently the most widely used and accepted measure of sensation seeking (Zuckerman, 2004). It is a 40-item, forced-choice list of statements, during which the participants were asked to choose which of the two sentences best describes them. The SSS-V consists of four 10-item subscales: Thrill and Adventure Seeking (e.g., "I like to dive off the high board;" "I don't like the feeling I get standing on the high board."), Experience Seeking (e.g., "I would like to take off on a trip with no pre-planned or definite routes, or timetable;" "When I go on a trip I like to plan my route and timetable fairly carefully."), Disinhibition (e.g., "A person should have considerable sexual experience before marriage;" "It's better if two married persons begin their sexual experience with each other."), and Boredom Susceptibility (e.g., "I get bored seeing the same old face;" I like the comfortable familiarity of everyday friends."). Each subscale score can range from 0 to 10, with greater scores reflecting greater sensation seeking tendencies. For the current study, the SSS-V was administered as a trait measure of sensation seeking.

Previous research suggests the SSS-V subscales have good internal consistency. Following a thorough literature review of all studies using the SSS-V that reported reliability estimates, Deditius-Island and Caruso (2002) reported the following mean reliabilities: .75 for Thrill and Adventure Seeking, .69 for Experience Seeking, .69 for Disinhibition and .62 for Boredom Susceptibility. This review suggested that the subscale with the lowest internal consistency across studies was the Boredom Susceptibility subscale. Studies that administered the SSS-V to college students (e.g., Hampson, Ellis, & Tenk, 2008) have found Cronbach's alphas similar to the mean reliability coefficients demonstrated by the review conducted by Deditius-Island and Caruso (2002). As seen in (Table 1), the Cronbach's alphas for the subscales

for the current study are as follows: .72 for Thrill and Adventure Seeking, .46 for Experience Seeking, .79 for Disinhibition and .57 for Boredom Susceptibility. Therefore, in the current study, the internal consistencies of the Thrill and Adventure Seeking and Disinhibition subscales were adequate. However, the internal consistency of the Boredom Susceptibility subscale was somewhat low and the internal consistency of the Experience Seeking was quite low. This is surprising given that the measure was designed with and normed on an undergraduate sample.

Aggression Questionnaire (AQ; Buss & Perry, 1992; Appendix F). The participants completed the AQ (Buss & Perry, 1992), which consists of 29-items that measure aggressive tendencies. The participants were asked to rate how characteristic each item is of them from 1 (extremely uncharacteristic of me) to 5 (extremely characteristic of me). The AQ consists of four subscales: Physical Aggression (e.g., "If somebody hits me, I hit back"; 9 items), Verbal Aggression (e.g., "I often find myself disagreeing with people"; 5 items), Anger (e.g., "When frustrated, I let my irritation show"; 7 items) and Hostility (e.g., "I know that 'friends' talk about me behind my back"; 8 items), thus representing the behavioral, affective and cognitive components of aggression. The scores on the AQ subscales can have the following ranges: Physical Aggression 9 to 45, Verbal Aggression 5 to 25, Anger 7 to 35, and Hostility 8 to 40. For the current study, the AQ was used as a trait measure of the behavioral, affective and cognitive aspects of aggression.

Previous research demonstrates that the internal consistency of the four subscales and total score range from .72 to .89 (Buss & Perry, 1992). In terms of test-retest reliability, across nine-weeks, the correlations ranged from .72 to .80 for the subscales and total score (Buss & Perry, 1992). In the current study, the Cronbach's alphas were as follows: .86 for Physical

Aggression, .80 for Verbal Aggression, .80 for Anger, and .80 for Hostility. Therefore, the subscales had adequate internal consistency.

Impulsive/Premeditated Aggression Scale (IPAS; Stanford, Houston, Mathias, Villemarette-Pittman, Helfritz, & Conklin, 2003; Appendix G). Participants completed the IPAS, which is a 30-item measure of impulsive (e.g., "When angry I reacted without thinking;" 8 items) and premeditated (e.g., "I understood the consequences of the acts before I acted;" 12 items) aggression. Participants rated each item from 1 (i.e., strongly disagree) to 5 (i.e., strongly agree) for the previous 6 months. Any items the participants answered as "agree" or "strongly agree" were rated as positive endorsements. The percentages of positive items for both the impulsive and premeditated subscales were then calculated. Higher percentages on each subscale indicate greater levels of that type of aggression. The IPAS was included in the current study as a measure of trait aggression that differentiates between impulsive (e.g., reactive) and premeditated (e.g., proactive) aggression.

In a college sample, the IPAS demonstrated high internal consistency (i.e., Cronbach's alpha of .77 for the impulsive aggression subscale and .81 for the premeditated aggression subscale; Haden, Scarpa, & Stanford 2008). As seen in (Table 1), the Cronbach's alpha for the premeditated subscale was high (i.e., .75) in the current study. Conversely, the internal consistency of the impulsive subscale was somewhat low (i.e., 56) for the current sample.

Taste Preference Inventory (Appendix H). This inventory consists of five tastes: spicy, sweet, tangy, sour and salty. The participants were asked to rank their preference for each taste from 1 (Extreme dislike) to 7 (Extreme like). The Taste Preference Inventory was administered as part of the deception involved in the current study because during the laboratory portion the participants were shown fake responses on this questionnaire by a fictitious "other" participant.

Psychophysiological Measures

Heart Rate (HR) and Heart Rate Variability (HRV). The Polar Heart Rate Monitor Model RS800sd (i.e., Polar monitor; Polar Electro, USA) is an ambulatory HR monitor that provides a wireless, valid and continuous recording of HR and R-R variability (i.e., HRV) that is comparable to the electrocardiogram, during both stationary laboratory tasks and physical exercise (e.g., riding a bicycle, running; Gamelin, Berthoin, & Bosquet, 2006; Goodie, Larkin, & Schauss, 2000). The polar monitor uses a combined sensor and transmitter that is strapped across the participant's chest with an elastic band, and a receiver that is worn on the non-dominant hand of the participant. The sensor detects cardiac electrical impulses and the signal is transmitted to the receiver which calculates the interbeat interval (IBI). The IBI is then converted into a HR recording, which is displayed on the receiver. The data were stored in the receiver until after the research session, when they were uploaded to a computer using the Polar computer interface unit and Polar HR Analysis Software (Polar Electro, USA). For the current study, R-R intervals were detected with a resolution of one millisecond and converted into HR, measured in beats per minute (bpm).

Participants wore the Polar Heart Rate Monitor throughout the entire laboratory session. Event marks were created to indicate the beginning and end of the baseline period (i.e., two minutes), treadmill task (i.e., approximately two minutes for the 'no arousal' group, four minutes for the 'exercise-induced arousal' group), driving game (i.e., approximately three and a half minutes), and hot sauce task (i.e., approximately 30 seconds). For the current study, the specific physiology variables that were analyzed were HR and the square root of the mean squared differences of successive heart periods (RMSSD). RMSSD is a time domain measure of high frequency variability in heart periods. It is one of the most commonly used physiology measures

of HRV and is recommended for when researchers are interested in time domain HRV measurement (Task Force of the European Society for Cardiology and the North American Society for Pacing and Electrophysiology, 1996). A study examining validity issues related to HRV found that RMSSD provided results comparable to both high frequency power and respiratory sinus arrhythmia (RSA; Friedman, Allen, Christie, & Santucci, 2002). Across the two studies examining the comparability of these psychophysiology measures, the correlation between RMSSD and the other measures ranged from .70 to .89. These measures also behaved similarly within and across conditions, and provided similar differentiations between groups on tasks. Further, the two main limitations of RMSSD that have been offered in the literature (i.e., stationarity and equal sampling) were not found to have a significant impact on the results and therefore are not likely of concern when analyzing real data. Given that RMSSD is more computationally simple, does not depend on the collection of respiration data, and research has found that many of the suggested limitations of RMSSD may not be present when used with real data, RMSSD is a robust measure of HRV.

Phase II Laboratory Tasks

Baseline Video. Baseline psychophysiological data were recorded while the participants watched a relaxing video of aquatic scenery with soothing music ("Coral Sea Dreaming," Small World Music, Inc.) for two minutes. The participants were seated in a comfortable chair and asked to look at the computer screen in front of them. According to Piferi, Kline, Younger, and Lawler (2000), watching a relaxing aquatic video was a more effective method of achieving baseline and recovery levels of cardiovascular activity than the traditional method, during which participants were simply asked to "sit quietly." The average resting HR of the participants in the current study was 73.51 (*SD* = 12.61) and resting RMSSD was 55.74 (*SD* = 38.39; See Table 1).

Treadmill Arousal Task. The participants were randomly assigned to either a 'no arousal' or 'exercise-induced arousal' group. Participants in the 'exercise-induced arousal' group walked on a treadmill until their HR was elevated to the lower of two values: 70% beyond their baseline level, or 85% of their age-predicted maximal HR (American College of Sports Medicine, 2006). Once the participants achieved the desired level of HR arousal, they were asked to walk for two minutes at a pace that maintained their assigned HR level. Age-predicted maximal HR is equal to 220 – age and it is not recommended that individuals exceed this value because it may be dangerous. For example, the age-predicted maximal HR for an 18 year old participant would be 220-18 = 202 bpm and therefore the highest level of arousal an 18 year old participant would be asked to achieve would be 85% x 202 = 171.7 bpm. The 'no arousal' group walked on the treadmill for two minutes at a pace that kept their HR within 30% of their baseline level. After piloting several participants, the researcher observed that participants typically evidenced a 20% increase beyond baseline HR from simply standing and walking to the treadmill. Therefore, a 30% increase in HR from baseline is minimal and results from minor movement and effort. In the current study, 65 participants were randomly assigned to the 'no arousal' group and 63 were randomly assigned to the 'exercise-induced arousal' group.

Risky Behavior Driving Task (Mather, Gorlick, & Lighthall, 2009). The participants completed a risky decision-making computer driving game used by Mather and colleagues (2009). The computer game took approximately 5-minutes to complete, including the practice trials and instructions. The participants had to decide how quickly to stop a car at a yellow light by pressing the space bar on the keyboard. While pressing the accelerator key, the car moved across the screen at a constant speed. The longer the car traveled across the screen, the more points the participant received. As soon as the car began to move, the traffic light turned yellow

and remained yellow for a predetermined amount of time that varied between trials (2 to 7 seconds). The participants were instructed to release the accelerator key whenever they would like to stop the car, which also stopped the point counter. If the car was stopped before the light turns red, then the participant was awarded the points and he or she heard a "yippee!"; however, if the light turned red before the car was stopped, then the participant lost all of the points for that trial and he or she heard a police siren. The number of points earned by the participant was a measure of risky behavior. In the current study, this task served as a measure of state sensation seeking. To clarify the results for the reader, the risky behavior driving task score was reverse coded. Therefore, more driving points represented greater levels of sensation seeking.

Hot Sauce Paradigm (Lieberman et al., 1999). The Hot Sauce Paradigm, a task that takes less than 5-minutes to complete and relies on deception, was used to measure state aggression (Lieberman et al., 1999). During this task, the research assistant announced that it was time for the food tasting portion of the session and that the participant had been randomly chosen to act as the food selector. The subjects were told that another participant in a separate room had been selected as the food taster; however, the other participant was fictitious.

The participant then looked at the fictitious participant's responses to the Taste Preference Inventory, which indicated that the person does not like spicy food (i.e., rating of 1 out of 7, indicating "extreme dislike"). The participant was told to taste the hot sauce to know exactly how hot it was. Because the typical commercial hot sauce is so spicy that it is ordinarily applied in a volume consisting of one to two drops, Lieberman and colleagues (1999) created their own recipe to allow for a greater range of responses. Therefore, the hot sauce used in the current study was made following the same recipe (i.e., a mixture of 5 parts Heinz chili sauce and 3 parts Tapatio salsa picante hot sauce from Empacadora Company, Vernon, CA). In Lieberman and

colleagues (1999) this mixture was rated as "quite hot" (i.e., 7.2 on a 9-point scale, with 9 representing extremely hot). In the current study, 86.8% of the participants reported the spiciness of the hot sauce as a 3 or above on a scale of 1 (i.e., not at all spicy) to 5 (i.e., very spicy; See Table 2). The participant was asked to choose the amount of hot sauce to place in a plastic container for the fictitious participant, place the lid on it, and slide the container into a paper bag to be delivered to the other participant. A second research assistant then appeared in the room to take the food sample to the other participant.

Aggression was measured as the amount of hot sauce the participant poured into the container, which was weighed on a food scale in ounces after the participant left. Previous research (e.g., McGregor, Lieberman, Greenberg, Solomon, Ardt, Simon, et al., 1998; Lieberman et al., 1999) suggests that the Hot Sauce Paradigm is a valid behavioral measure of aggression that is not subject to many of the ethical and practical limitations of other measures. Specifically, it is inexpensive to carry out the task, the behavior is easily quantifiable, the behavior is less likely to reflect competition than other lab tasks, and spicy food has been used in real world acts of aggression (Ritter & Eslea, 2005). For example, as cited in Ritter and Eslea (2005), a cook purposely placed Tabasco sauce in the food of two state troopers in a New Hampshire Denny's and he was arrested for assault.

The procedure for the Hot Sauce Paradigm in the current study is slightly modified from the procedures typically seen in the literature. The current procedure does not include any provocation by the fictitious participant. This decision was made so that the current task serves as a measure of proactive and not reactive aggression because of the theoretical connection to sensation seeking. The procedure nonetheless does include the vital parts to ensure that this is a behavioral measure of aggression. Specifically, the paradigm requires that some manipulation

occurs that is hypothesized to influence aggression (i.e., exercise-induced arousal), the participants understand that the fictitious participant does not like spicy food, and the hot sauce, in large enough quantities, would be unpleasant to eat.

Lieberman and colleagues (1999) examined performance on the Hot Sauce Paradigm in relation to AQ scores. Because the Hot Sauce Paradigm is a behavioral measure of physical aggression, the physical aggression subscale of the AQ is likely the most relevant. They found a wide-range of correlations depending on the nature of the manipulation used in the study. In Lieberman et al.'s (1999) study, the group of participants cognitively primed to be effortful and analytic evidenced a significant correlation (i.e., $r = .35$); however, the group of participants primed to be quick and emotionally driven evidenced a non-significant correlation (i.e., $r = .03$). Lieberman and colleagues stated that the significant correlation in the first group provides some convergent validity for the measure and the difference among the groups reflects the frequently demonstrated finding that aggression is context specific. A second study also demonstrated convergent validity by finding a correlation of .32 between a self-report aggression measure and the Hot Sauce Paradigm (Adachi & Willoughby, 2011).

Phase II Self-Report Measures

Exercise and Caffeine (Appendix I). Prior to their laboratory session appointments, participants were asked to refrain from consuming caffeine or nicotine products, or engaging in exercise for at least one hour. To ensure they complied with instructions, participants were asked whether they had followed instructions. As seen in Table 2, almost all of the participants complied with this request. Also, participants who failed to comply did not significantly differ from participants who did comply and therefore were included in the sample.

Rating of Perceived Exertion (Appendix J). After participants completed the treadmill task, they were asked to rate the level of exertion they experienced during the task using a modified Rating of Perceived Exertion (Borg, 1998). Participants were asked to rate from 1 (i.e., very, very light) to 7 (i.e., very, very hard) their total amount of fatigue and exertion after completing the treadmill task.

Hot Sauce Follow-Up (Appendix K). In the current study, the participants were asked to respond to the following questions from 1 (i.e., not at all) to 5 (very): "please rate how much you enjoyed the hot sauce," "please rate how spicy you thought the hot sauce was," and "please rate how spicy you think someone else would think the hot sauce is." The participants answered these questions after they allocated the hot sauce to the fictitious participant. See Table 2 for a summary of the responses.

Procedures

The study was advertised as "Mood and food preference: The role of exercise." Therefore, the participants believed that the researcher was examining the effects of exercise on mood and food preference. Throughout the laboratory session, the participants were led to believe that there was another participant in a separate room, who was fictitious. This deception was necessary for the Hot Sauce Paradigm to be a reliable measure of state aggression. That is, aggression involves the actual, attempted or threatened physical or verbal acts against another individual in which the intent is to inflict harm. Therefore, it was necessary that the participants believed that their actions would affect another person.

The participants received extra credit towards any instructor-approved psychology course if they participated in Phase I. Participants received additional extra credit for participating in Phase II or could choose to be entered into a raffle to win a $50 Amazon giftcard. The current

study was approved by the Institutional Review Board of Virginia Tech and the Psychology Department Human Subjects Committee.

The study was conducted in two phases. Phase I involved screening instruments administered through an online survey. The instruments included the Informed Consent Form I (Appendix L), Demographics Questionnaire, Health Questionnaire, PFA, PA-R, SSS-V, AQ, IPAS, and Taste Preference Inventory. The online portion of the study took approximately 45 minutes to complete. The participants who met the eligibility requirements for Phase II were contacted by email within 24 hours of completing the online portion. In total, 1,571 participants completed Phase I and 1,032 were invited to participate in Phase II.

After signing up for Phase II, participants were randomly assigned to either the 'no arousal' or 'exercise-induced arousal' group. When arriving at the laboratory, the participant was greeted by a same-gendered research assistant. After reviewing and agreeing to the informed consent document (Informed Consent Form II; Appendix M), height and weight was measured by the research assistant, so that BMI could be used to estimate VO_{2max}.

Next, the participant was shown how to attach the electrode strap to his or her chest and the research assistant left the room to give the participant privacy. A diagram was placed in the room to serve as a visual aid for the participant to put on the strap. After returning to the room, the participant was seated in a comfortable chair in front of a computer. The participant was asked to remain as still as possible throughout the baseline video to reduce artifact in the physiological data. Throughout the lab session, the research assistant made references to a fictitious participant in another room (e.g., "I am going to go check on the other participant, but I will be right back").

Following a period of three to five minutes to allow the participant to adapt to the environment of the room, the participants viewed the two-minute baseline video of relaxing aquatic scenery. At this time, the Treadmill Arousal Task was completed. Afterwards, the participant was seated in a comfortable chair to complete the Risky Behavior Driving Task and Hot Sauce Paradigm. These tasks were presented in the same order for all participants because of the proposed causal relationships between arousal and sensation seeking, and sensation seeking and aggression.

After the completion of those tasks, the research assistant left the room and the participant was asked to remove the electrode strap. Then, the participant was asked to rate his or her current emotional state after participating in the research study, from 1 (no effect) to 5 (significant impact such as depression, distress; See Appendix N). Of the current sample, 86.7% rated their participatory distress as a 1 (i.e., no effect), 9.4% rated their distress as a 2, and 3.9% rated their distress as a 3. No participants rated their distress as a 4 or 5. No grievances were reported and the only negative feedback received from participants was that they reportedly were nervous at the beginning of the study and were unsure what they would be asked to do. After data collection was completed, the participants who completed Phase II were sent a debriefing email to explain the nature of and reason for the deception (Appendix O). The Phase II experimental session lasted approximately 45 minutes.

Analytic Plan

Preliminary Analysis

The data was thoroughly examined for assumptions of normality, linearity, and homoscedasticity. Means, standard deviations, and ranges were calculated for all variables of interest. Also, inter-correlations were examined between all of the continuous variables of

interest to determine whether it was necessary to enter any covariates into the primary analyses. For example, the effects of the subjects' age, gender, income, and BMI (i.e., height and weight), as well as other potential confounds (e.g., baseline HR) were initially examined by conducting Pearson product moment correlations. In addition, analyses were conducted to ensure that the participants conformed to the guidelines of their assigned arousal group. For example, if participants assigned to the 'no arousal' group exceeded the allotted 30% increase in baseline HR, then they were excluded from the analyses. If participants assigned to the 'excerise-induced arousal' group did not maintain the 70% increase in baseline HR, then they will be excluded from the analyses. Additionally, if any other situations occurred that may impact the arousal manipulation or execution of the laboratory tasks, then those participants were excluded, with the reason documented. The number of participants excluded for each reason will be discussed in a subsequent section.

Missing Data

Every possible measure was taken to prevent missing data. The research assistants checked over participant responses to ensure all questions were completed prior to the conclusion of the laboratory session. Also, if any items were left incomplete during the online portion of the study, the research assistants inquired whether the participant left the question blank accidentally or intentionally. Of course, participants were not forced to answer any questions, but this check was done to maximize the completeness of the data. As will be discussed in a later section, there were no missing data and therefore, no steps were taken to address missing data during analyses.

Hypotheses Part I

PRODCLIN (MacKinnon, Fritz, Williams, & Lockwood, 2007) was used to test whether trait sensation seeking mediated the relationship between resting HR/HRV and trait aggression. This macro was used to obtain the 95% confidence limits for the indirect effect which was calculated using the distribution of the product, which is the distribution formed from the product of two normally distributed random variables. Using the distribution of the product is ideal because MacKinnon, Lockwood and Williams (2004) found that computing confidence limits based on this distribution is more accurate than those calculated from the standard normal distribution. To use PRODCLIN to estimate the indirect effect, the following values were entered into the macro: the value for the relationship between the predictor and mediator (i.e., *a* path), the value for the relationship between the mediator and the outcome (i.e., *b* path), the standard errors for the *a* and *b* paths, correlation between *a* and *b* (i.e., 0), and the type I error rate (i.e., alpha = .05). These values were used to compute the corresponding standardized critical values. Next, the 95% confidence intervals were calculated for the standardized critical values. If the confidence interval did not contain zero, the mediated effect was considered to be significant.

Hypotheses Part II

The same PRODCLIN procedures were used to test whether or not state sensation seeking mediated the relationship between HR arousal groups and state aggression. State sensation seeking was measured with the Risky Behavior Driving Task and state aggression was measured with the Hot Sauce Paradigm. The only difference from the analyses conducted to the previous hypotheses was that the HR arousal variable was categorical, but the same analytic procedure was still appropriate.

Exploratory Analyses

As will be discussed in the results section, many of the hypotheses were not supported by the findings of the current study. The lack of significant relations between the arousal measures and trait measures of both sensation seeking and aggression was surprising given the large numbers of previous studies that have demonstrated this relationship. Furthermore, the foundation of this study was based on this consistently replicated relationship. Substantial literature has supported the independent roles of psychophysiology measures and sensation seeking in predicting aggression (e.g., Lorber, 2004; Ortiz & Raine, 2004; Raine et al., 1997; Wilson & Scarpa, 2011), but few studies have examined these variables in tandem in a single design. Although the assumption in the literature is that sensation seeking may be a possible explanation for the link between arousal levels and aggression, it is also possible that the combined influence of arousal levels and sensation seeking predict levels of aggression. Therefore, moderation analyses were conducted to follow-up on the non-significant findings presented below.

To conduct the moderation analyses, the continuous predictors and covariates were first mean-centered. An interaction term was then created by taking the product of the mean-centered predictors. Linear regression analyses were conducted by entering the mean-centered main effects and the interaction term. Age, gender, and income were controlled for in all of the following analyses of the trait measures. Separate analyses will be presented for HR and RMSSD. Analyses were conducted for all AQ and IPAS subscales for completeness, but the primary subscales of interest were the physical aggression subscale of the AQ and premeditated aggression subscale of the IPAS for reasons previously discussed.

As will be presented in a subsequent section, the laboratory manipulation was not sufficient enough to last until the completion of the tasks and the participants' physiology levels quickly returned to baseline. Therefore, the baseline physiology of the participants should then predict their performance on the state measures of sensation seeking and aggression, rather than the participant's arousal group assignment. Because of this, the baseline physiology measures will be used in the exploratory analyses with the state measures of sensation seeking and aggression. The same moderation analytic plan that was described above was conducted here using the state measures of sensation seeking and aggression. Spiciness, gender, and income were entered as covariates in these analyses.

Results

Preliminary Analysis

After reviewing the data for assumptions of normality, linearity, homoscedasticity, and interrelations, several findings were noted. The kurtosis and skew for all measures of interest were in the acceptable range (Table 1), with the exception of BMI. The kurtosis BMI was 22.03, which indicates the variable is quite leptokurtotic. This resulted from the calculation of BMI, which is weight (kilograms) divided by the square of height (meters). In the current sample, the kurtosis of height was slightly high (i.e., 9.66) and this was exaggerated when height was squared. To reduce the influence of the highly kurtotic variable, all further analyses include height and weight entered separately.

After examining the correlations among the variables (Table 3), several covariates were included in the trait measures analyses. Age was significantly positively correlated with the experience seeking and disinhibition subscales. Income was significantly negatively correlated with the experience seeking subscales. SES was significantly negatively correlated with the

physical aggression subscale. Rather than including both income and SES as covariates, only income was included because it was more strongly correlated with more variables of interest than SES and more directly reflects the financial status of the participants' families during childhood. Also, numerous gender differences were observed and will be further discussed in the results section (see Table 4). Therefore, in the analyses of the trait measures, age, income, and gender were entered as covariates.

After examining the correlations among the variables (Table 3), several covariates were included in the state measures analyses. The questions related to how much the participants enjoyed the hot sauce, how spicy the participants thought the hot sauce was, and how spicy the participants think someone else would find the hot sauce were correlated with numerous variables of interest and each other. Therefore, the question regarding how spicy the participants think someone else would think the hot sauce was will be included as a covariate because it is the most applicable to their decision-making for the hot sauce task. Because the correlation between baseline HR and hot sauce weight approached significance, it is necessary to include baseline HR as a covariate. Furthermore, as will be discussed later, the 'no arousal' and 'exercise-induce arousal' groups significantly differed on baseline HR. Gender was included as a covariate because numerous gender differences were observed and these findings will be further discussed in a later section. VO_{2max} was included as a covariate because the current study demonstrated a significant negative correlation between VO_{2max} and a state measure of aggression (i.e., hostility). Also because the experimental manipulation involves exercise and the study was advertised as a fitness study, it was useful to include a measure of cardiorespiratory fitness when examining the impact of the arousal manipulation. The negative correlation between income and hot sauce weight approached significance and therefore income was included as a covariate. For the

analyses of state measures, how spicy the participant thinks someone else will think the hot sauce is, baseline HR, gender, VO_{2max}, and income were included as covariates.

Several participants who completed Phase II were excluded in the analyses. Six participants were excluded because the psychophysiology equipment malfunctioned or event marks were not properly obtained, one participant was excluded because they did not complete an adequate number of Phase I items, one participant was excluded because the hot sauce task instructions were not properly read, and 10 participants were excluded because they did not maintain the proper HR level for their assigned arousal group. Independent samples t-tests (Table 5) revealed that the participants not included in the analyses had significantly higher HR throughout the entire laboratory session when compared to participants included in the analyses. Also, participants not included in the analyses had lower RMSSD during the hot sauce task than participants included in the analyses. No other significant differences were observed. Of the 146 participants who completed Phase II, 128 participants will be included in the following analyses. Complete data were available for the 128 participants included in the analyses. Therefore, no additional steps were necessary to deal with missing data because no missing data existed.

Correlations

See Table 3 for a full list of correlations among all continuous variables of interest. Several correlations are of note. Baseline HR was not significantly related to any variables of interest, other than a strong negative correlation with RMSSD. Baseline RMSSD was significantly positively related to hot sauce weight. Thrill and adventure seeking was negatively related to hostility, but unrelated to other measures of aggression. Experience seeking was positively related to premeditated aggression. Disinhibition was positively related to physical aggression, verbal aggression, anger, and premeditated aggression. Boredom susceptibility was

positively related to physical aggression, verbal aggression, and premeditated aggression. Driving game points was not significantly correlated with the trait measures of sensation seeking and hot sauce weight was not significantly correlated with the traits measures of aggression.

Gender Differences

Independent samples *t*-tests revealed that men evidenced significantly lower baseline HR and hot sauce task HR, and higher baseline RMSSD than women. Men evidenced significantly higher boredom susceptibility, physical aggression, verbal aggression, and premeditated aggression than women. Men allocated more hot sauce than women during the hot sauce task. Men were significantly taller, weighed more, and had lower $VO_{2\ Max}$ than women.

Trait Measures Results

As discussed in the proposed analyses section, the mediation analyses will be presented using the causal steps of Baron and Kenny (1986). The analyses are based on partial correlation and linear regression analyses. The HR and RMSSD analyses will be presented separately. Age, gender, and income were controlled for in all of the following analyses based on the trait measures.

HR. First, baseline HR was not significantly associated with physical aggression, verbal aggression, anger, hostility, impulsive aggression or premeditated aggression (See Table 6). Second, based on partial correlation coefficients, baseline HR was not significantly related to thrill adventure seeking ($r = .12$, *ns*), experiencing seeking ($r = .03$, *ns*), disinhibition ($r = .05$, *ns*), or boredom susceptibility ($r = .02$, *ns*). Third, once controlling for baseline HR, several of the subscales of trait sensation seeking were significantly related to aggression (See Table 6). Specifically, across mediation analyses, greater disinhibition was related to greater physical aggression, verbal aggression and hostility. A trend suggested that greater disinhibition was

related to greater anger. Less thrill adventure seeking significantly predicted greater levels of hostility, impulsive aggression and premeditated aggression. Greater experience seeking and greater boredom susceptibility were associated with greater premeditated aggression. A trend suggested that greater boredom susceptibility was associated with greater verbal aggression. Although a significant relationship between the predictor and outcome is not necessary to demonstrate mediation (MacKinnon & Fairchild, 2009), the analyses also failed to demonstrate a significant relationship between the predictor and mediators. Therefore, mediation was not supported and PRODCLIN analyses were not conducted.

RMSSD. First, baseline RMSSD was not significantly associated with physical aggression, verbal aggression, anger, hostility, impulsive aggression or premeditated aggression (See Table 6). Second, based on partial correlation coefficients, baseline RMSSD was not significantly related to thrill adventure seeking (r = -.09, *ns*), experiencing seeking (r = -.04, *ns*), disinhibition (r = -.03, *ns*), or boredom susceptibility (r = .13, *ns*). Third, once controlling for baseline RMSSD, several of the subscales of trait sensation seeking were significantly related to aggression (See Table 6). Greater disinhibition was related to greater physical aggression, verbal aggression, anger, and hostility. Less thrill and adventure seeking was related to greater hostility, impulsive aggression, and premeditated aggression. Greater experiencing seeking and greater boredom susceptibility were related to greater premeditated aggression. A trend suggested that greater boredom susceptibility was related to greater verbal aggression. Similar to the HR results, the analyses also failed to demonstrate significant relationships between the predictor and mediator, and predictor and outcome. Therefore, mediation was not supported and PRODCLIN analyses were not conducted.

Trait Exploratory Analyses

HR. The main effect of disinhibition significantly predicted physical aggression, verbal aggression, anger, and premeditated aggression. The main effect of disinhibition approached significance in predicting hostility. The main effect of thrill adventure seeking significantly predicted hostility. The main effect of experience seeking significantly predicted premeditated aggression. The main effect of boredom susceptibility predicted physical aggression and verbal aggression. The interaction of baseline HR x experience seeking significantly predicted physical aggression. The interaction of baseline HR x boredom susceptibility significantly predicted physical aggression. The interaction of baseline HR x disinhibition predicted verbal aggression and premeditated aggression. All other main effects and interactions were not statistically significant. See Table 7 for a complete list of these findings.

To further explore the nature of the significant interactions, the effect sizes, simple regression equations and simple slopes were examined. The physical aggression subscale of the AQ and premeditated aggression subscale of the IPAS were the main subscales of interest and therefore the significant interactions will only be examined for these subscales. Because there were no specific values of interest, two standard deviations below the mean, one standard deviation below the mean, the mean (i.e., 0), one standard deviation above the mean, and two standard deviations above the mean were used as values to probe the interactions. The simple regression equations were plotted (See Figures 1-3 for men and Figures 4-6 for women).

To test the simple slopes for significance, the sensation seeking variables were re-centered at two standard deviations below the means, one standard deviation below the mean, one standard deviation above the mean, and two standard deviations above the mean. The regression analyses were then re-run to test for significance. These analyses test whether or not

the slope of each simple regression equation is significantly different from zero. Simple regression equations will be presented separately for men (gender = 0) and women (gender = 1). It should be noted that the simple slopes for men and women will be the same because gender was included as a covariate and not moderator; however, the intercepts will differ.

The ΔR^2 for adding the interaction of baseline HR x experience seeking to the model was .03, $p = .031$. See Figure 1 for the simple regression equations and the tests for significance of the simple slopes for the baseline HR x experience seeking interaction for men and Figure 4 for women. The simple slope for individuals two standard deviations below the mean was statistically significant. The simple slopes for individuals one standard deviation below the mean and two standard deviations above the mean approached significance. The other simple slopes were not statistically significant.

The ΔR^2 for adding the interaction of baseline HR x boredom susceptibility to the model was .03, $p = .025$. See Figure 2 for the simple regression equations and the tests for significance of the simple slopes for the interaction of baseline HR x boredom susceptibility interaction for men and Figure 5 for women. The simple slope for individuals two standard deviations below the mean was statistically significant. The other simple slopes were not statistically significant.

The ΔR^2 for adding the interaction of baseline HR x disinhibition to the model was .04, $p = .018$. See Figure 3 for the simple regression equations and the tests for significance of the simple slopes for the baseline HR x disinhibition interaction for men and Figure 6 for women. The simple slopes for individuals two standard deviations and one standard deviation below the mean was statistically significant. The other simple slopes were not statistically significant.

The simple regression equations, *t*-tests, and *p*-values are presented in the captions of Figures 1-6. The interactions will be further discussed in the discussion section.

RMSSD. The main effect of disinhibition significantly predicted physical aggression, verbal aggression, and anger. The relationship between disinhibition and hostility approached significance. The main effect of thrill adventure seeking significantly predicted hostility. The main effect of boredom susceptibility significantly predicted physical aggression, verbal aggression, and premeditated aggression. The main effect of experience seeking significantly predicted premeditated aggression. The interaction of baseline RMSSD x boredom susceptibility significantly predicted physical aggression. All other main effects and interactions were not statistically significant. See Table 7 for a complete list of these findings.

To further explore the nature of the significant interaction, the same procedures discussed above were used. See Figures 7 and 8 for graphs of the significant interaction between baseline RMSSD and boredom susceptibility for men and women. The ΔR^2 for adding the interaction of baseline RMSSD x boredom susceptibility to the model was .03, $p = .035$. To examine the simple slopes, the sensation seeking variable was re-centered at two standard deviations above the mean, one standard deviation above the mean, one standard deviation below the mean, and two standard deviations below the mean. The regression analyses were then rerun to test the simple slopes for significance. See Figure 7 for the simple regression equations and the tests of significance of the simple slopes for the interaction of baseline RMSSD x boredom susceptibility for men and Figure 8 for women. The simple slopes for individuals two standard deviations above the mean was statistically significant. The simple slope for individuals two standard deviations below the mean approached significance. The other simple slopes were not statistically significant.

The simple regression equations, *t*-tests, and *p*-values are presented in the caption of Figures 7 and 8. The interactions will be further discussed in the discussion section.

State Measures Results

The first step of analyses related to the laboratory measures was to determine whether the arousal manipulation was sufficient to result in maintained HR differences among the HR arousal groups. Because it was hypothesized that the HR arousal groups would differ on sensation seeking and aggression, and sensation seeking would mediate the relationship between arousal group and aggression, a requirement is that the experimentally induced group differences on HR would be maintained when the participants were completing the laboratory tasks. Additionally, there should be minimal differences between the arousal groups on HR and RMSSD at baseline.

To test these requirements, independent samples t-tests were conducted to compare the 'no arousal' and 'exercise-induced arousal' groups on HR and RMSSD during the baseline, treadmill task, driving game, and hot sauce task. As seen in Table 8, the groups significantly differed on baseline HR, but not baseline RMSSD. The 'no arousal' group evidenced significantly higher baseline HR than the 'exercise-induced arousal' group. However, this baseline difference in HR likely did not affect the manipulation because the difference was less than five bpm. The 'no arousal' and 'exercise-induced arousal' groups significantly differed on HR and RMSSD during the treadmill task. This finding is expected given that the purpose of the task was to increase the HR of the 'exercise-induced arousal' group, while minimally increasing the 'no arousal' group. Therefore, this finding serves as evidence that the arousal groups did differ in HR and RMSSD during the treadmill task. The 'no arousal' and 'exercise-induced arousal' groups did not significantly differ on HR or RMSSD during the driving game or hot sauce task. The HR and RMSSD of the 'no arousal' and 'exercise-induced arousal' groups were

almost identical during the driving game. Similarly, the HR and RMSSD of the 'no arousal' and 'exercise-induced arousal' groups were very similar during the hot sauce task.

Overall, these findings suggest that the arousal manipulation initially resulted in the necessary HR and RMSSD differences; however, these differences were not maintained once the participants stepped off the treadmill. This finding will be further discussed in the discussion section. In light of these findings, it is not expected that the hypotheses related to the laboratory tasks will be supported because the manipulation was insufficient to produce the necessary arousal differences. Regardless, for completeness, those analyses will be presented here.

As discussed in the proposed analyses section, the results will be presented using the causal steps of Baron and Kenny (1986) and were conducted using linear regressions. As discussed previously, spiciness, gender, baseline HR, $VO_{2\ Max}$ and income were entered as covariates in these analyses. First, the HR arousal groups did not significantly differ on the weight of the hot sauce they allocated. Second, the HR arousal groups did not significantly differ on the number of driving game points won. Third, after controlling for the arousal group, the driving game points variable was not significantly related to hot sauce weight (See Table 9). Therefore, based on the Baron and Kenny (1986) causal steps, none of the necessary steps for mediation are supported and therefore PRODCLIN analyses will not be conducted.

State Exploratory Analyses

The main effect of baseline HR, the main effect of driving game points, the interaction of baseline HR x driving game points weight, and the interaction of baseline RMSSD x driving game points did not significantly predict hot sauce weight (See Table 10). Conversely, the main effect of baseline RMSSD significantly predicted hot sauce weight.

Discussion

Several key findings from the current study are of note. Some of the results support previous findings; however, many of the findings are offer new suggestions to the literature. Each finding will be discussed in reference to previous literature.

Correlations

The correlations among the variables will only be mentioned here. These findings will be discussed more thoroughly in reference to the trait and state findings because they are more meaningful once the covariates have been taken into account. Baseline HR was not significantly correlated with any of the state or trait measures of sensation seeking or aggression. Baseline RMSSD was significantly correlated with hot sauce weight in the predicted direction, but was not significantly related to any other variables of interest. The overall lack of significant relationships between the physiology measures and measures of sensation seeking and aggression was surprising and contrary to a substantial body of literature. These results will be discussed more in the description of the findings related to the state and trait mediation models.

As predicted, several of the sensation seeking and aggression subscales were correlated. Contrary to previous research, thrill and adventure seeking was inversely related to hostility. The other relations between the measures of sensation seeking and aggression were in the expected direction based on previous literature. These findings will be discussed more when describing the findings related to the state and trait mediation models. Of note, three of the four SSS-V subscales were significantly positively correlated with the premeditated aggression subscale, whereas none of the SSS-V subscales were significantly related to the impulsive aggression subscale. This finding supports the current study's focus on proactive aggression, given that

sensation seeking appears to be a correlate of premeditated aggression rather than impulsive aggression.

The correlations between the state and trait measures of sensation seeking and aggression were non-significant and quite small. This is unexpected and suggests that the state and trait measures may be capturing different constructs. These findings will be further discussed in the limitations section.

Gender Differences

Several gender differences were observed and therefore gender was entered as a covariate throughout the analyses. Many of these differences were expected based on prior findings. Men were taller and weighed more than women, which is not surprising given that research has consistently found this gender difference (e.g., Ogden, Fryar, Carroll, & Flegal, 2004). Men evidenced significantly lower baseline HR and higher baseline RMSSD, which is also consistent with previous research (e.g., Umetani, Singer, McCraty, & Atkinson, 1998). Men evidenced significantly greater boredom susceptibility, physical aggression, verbal aggression, premeditated aggression, and hot sauce weight than women. Again, these findings are consistent with previous results. Zuckerman et al. (1978) found that in an English sample, men scored significantly higher than women on boredom susceptibility and no other subscales. Numerous studies across populations have found that men score significantly higher than women on the physical aggression (e.g., Williams, Boyd, Cascardi, & Poythress, 1996; Bernstein & Gesn, 1997) and verbal aggression (e.g., Archer, Killpatrick, & Bramwell, 1995; Nakano, 2001; Ramirez, Andreu, & Fuhiharu, 2001) subscales of the AQ. Haden and colleagues (2008) found that men scored significantly higher on impulsive and premeditated aggression than women. This finding is consistent with the current study; however, the difference on the impulsive scale was

non-significant. Fischer and Greitemeyer (2006) found that men who were asked to pick the amount of hot sauce for a male confederate allocated more hot sauce than women who were asked to pick the amount of hot sauce for a female confederate. Overall, these gender differences provide the rationale for including gender as a covariate in all analyses of interest and are consistent with previous research.

One of the gender differences observed in the current study was surprising and contrary to previous literature. Previous studies using similar samples have found that men tend to have higher mean VO_{2max} than women, which reflects greater cardiorespiratory fitness levels (George et al., 1997). Conversely, men in the current sample evidenced significantly lower VO_{2max} than women. The mean VO_{2max} for the men (M = 44.25, SD = 5.40) in the current study is similar to the mean VO_{2max} for the physically fit college men (M = 46.47, SD = 7.0) in the study conducted by George et al. (1997). Whereas, women in the current study evidenced much higher VO_{2max} values (M = 48.76, SD = 5.60) than women in the study conducted by George et al. (M = 41.62, SD = 5.20; 1997). This finding is of particular importance given that the current sample was predominately female (73.4%). Because VO_{2max} is an estimate of cardiorespiratory fitness, the high mean value among participants in the current study, particularly the female participants, likely resulted in fast arousal recovery once the participants finished the treadmill task and affected the researcher's ability to test the state measures hypotheses. This will be further discussed in reference to the state measures.

Trait Measures

One of the major contributions of the current study was to test the proposed mediation model that has been offered as an explanation of the consistently replicated inverse relationship between baseline HR and trait aggression. Specifically, the four subscales of the SSS-V

(Zuckerman, 1994) were tested as mediators in the relationships between baseline HR and aggression and between baseline RMSSD and aggression. All four subscales of the AQ (Buss & Perry, 1992) and two scales of the IPAS (Stanford et al., 2008) were examined for completeness. The physical and premeditated aggression subscales were of primary interest, however, because the hypotheses aimed to test predictors of intentional physical acts of proactive violence against another individual.

Overall, the analyses failed to support the proposed mediation model. When examining baseline HR as the predictor, the results suggested that greater disinhibition was related to greater physical aggression, verbal aggression, anger, and hostility. Also greater experience seeking was related to greater premeditated aggression. Conversely, greater thrill and adventure seeking was related to less hostility, impulsive aggression, and premeditated aggression. These findings are consistent with the meta-analysis conducted by Wilson and Scarpa (2011) that demonstrated a significant positive relationship between sensation seeking and aggression. However, the finding related to thrill and adventure seeking is contrary to the meta-analysis. The differences based on the SSS-V subscale will be discussed further in a subsequent section.

The current study suggests that sensation seeking may not be a causal link between baseline HR and aggression, as has been previously suggested. Furthermore, the findings suggest that the relationship may differ depending on the type of sensation seeking- and aggression-related constructs being examined. Greater disinhibition appears to be particularly important when examining levels of aggression, given that it is positively related to multiple aspects of aggression (i.e., physical aggression, verbal aggression, hostility, anger). The disinhibition subscale assesses behaviors that represent seeking sensation through others (e.g., sexually promiscuous behaviors), consuming alcohol to feel disinhibited, and a “hedonistic lifestyle”

(Zuckerman, 2007). The SSS-V disinhibition subscale includes items such as "(a) I find that stimulants make me uncomfortable, (b) I often like to get high (drinking liquor or smoking marijuana; (a) a person should have considerable sexual experience before marriage, (b) It's better if two married persons begin their sexual experience with each other." The finding in the current study is consistent with prior evidence suggesting that the disinhibition subscale is the SSS-V subscale most highly related to the biological markers of sensation seeking and best differentiates between psychopathic and non-psychopathic personalities (Zuckerman, 2007).

Conversely, higher levels of thrill and adventure seeking were associated with less hostility, impulsive aggression, and premeditated aggression. The items of the thrill and adventure seeking SSS-V subscale include socially acceptable behaviors associated with sensation seeking tendencies, such as skydiving and mountain climbing. For example, "(a) I would like to take up the sport of water skiing, (b) I would not like to take up water skiing." It is likely that individuals who are high sensation seekers that engage in socially acceptable behaviors as an appropriate outlet for their sensation seeking tendencies are less likely to exhibit high levels of aggression-related behaviors.

Three of the four SSS-V subscales were associated with premeditated aggression and none of the SSS-V subscales were significantly related to impulsive aggression. This pattern of results suggests that sensation seeking is more robustly correlated with proactive aggression than impulsive aggression. However, it is also possible that the impulsive sensation seeking subscale was unrelated to aggression in the current study because of the low Cronbach's alpha. Therefore, future research should further examine this finding to confirm that it is not an artifact of the low internal consistency in the current study.

These findings expand on prior studies and demonstrate that the relationship between sensation seeking and aggression is complex. A meta-analysis by Wilson and Scarpa (2011) demonstrated a significant positive relationship between sensation seeking and aggression. The findings presented here suggest that disinhibition is positively related to numerous aggression-related constructs. Conversely, thrill and adventure seeking is inversely related to several aggression-related constructs. In fact, throughout the analyses, thrill and adventure seeking was inversely related to all of the aggression-related constructs, albeit at a non-significant level, whereas the other three SSS-V subscales tended to be positively related to all of the aggression-related constructs. Although the meta-analysis by Wilson and Scarpa (2011) found a small effect size, it is possible that if the researchers had been able to specify types of sensation seeking behaviors (e.g., disinhibition, thrill and adventure seeking), the effect size may have been larger. Because thrill and adventure seeking is inversely related to aggression the researchers' inability to specify the type of sensation seeking may have attenuated the effect size in the meta-analysis.

Exploratory Analyses. Although sensation seeking has been suggested as a possible mediator between underarousal and aggression, evidence based on previous studies also suggests that an interaction between baseline HR and sensation seeking may predict aggression levels. Because the majority of the prior research has examined baseline HR and sensation seeking as independent predictors of aggression, little is known about the role of sensation seeking. Therefore, moderation is another possible explanation for the associations observed in the literature and has not been tested in previous studies. The moderator analyses are considered exploratory analyses because they were not formally hypothesized in the current study. However, these analyses follow from the findings of previous studies.

Overall, the moderator analyses based on the trait measures do support the presence of an interaction between baseline HR/RMSSD and sensation seeking in predicting aggression. Furthermore, the significant interaction terms in the current study accounted for between 3-4% of the variance in the outcome and accounted for a significant percentage of variance above and beyond the main effects. By measuring incremental increases in R^2, Champoux and Peters (1987) and Chaplin (1991) found that studies in social science typically find interaction terms that account for 1-3% of the variance. These papers also emphasized that even small moderator effects are important, particularly in terms of theory disconfirmation. Thus, the moderator effects in the current sample are comparable in size or slightly larger than the typical moderator effects observed in the social sciences. The effect sizes for the significant interactions suggest that although numerous statistics were conducted on a single dataset and the moderator tests were exploratory analyses, experimentwise error likely did not result in spurious findings. Therefore, the researcher is confident that the results are not due to chance because the effect sizes suggest the interaction effects are capturing an amount of variance typical of moderator effects in the field of psychology.

Before examining the simple slope results, it is important to keep in mind the difference between a significant interaction term and a significant slope. A significant interaction term indicates that the relationship between one predictor and the outcome significantly varies as a function of a second predictor. Whereas, testing the significance of the simple slopes tests whether or not the slope of the regression line for each value of interest significantly differs from zero.

In individuals low (i.e., 2 standard deviations below the mean) on experience seeking, boredom susceptibility, or disinhibition there was an inverse relationship between baseline HR

and the aggression measures of interest. Specifically, an increase in baseline HR was associated with a significant decrease in physical aggression or premeditated aggression, depending on the specific finding. For individuals at or closer to the mean or high on experience seeking, boredom susceptibility and disinhibition, the slopes for the relationship between HR and aggression levels were non-significant. Conversely, the simple slope for the RMSSD x boredom susceptibility interaction was statistically significant at high levels of boredom susceptibility (i.e., 2 standard deviations above the mean). Overall, these results suggest that the proposed inverse relationship between baseline HR and aggression was observed, but only in individuals low on experience seeking, boredom susceptibility, and disinhibition. Also, a significant inverse relationship between RMSSD and aggression was observed, but only in individuals high on boredom susceptibility.

Overall, these analyses support the presence of an interaction between HR arousal and sensation seeking, rather than a mediation model. High baseline HR appears to be a protective factor against aggressive tendencies and low baseline HR appears to be a risk factor for greater aggressive tendencies, but only in individuals low on experience seeking, boredom susceptibility, and disinhibition. In individuals with average or high levels of experience seeking, boredom susceptibility and disinhibition, baseline HR is not significantly related to aggression levels.

This finding could relate to the social push theory (Raine & Venables, 1981) and studies that have supported this theory (e.g., Maliphant, Hume, & Furnham, 1990; Raine, Venables, & Mednick, 1997; Scarpa & Ollendick, 2003; Wadsworth, 1976), which states that physiological factors are stronger correlates of antisocial outcomes in the absence of sociological risk. Specifically, the relationship between physiology and antisocial tendencies is strongest in individuals who do not have social risk factors that may "push" them towards such outcomes.

Studies, such as Scarpa and Ollendick (2003) and Raine and Venables (1984), have found a significant interaction between arousal levels (e.g., low resting HR, high HRV) and sociological risk factors (e.g., violence exposure, SES), such that arousal is associated with aggression in individuals not exposed to sociological risk. The current findings may extend the social push theory to include personality risk factors. Thus, the link between physiology and aggression is strongest in the absence of personality trait risk factors.

The results support the presence of an interaction between RMSSD arousal and sensation seeking in that high RMSSD appears to be a protective factor against aggressive tendencies and low RMSSD appears to be a risk factor for greater aggressive tendencies, but only in individuals high on boredom susceptibility. In individuals with average or low levels of boredom susceptibility, RMSSD is not significantly related to aggression levels. The findings related to the interaction of baselineRMSSD and sensation seeking differ from the findings related to baseline HR and sensation seeking in that high levels of baseline RMSSD as a protective factor occurs in the context of high sensation seeking, whereas high levels of baseline HR as a protective factor occurs in the context of low sensation seeking.

This finding makes sense when considered in the context of RMSSD as a measure of parasympathetic activity. Low levels of parasympathetic activity, coupled with high levels of boredom susceptibility places an individual at greater risk of aggressive tendencies. Conversely, if an individual with high levels of boredom susceptibility has higher RMSSD (i.e., parasympathetic activity) then they evidenced lower levels of aggressive tendencies. Overall, the findings supporting an interaction between physiological arousal and sensation seeking highlight the complexity of the mechanisms behind aggressive tendencies.

State Measures

The second major contribution of the current study was to test whether an arousal manipulation would result in the proposed changes in state sensation seeking and aggression. As discussed in the method section of the current paper, 10 participants were excluded from the analyses because they were unable to maintain their assigned HR levels. Therefore, less than 7% of the total sample had difficulties completing their manipulation assignment. Based on this finding, the exercise manipulation appears to be feasible for most participants.

The next step was to determine whether the manipulation achieved its purpose. Upon examination of the data, it appeared as though the arousal manipulation was initially successful in achieving the desired HR level, but the participants' arousal levels quickly returned to baseline levels of physiology. Thus, the arousal manipulation was not effective in creating sustained HR changes that were maintained long enough for the participants to complete the laboratory tasks. Consequently, the proposed mediation model could not be tested given that the manipulation was not successful.

If the researcher were to conduct this study again, one possible improvement would be to ask the participants to respond to measures of state sensation seeking and aggression while completing the arousal manipulation task. Therefore, the participants' arousal levels would still be at their manipulation level and the researcher could examine whether the manipulation task does result in reduced levels of sensation seeking and aggression. However, it would be challenging to find tasks that the participants could easily complete while walking on the treadmill. Also, the everyday implications of the study would be reduced because there would be no long-term changes in participants' levels of sensation seeking and aggression once they stepped off of the treadmill.

A second improvement for the treadmill task would be to increase the time the participants are asked to stay on the treadmill or to increase the intensity of the task. For example, the participants could be asked to stay on the treadmill for 10 minutes or could be asked to run. This option may be a viable option and future research could test the successfulness of this laboratory manipulation.

Researchers should also consider other possible techniques to examine the effects of increased arousal, such as stimulant medications. In fact, two separate meta-analyses (Pappadopulos, Woolston, Chait, Perkins, Connor, & Jensen, 2006; Connor, Glatt, Lopez, Jackson, & Melloni, 2002) evidenced significant effect sizes (ES = .78 and ES = .84, respectively) demonstrating a significant reduction in aggression as a result of stimulant medication. Using such methods would allow researchers to test the effects of the arousal manipulation because stimulant medications result in sustained alterations in arousal levels.

Because the arousal manipulation task was not effective in generating long-term changes in participant levels of arousal, the proposed mediation model could not be properly tested. The results were presented for completeness and confirmed that the arousal task did not result in changes in levels of sensation seeking or aggression. Again, this finding stems from the ineffectiveness of the arousal task to create sustainable changes in HR levels therefore the study could not test a mediating effect. It remains for future studies with improved research design to test if sensation seeking and aggression can truly be altered through arousal manipulation. Future research should improve on the research design and findings presented here to continue to test the malleability of state sensation seeking and aggression.

Follow-up analyses on the state measures of sensation seeking and aggression aimed to explore a possible moderation model. Because the arousal manipulation was not maintained

while the participants completed the state measures of sensation seeking and aggression, it could be hypothesized that baseline levels of arousal would predict performance on these behavioral measures. Therefore, analyses were conducted on the state measures and used baseline levels of arousal as the predictors (i.e., baseline HR, baseline RMSSD). However, no significant interactions were demonstrated. The significant main effect of RMSSD suggests that RMSSD levels are positively related to the amount of hot sauce allocated by participants. This is in the predicted direction based on previous literature and the hypotheses of the current study. However, the low correlations between the state and trait measures of sensation seeking and aggression suggest issues related to validity, which is discussed further in the limitations section. Because of this limitation and the ineffective arousal manipulation, no further interpretation of the state findings will be provided.

Limitations

Several limitations need to be considered when examining the results. First, the sample was self-selected, which likely resulted in a biased group of individuals who volunteered to participate. Because the study was advertised as an examination of fitness and participants had to self-report that they were able to complete 30 minutes of moderate exercise before they were invited to participate, the resulting sample was very physically fit. The high level of cardiovascular fitness appears to have affected the success of the HR manipulation task because the participants' HR levels quickly returned to baseline state. Also, the self-selected nature of the sample may have reduced the external validity of the findings. It is unclear whether the results will generalize to a non-physically fit or non-college sample.

Second, because 82% of the sample was Caucasian, the researcher was not able to conduct analyses to determine whether the presented findings may have differed depending on

ethnicity. Therefore, future studies should strive to include a more diverse sample to allow researchers to further explore whether these relationships may differ across ethnicities.

Third, although the researcher proposed a mediation model among the trait measures, the trait data collected in the current study cannot fully support testing mediation because the data are correlational. The data can support whether "mediation-like" correlational relationships exist. When considering the findings based on the trait measures, it is important to keep in mind that these results do not imply causation. Had the manipulation been successful, the results based on the state measures would be a better method to test causation because an experimental design was used to test the mediation model and the temporal sequence of the variables is correct.

Moreover, as seen in Table 3, the correlations between the state and trait measures of aggression are small, which lead one to question the validity of the Hot Sauce Paradigm for measuring true aggressive tendencies. Numerous previous studies (e.g., McGregor et al., 1998; Lieberman et al., 1999) support the Hot Sauce Paradigm as a valid behavioral measure of aggression, and there is some evidence of convergent validity between the AQ and Hot Sauce Paradigm (Adachi & Willoughby, 2011; Lieberman et al., 1999). The current study revealed correlations of .09, .04, .06, and .11 between the hot sauce weight and the physical aggression, verbal aggression, anger and hostility subscales, respectively. These findings suggest there is a slight positive relationship between participants' performances on these measures, but it was expected that these correlations would be higher. Studies examining the relationship between the AQ and other well accepted behavioral measures of aggression, however, have yielded similar correlation coefficients. For example, one study found that the correlation between the AQ physical aggression subscale and Taylor Aggression Paradigm, one of the most commonly used laboratory measure of aggression, was .11 (Phillips, 2011). Given the comparable results with

the Taylor Aggression Paradigm, the slight positive correlations between the state and trait measures and the previous literature supporting the Hot Sauce Paradigm as a valid behavioral measure of aggression, the Hot Sauce Paradigm will be considered a valid measure of state aggression in the current study. However, the reader should keep these findings in mind when interpreting the results and future research should be dedicated to further exploring the validity of the Hot Sauce Paradigm.

Similarly, the correlations between the state and trait measures of sensation seeking are small. In fact, the correlations are practically zero (i.e., .01 to .06) suggesting there is little to no relationship between these measures. As previously discussed, there are no known existing behavioral measures of sensation seeking because the construct is typically defined as a personality trait. However, at the time this project was started, Steinberg et al. (2008) were in the process of piloting and refining such a measure, called "Stoplight." The small correlations found in the current study suggest low construct validity for the behavioral measure of choice and suggest the measure may be capturing a different construct. This finding should be considered a limitation of the current study and should qualify the state sensation seeking findings. Future research, such as the studies being conducted by Steinberg and colleagues, should be dedicated to developing a valid behavioral measure of sensation seeking to help further this area of the literature.

A final limitation that should be considered is that several of the subscales in the current study had low Cronbach's alpha coefficients. As discussed by Henson (2001), alpha coefficients estimate internal consistency, which represents item homogeneity. In other words, internal consistency is the extent to which all items within a measure assess the same construct. When Cronbach's alpha is low (i.e., less than .70; Nunnaly, 1978), the issue is whether or not a

researcher can use a sum score obtained from the scale as an accurate representation of the participant's responses to all of the items on the inventory. Furthermore, as detailed by the APA Task Force on Statistical Inference (Wilkinson & APA Task Force on Statistical Inference, 1999), it is important to assess and report reliability because the interpretation of effect sizes and observed relationships among variables are dependent on assessing the reliability of the measures. Because effect size can be attenuated by the reliability of items within a measure (Reinhardt, 1996), researchers should also recognize that reliability has a direct effect on statistical power. This is noteworthy given that moderation analyses were conducted and interactions in social science research tend to be small effect sizes. The attenuation of power stemming from low measurement reliability is of particular concern when conducting moderation analyses (Cohen, Cohen, West, & Aiken, 2003). Furthermore, the reliability of an interaction term is the product of the reliabilities of the individual variables. Therefore, when variables evidence low reliability, any interaction term created from those variables will be even more unreliable.

In the current study, the experience seeking subscale of the SSS-V had a particularly low Cronbach's alpha. The boredom susceptibility subscale of the SSS-V and impulsive aggression subscale of the IPAS also had fairly low Cronbach's alphas. This is surprising given that both the SSS-V and IPAS have demonstrated adequate internal consistency in college samples similar to the sample in the current study. Given that these measures have yielded high Cronbach's alphas in previous studies with comparable samples, it is possible that the low coefficients in the current sample reflect haphazard responding by participants. However, the other subscales of the SSS-V and IPAS evidenced adequate internal consistency, which suggests that the participants did not respond at random.

Conclusions

After reviewing the findings, the primary contribution of the current study is the support of a moderation model that suggests the interaction between baseline HR arousal and sensation seeking in relation to aggression. Specifically, the results suggest that low resting HR is a risk factor for aggression, but only when individuals experience low levels of sensation seeking traits, such as boredom susceptibility. This finding may provide support for extending the social push theory to include personality trait risk factors, in addition to social risk factors. Furthermore, the current study failed to find support for the frequently hypothesized model that claims that sensation seeking is a causal explanation for the relationship between baseline HR/HRV and aggression, although a state mediation model could not be tested in this study. The results of the trait measures, however, should drive future research to continue to explore the interaction between these predictors, rather than conducting studies with only one of these predictors included.

Second, the current study demonstrated that the relationship between sensation seeking and aggression depends on the SSS-V subscale under examination. This finding expands on the meta-analysis conducted by Wilson & Scarpa (2011) that demonstrated an overall significant relationship between sensation seeking and aggression. Specifically, thrill and adventure seeking appears to be negatively related to multiple aggression-related constructs. As previously described, this unexpected relationship may reflect the nature of the questions in the thrill and adventure seeking subscale. By asking participants about behaviors, such as skydiving and mountain climbing, the thrill and adventure seeking subscale may be capturing socially appropriate ways people can express sensation seeking tendencies. Conversely, the disinhibition subscale was significantly positively related to aggression. The items of the disinhibition

subscale assess less positive behaviors, such as heavy drinking and sexually promiscuous behaviors. While the thrill and adventure seeking subscale captures social acceptable releases for sensation seeking tendencies, the disinhibition subscale may reflect a general pattern of negative behaviors associated with sensation seeking, which may include aggression.

Third, as has been suggested in the literature, sensation seeking was positively related to premeditated aggression and not to impulsive aggression. Again, this supports the claim that high sensation seekers tend to engage in goal-directed behaviors and are not emotionally-driven. This finding should encourage researchers to use more targeted measures of aggression that differentiate between the motives of the aggressive acts.

Fourth, the current study evidenced several methodological weaknesses that should be the focus of future research. The failure of the arousal manipulation to result in sustained changes in HR and HRV during the laboratory tasks interfered with the current researcher's ability to complete an experimental test of the role of arousal in predicting aggression. Researchers should build on the current attempt and strive to design an arousal manipulation that would allow them to successfully conduct an experiment. Similarly, the behavioral measure of state sensation seeking used in the current study evidenced low construct validity when compared to the trait measures of sensation seeking. Given that there is no other evidence available related to whether or not the measure assesses state sensation seeking, the current researcher had to conclude that the measure may be assessing a different construct. Therefore, future research should be dedicated to designing and refining a behavioral measure of sensation seeking.

Overall, the findings contributed to the field examining predictors of aggression. The findings do not support several hypothesized relationships that have been consistently cited in the literature. Furthermore, the results suggest that researchers should focus on an interaction

between arousal and sensation seeking when understanding aggression levels. Also, the findings should encourage researchers to be more specific than referring to the broad constructs of sensation seeking and aggression, given that the current results suggest the relations between the variables differ depending on the specific definition of the construct of interest. Although the current study failed to examine the malleability of arousal because of methodological issues, the findings advance the field by further elucidating the relationships among measures of HR, sensation seeking, and aggression.

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Table 1
Descriptive Statistics for Continuous Variable of Interest (N = 128)

Variable	Mean (*SD*)	Minimum	Maximum	Cronbach's Alpha	Skewness	Kurtosis
Demographics						
Age	19.47 (1.22)	18.00	22.00	-	.40	-.84
Height (inches)	65.16 (4.66)	40.94	79.13	-	-1.62	9.66
Weight (feet)	143.48 (26.83)	93.00	227.00	-	.89	.45
Resting HR	73.51 (12.61)	38.53	104.82	-	-.07	.15
Resting RMSSD	55.74 (38.39)	7.70	220.70		1.78	4.46
Predicted VO_{2Max}	47.56 (5.87)	23.67	61.22	-	-1.00	2.53
Phase I						
Thrill Adventure Seeking	7.01 (2.38)	0.00	10.00	.72	-.74	-.10
Experience Seeking	4.32 (1.89)	0.00	9.00	.46	.16	-.47
Disinhibition	4.40 (2.79)	0.00	10.00	.79	.29	-.96
Boredom Susceptibility	2.35 (1.82)	0.00	8.00	.57	.69	-.02
Physical Aggression	17.39 (6.77)	9.00	42.00	.86	1.01	-.84
Verbal Aggression	12.50 (4.12)	5.00	23.00	.80	.51	-.25
Anger	14.21 (4.85)	7.00	31.00	.80	.82	.29
Hostility	18.95 (6.13)	8.00	36.00	.80	.30	-.52
Impulsive Aggression %	22.07 (19.94)	0.00	100.00	.56	1.16	2.25
Premeditated Aggression %	24.74 (21.07)	0.00	100.00	.75	.67	-.01
Phase II						
Driving Game Points	594.34 (222.69)	0.00	1075.00	-	-.56	.75
Hot Sauce Weight (Ounces)	0.20 (.26)	0.00	1.28	-	2.05	3.79

Note: HR = Heart Rate.

Table 2
Descriptive Statistics for Categorical Variables of Interest (N = 128)

Variable	Percentage (*n*)
Gender	
Men	26.6 (34)
Women	73.4 (94)
Arousal Group Assignment	
Low	50.8 (65)
High	49.2 (63)
Student Status	
Undergraduate	98.4 (126)
Graduate	1.6 (2)
Race/Ethnicity	
Caucasian	82.0 (105)
African American/Black/ African Origin	3.9 (5)
Hispanic/Latino/Latina	3.9 (5)
Asian American/Asian Origin/Pacific Islander	6.3 (8)
American Indian/Alaska Native	1.6 (2)
Bi-Racial/Multi-Racial	2.3 (3)
Socioeconomic Status	
Poor, Working Class	1.6 (2)
Blue Collar, Working Class	3.1 (4)
Lower Middle Class	3.1 (4)
Middle Class	46.9 (60)
Upper Middle Class/Professionals	42.2 (54)
Wealthy	3.1 (4)

Table 2
Continued

Variable	Percentage (*n*)
Income	
$10,000 to $25,000	1.6 (2)
$25,0001 to $50,000	10.9 (14)
$50,001 to $75,000	20.3 (26)
$75,001 to $100,000	23.4 (30)
More than $100,000	43.8 (56)
Have you consumed caffeine in the past hour?	
No	98.4 (128)
Have you consumed nicotine containing products in the past hour?	
No	98.4 (128)
Have you exercised in the past hour?	
No	99.2 (127)
Please rate how much you enjoyed the hot sauce.	
1- Not at all	28.9 (37)
2	21.9 (28)
3	21.9 (28)
4	14.8 (19)
5- Very much	12.5 (16)
Please rate how spicy you thought the hot sauce was.	
1- Not at all spicy	0.8 (1)
2	12.5 (16)
3	33.6 (43)
4	43.8 (56)
5- Very spicy	9.4 (12)

Table 2
Continued

Variable	Percentage (*n*)
Please rate how spicy you think someone else would think the hot sauce is.	
1- Not at all spicy	0.0 (0)
2	9.4 (12)
3	35.9 (46)
4	40.6 (52)
5- Very spicy	14.1 (18)
Participatory Distress	
1- No Effect	86.7 (111)
2	9.4 (12)
3	3.9 (5)
4	0.0 (0)
5- Significant Impact	0.0 (0)

Table 3

Pearson Moment Correlations Among All Continuous Variables of Interest (N =128)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. Age	1										
2. Height (inches)	.01	1									
3. Weight (pounds)	.00	.58**	1								
4. VO_{2Max}	-.03	.24**	-.38**	1							
5. Baseline HR	.16	-.04	-.14	.09	1						
6. Baseline RMSSD	-.08	-.06	.14	-.20*	-.72**	1					
7. SES	.00	.01	-.02	.20*	-.10	-.04	1				
8. Income	-.09	.05	.01	.09	-.07	-.01	.34**	1			
9. TAS	.02	-.07	.09	.04	.12	-.09	.04	-.02	1		
10. ES	.18*	.04	.13	-.04	.07	-.05	-.15	-.24**	.41**	1	
11. Dis	.23*	.02	.02	.02	.09	-.05	-.02	-.03	.07	.30**	1
12. BS	-.03	.19*	.16	.02	-.02	.17	-.04	-.08	.02	.16	.41**
13. PA	.05	.23**	.24**	-.11	-.09	.07	-.20*	-.02	-.09	.11	.33**
14. VA	.01	.11	.11	.01	-.03	.12	-.02	.09	-.08	.03	.26**
15. Anger	.03	-.01	.00	-.05	-.09	.15	-.02	.08	-.14	-.03	.20*
16. Hostility	.02	.00	.02	-.20*	-.09	.09	.02	.05	-.28**	-.15	.16
17. ImpA	-.03	.14	.09	-.07	-.07	-.04	.05	-.04	-.12	.13	.14
18. PreA	.04	.16	.10	-.05	-.11	.16	-.14	-.15	-.15	.22*	.20*
19. Driving Game	.03	-.06	-.07	.08	.08	-.04	.13	.09	.05	.01	.06
20. HS Weight	-.08	.03	.10	-.13	.15	.19*	-.10	-.17	-.17	-.03	-.13
21. HS Enjoy	.03	.22**	.30**	.17	.04	-.08	-.08	-.12	.07	.11	-.06
22. HS Spicy	-.19*	-.10	-.17	.22*	-.04	.09	.09	.12	.03	-.09	.04
23. HS Other	-.04	.07	.09	.02	.02	.04	.04	-.02	.19*	.10	.02

Note. HR = Heart Rate, SES= Socioeconomic Status, TAS = Thrill and Adventure Seeking, ES = Experience Seeking, Dis= Disinhibition, BS= Boredom Susceptibility, PA= Physical Aggression, VA= Verbal Aggression, ImpA= Impulsive Aggression, PreA= Premeditated Aggression, HS= Hot Sauce; * $p < .05$, ** $p < .01$.

Table 3
Continued

	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
1. Age												
2. Height (inches)												
3. Weight (pounds)												
4. VO^2Max												
5. Baseline HR												
6. Baseline RMSSD												
7. SES												
8. Income												
9. TAS												
10. ES												
11. Dis												
12. BS	1											
13. PA	.33**	1										
14. VA	.30**	.59**	1									
15. Anger	.14	.59**	.55**	1								
16. Hostility	.09	.37**	.38**	.62**	1							
17. ImpA	.14	.29**	.15	.30**	.21*	1						
18. PreA	.31**	.42**	.36**	.22*	.14	.39**	1					
19. Driving Game	.03	-.10	.08	.03	.11	-.07	.05	1				
20. HS Weight	.07	.09	.04	.06	.11	-.12	.00	-.02	1			
21. HS Enjoy	.15	.19*	.08	-.06	.03	.08	.12	-.20*	.24**	1		
22. HS Spicy	-.09	-.10	-.06	-.03	-.06	.09	-.09	-.08	-.15	.25**	1	
23. HS Other	.07	-.01	-.02	.06	.04	.03	-.02	-.09	.00	.36**	.34**	1

Note. HR = Heart Rate, SES= Socioeconomic Status, TAS = Thrill and Adventure Seeking, ES = Experience Seeking, Dis= Disinhibition, BS= Boredom Susceptibility, PA= Physical Aggression, VA= Verbal Aggression, ImpA= Impulsive Aggression, PreA= Premeditated Aggression, HS= Hot Sauce; * $p < .05$, ** $p < .01$.

Table 4
Independent Samples T-Tests Comparing Men and Women on Trait Sensation Seeking, Trait Aggression, Physical, Physiological, and Laboratory Measures (N = 128)

Variable	*t*-value	*df*	Women Mean	Men Mean
Baseline Heart Rate	-2.46*	126	75.12	69.05
Baseline RMSSD	2.12*	126	51.49	67.51
Treadmill Task Heart Rate	-1.73	126	106.44	98.18
Treadmill Task RMSSD	1.60	126	19.15	25.45
Driving Game Task Heart Rate	-1.91	126	77.06	72.17
Driving Game RMSSD	1.27	126	47.19	55.47
Hot Sauce Task Heart Rate	-2.57*	126	84.13	77.93
Hot Sauce Task RMSSD	1.86	126	39.37	49.67
Thrill Adventure Seeking	-.02	126	7.01	7.00
Experiencing Seeking	.22	126	4.30	4.38
Disinhibition	-.47	126	4.47	4.21
Boredom Susceptibility	2.47*	126	2.12	3.00
Physical Aggression	5.34**	126	15.65	22.21
Verbal Aggression	3.01**	126	11.86	14.26
Anger	1.15	126	13.91	15.03
Hostility	1.66	126	18.41	20.44
Impulsive Aggression	1.05	126	21.14	24.63
Premeditated Aggression	2.26*	126	22.25	31.62
Height (inches)	7.63**	126	63.59	69.50
Weight (pounds)	9.08**	126	132.12	174.87
Predicted $VO_{2\ Max}$	-4.06**	126	48.76	44.25
Driving Game Points	.80	126	584.81	620.71
Hot Sauce Weight	3.20**	126	.16	.32

Note. *df* = degrees of freedom; * $p < .05$, ** $p < .01$.

Table 5
Independent Samples T-Tests Comparing Participants Included in Analyses (N = 128) and Participants Excluded from Analyses (N =12) on Trait Sensation Seeking, Trait Aggression, Physical, Physiological, and Laboratory Measures

Variable	*t*-value	*df*	Participants Included	Participants Not Included
Baseline HR	2.09*	138	73.51	81.63
Baseline RMSSD	-1.53	138	55.74	38.55
Treadmill Task HR	2.42*	138	104.25	122.00
Treadmill Task RMSSD	-1.41	138	20.83	12.62
Driving Game Task HR	2.18*	138	75.76	84.23
Driving Game RMSSD	-1.88	138	49.39	31.39
Hot Sauce Task HR	2.38*	138	82.48	91.34
Hot Sauce Task RMSSD	-2.01*	138	42.11	25.73
Thrill Adventure Seeking	.44	145	7.01	7.26
Experiencing Seeking	.78	145	4.32	4.68
Disinhibition	-.28	145	4.40	4.21
Boredom Susceptibility	-1.38	145	2.35	1.74
Physical Aggression	.63	145	17.39	18.42
Verbal Aggression	.51	145	12.50	13.00
Anger	1.75	145	14.21	16.26
Hostility	1.66	145	18.95	21.47
Impulsive Aggression	.59	144	22.07	25.00
Premeditated Aggression	.05	144	24.74	24.74
Height (inches)	-1.33	145	65.16	62.09
Weight (weight)	-.93	145	143.48	137.51
Predicted $VO_{2\ Max}$	-1.47	145	47.56	45.14
Driving Game Points	1.55	138	594.34	697.00
Hot Sauce Weight	-.69	138	.20	.15

Note. HR = Heart Rate; *df* = degrees of freedom; * $p < .05$, ** $p < .01$.

Table 6
Hierarchical Linear Regressions: Trait Sensation Seeking as a Mediator in the Relationship between Baseline Physiology and Trait Aggression Measures (N = 128)

Variable	*B*	*SE*	β	
Model 1- Outcome: Physical Aggression				
Step 1				
Age	.46	.45	.08	
Gender (0 = Male, 1 = Female)	-6.65	1.24	-.44**	
Income	-.10	.50	-.02	$F(3, 124) = 9.81$, $p < .001$, $R^2 = .19$
Step 2				
Age	.47	.46	.09	
Gender (0 = Male, 1 = Female)	-6.61	1.27	-.43**	
Income	-.10	.50	-.02	
Baseline HR	-.01	.05	-.01	$F(4, 123) = 7.31$, $p < .001$, $\Delta R^2 = .00$
Step 3				
Age	.10	.44	.02	
Gender (0 = Male, 1 = Female)	-6.31	1.21	-.41**	
Income	.02	.48	.00	
Baseline HR	-.01	.04	-.02	
Thrill Adventure Seeking	-.37	.24	-.13	
Boredom Susceptibility	.43	.32	.12	
Disinhibition	.70	.22	.29**	
Experience Seeking	.18	.32	.05	$F(8, 119) = 7.31$, $p < .001$, $\Delta R^2 = .14$

Note. HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 6
Continued

Variable	*B*	*SE*	β	
Model 2- Outcome: Verbal Aggression				
Step 1				
Age	.13	.29	.04	
Gender (0 = Male, 1 = Female)	-2.43	.80	-.26	
Income	.36	.32	.10	$F(3, 124) = 3.45$, $p = .019$, $R^2 = .08$
Step 2				
Age	.12	.30	.04	
Gender (0 = Male, 1 = Female)	-2.47	.82	-.27	
Income	.36	.32	.10	
Baseline HR	.01	.03	.02	$F(4, 123) = 2.587$, $p = .040$, $\Delta R^2 = .00$
Step 3				
Age	-.01	.30	.00	
Gender (0 = Male, 1 = Female)	-2.15	.81	-.23	
Income	.43	.32	.11	
Baseline HR	.01	.03	.02	
Thrill Adventure Seeking	-.18	.16	-.10	
Boredom Susceptibility	.42	.22	.19[a]	
Disinhibition	.29	.14	.20*	
Experience Seeking	.01	.22	.01	$F(8, 119) = 3.36$, $p = .002$ $\Delta R^2 = .11$

Note. HR = Heart Rate; * $p < .05$, ** $p < .01$, [a] $p < .06$

Table 6
Continued

Variable	*B*	*SE*	β	
Model 3- Outcome: Anger				
Step 1				
Age	.17	.36	.04	
Gender (0 = Male, 1 = Female)	-1.15	.98	-.11	
Income	.35	.39	.08	$F(3, 124) = .76$, *ns*, $R^2 = .02$
Step 2				
Age	.21	.36	.05	
Gender (0 = Male, 1 = Female)	-.99	1.00	-.09	
Income	.33	.39	.08	
Baseline HR	-.03	.04	-.07	$F(4, 123) = .72$, *ns*, $\Delta R^2 = .01$
Step 3				
Age	.06	.37	.02	
Gender (0 = Male, 1 = Female)	-.94	1.01	-.09	
Income	.31	.40	.07	
Baseline HR	-.03	.04	-.07	
Thrill Adventure Seeking	-.28	.20	-.14	
Boredom Susceptibility	.15	.27	.06	
Disinhibition	.35	.18	.20[a]	
Experience Seeking	-.07	.27	-.03	$F(8, 119) = 1.46$, *ns*, $\Delta R^2 = .07$

Note. HR = Heart Rate; * $p < .05$, ** $p < .01$, [a] $p < .06$

Table 6
Continued

Variable	*B*	*SE*	β	
Model 4- Outcome: Hostility				
Step 1				
Age	.16	.45	.03	
Gender (0 = Male, 1 = Female)	-2.06	1.23	-.15	
Income	.28	.49	.05	F(3, 124) = 1.05, *ns*, R^2 = .03
Step 2				
Age	.20	.45	.04	
Gender (0 = Male, 1 = Female)	-1.88	1.26	-.14	
Income	.26	.50	.05	
Baseline HR	-.03	.05	-.06	F(4, 123) = .90, *ns*, ΔR^2 = .00
Step 3				
Age	.06	.45	.01	
Gender (0 = Male, 1 = Female)	-2.07	1.24	-.15	
Income	.10	.49	.02	
Baseline HR	-.02	.04	-.04	
Thrill Adventure Seeking	-.63	.24	-.24*	
Boredom Susceptibility	-.01	.33	.00	
Disinhibition	.47	.22	.21*	
Experience Seeking	-.36	.33	-.11	F(8, 119) = 2.50, p = .015, ΔR^2 = .12

Note. HR = Heart Rate; * $p < .05$, ** $p < .01$

Table 6
Continued

Variable	*B*	*SE*	β	
Model 5- Outcome: Impulsive Aggression				
Step 1				
Age	-.50	1.47	-.03	
Gender (0 = Male, 1 = Female)	-3.39	4.03	-.08	
Income	-.77	1.62	-.04	F(3, 124) = .36, *ns*, R^2 = .01
Step 2				
Age	-.38	1.49	-.02	
Gender (0 = Male, 1 = Female)	-2.93	4.31	-.07	
Income	-.83	1.62	-.05	
Baseline HR	-.08	.15	-.05	F(4, 123) = .34, *ns*, ΔR^2 = .00
Step 3				
Age	-1.12	1.52	-.07	
Gender (0 = Male, 1 = Female)	-2.22	4.18	-.05	
Income	.10	1.65	.00	
Baseline HR	-.06	.15	-.04	
Thrill Adventure Seeking	-1.68	.82	-.20*	
Boredom Susceptibility	1.98	1.10	.19	
Disinhibition	.63	.74	.09	
Experience Seeking	.75	1.10	.07	F(8, 119) = 1.27, *ns*, ΔR^2 = .07

Note. HR = Heart Rate; * $p < .05$, ** $p < .01$

Table 6
Continued

Variable	*B*	*SE*	β	
Model 6- Outcome: Premeditated Aggression				
Step 1				
Age	.76	1.51	.04	
Gender (0 = Male, 1 = Female)	-9.52	4.14	-.20	
Income	-2.71	1.66	-.14	$F(3, 124) = 2.75$, $p = .046$, $R^2 = .06$
Step 2				
Age	.97	1.53	.06	
Gender (0 = Male, 1 = Female)	-8.68	4.24	-.18	
Income	-2.81	1.67	-.15	
Baseline HR	-.15	.15	-.09	$F(4, 123) = 2.29$, *ns*, $\Delta R^2 = .01$
Step 3				
Age	.16	1.47	.01	
Gender (0 = Male, 1 = Female)	-6.33	4.06	-.13	
Income	-1.42	1.61	-.08	
Baseline HR	-.12	.14	-.07	
Thrill Adventure Seeking	-2.29	.80	-.26**	
Boredom Susceptibility	2.50	1.07	.22*	
Disinhibition	.49	.72	.07	
Experience Seeking	2.84	1.08	.26*	$F(8, 119) = 4.24$, $p < .001$, $\Delta R^2 = .15$

Note. HR = Heart Rate; * $p < .05$, ** $p < .01$

Table 6
Continued

Variable	*B*	*SE*	β	
Model 7- Outcome: Physical Aggression				
Step 1				
Age	.46	.45	.08	
Gender (0 = Male, 1 = Female)	-6.65	1.24	-.44**	
Income	-.10	.50	-.02	$F(3, 124) = 9.81$, $p < .000$, $R^2 = .19$
Step 2				
Age	.46	.45	.08	
Gender (0 = Male, 1 = Female)	-6.67	1.26	-.44**	
Income	-.10	.50	-.02	
Baseline RMSSD	.00	.02	-.01	$F(4, 123) = 7.30$, $p < .000$, $\Delta R^2 = .00$
Step 3				
Age	.09	.44	.02	
Gender (0 = Male, 1 = Female)	-6.42	1.20	-.42**	
Income	.03	.48	.00	
Baseline RMSSD	-.01	.01	-.03	
Thrill Adventure Seeking	-.38	.24	-.13	
Boredom Susceptibility	.45	.32	.12	
Disinhibition	.70	.22	.29**	
Experience Seeking	.18	.32	.05	$F(8, 119) = 7.32$, $p < .000$, $\Delta R^2 = .14$

Note. * $p < .05$, ** $p < .01$.

Table 6
Continued

Variable	*B*	*SE*	β	
Model 8- Outcome: Verbal Aggression				
Step 1				
Age	.13	.29	.04	
Gender (0 = Male, 1 = Female)	-2.43	.80	-.26**	
Income	.36	.32	.10	$F(3, 124) = 3.45$, $p = .019$, $R^2 = .08$
Step 2				
Age	.14	.29	.04	
Gender (0 = Male, 1 = Female)	-2.31	.82	-.25**	
Income	.36	.32	.10	
Baseline RMSSD	.01	.01	.07	$F(4, 123) = 2.75$, $p = .031$, $\Delta R^2 = .01$
Step 3				
Age	.00	.29	.00	
Gender (0 = Male, 1 = Female)	-2.04	.80	-.22*	
Income	.42	.32	.11	
Baseline RMSSD	.01	.01	.05	
Thrill Adventure Seeking	-.16	.16	-.10	
Boredom Susceptibility	.40	.22	.18[a]	
Disinhibition	.30	.14	.20*	
Experience Seeking	.01	.22	.00	$F(8, 119) = 3.40$, $p = .001$, $\Delta R^2 = .10$

Note. * $p < .05$, ** $p < .01$, [a] $p < .06$

Table 6
Continued

Variable	*B*	*SE*	β	
Model 9- Outcome: Anger				
Step 1				
Age	.17	.36	.04	
Gender (0 = Male, 1 = Female)	-1.15	.98	-.11	
Income	.35	.39	.08	$F(3, 124) = .76$, *ns*, $R^2 = .02$
Step 2				
Age	.20	.35	.05	
Gender (0 = Male, 1 = Female)	-.88	.99	-.08	
Income	.36	.39	.08	
Baseline RMSSD	.02	.01	.14	$F(4, 123) = 1.16$, *ns*, $\Delta R^2 = .02$
Step 3				
Age	.04	.36	.01	
Gender (0 = Male, 1 = Female)	-.89	1.00	-.08	
Income	.34	.40	.08	
Baseline RMSSD	.02	.01	.13	
Thrill Adventure Seeking	-.28	.20	-.14	
Boredom Susceptibility	.09	.27	.03	
Disinhibition	.37	.18	.21*	
Experience Seeking	-.06	.27	-.02	$F(8, 119) = 1.67$, *ns*, $\Delta R^2 = .06$

Note. * $p < .05$, ** $p < .01$, [a] $p < .06$

Table 6
Continued

Variable	*B*	*SE*	β	
Model 10- Outcome: Hostility				
Step 1				
Age	.16	.45	.03	
Gender (0 = Male, 1 = Female)	-2.06	1.23	-.15	
Income	.28	.49	.05	$F(3, 124) = 1.05$, *ns*, $R^2 = .03$
Step 2				
Age	.17	.45	.04	
Gender (0 = Male, 1 = Female)	-1.89	1.26	-.14	
Income	.28	.49	.05	
Baseline RMSSD	.01	.01	.07	$F(4, 123) = .91$, *ns*, $\Delta R^2 = .00$
Step 3				
Age	.04	.45	.01	
Gender (0 = Male, 1 = Female)	-2.10	1.23	-.15	
Income	.12	.49	.02	
Baseline RMSSD	.01	.01	.05	
Thrill Adventure Seeking	-.63	.24	-.25*	
Boredom Susceptibility	-.04	.33	.00	
Disinhibition	.48	.22	.22*	
Experience Seeking	-.36	.33	-.11	$F(8, 119) = 2.51$, $p = .015$, $\Delta R^2 = .12$

Note. * $p < .05$, ** $p < .01$

Table 6
Continued

Variable	*B*	*SE*	β	
Model 11- Outcome: Impulsive Aggression				
Step 1				
Age	-.50	1.47	-.03	
Gender (0 = Male, 1 = Female)	-3.39	4.03	-.08	
Income	-.77	1.62	-.04	F(3, 124) = .36, *ns*, R^2 = .01
Step 2				
Age	-.55	1.47	-.03	
Gender (0 = Male, 1 = Female)	-3.82	4.11	-.09	
Income	-.78	1.62	-.04	
Baseline RMSSD	-.03	.05	-.05	F(4, 123) = .35, *ns*, ΔR^2 = .00
Step 3				
Age	-1.23	1.50	-.08	
Gender (0 = Male, 1 = Female)	-3.01	4.13	-.07	
Income	.05	1.62	.00	
Baseline RMSSD	-.04	.05	-.07	
Thrill Adventure Seeking	-1.76	.81	-.21*	
Boredom Susceptibility	.89	1.12	.08	
Disinhibition	.56	.74	.08	
Experience Seeking	1.99	1.11	.19	F(8, 119) = 1.33, *ns*, ΔR^2 = .07

Note. * $p < .05$, ** $p < .01$

Table 6
Continued

Variable	*B*	*SE*	β	
Model 12- Outcome: Premeditated				
Step 1				
Age	.76	1.51	.04	
Gender (0 = Male, 1 = Female)	-9.52	4.14	-.20	
Income	-2.71	1.66	-.14	F(3, 124) = 2.75, p = .046 R^2 = .06
Step 2				
Age	.88	1.50	.05	
Gender (0 = Male, 1 = Female)	-8.40	4.19	-.18	
Income	-2.68	1.65	-.14	
Baseline RMSSD	.07	.05	.13	F(4, 123) = 2.63, p = .038, ΔR^2 = .02
Step 3				
Age	.03	1.46	.00	
Gender (0 = Male, 1 = Female)	-6.37	4.01	-.13	
Income	-1.33	1.60	-.07	
Baseline RMSSD	.05	.05	.10	
Thrill Adventure Seeking	-2.30	.79	-.26**	
Boredom Susceptibility	2.30	1.08	.20*	
Disinhibition	. 53	.72	.07	
Experience Seeking	2.88	1.08	.26**	F(8, 119) = 4.33, p < .001, ΔR^2 = .15

Note. * p < .05, ** p <.01

Table 7

Hierarchical Linear Regressions: Testing the Interaction between Baseline Physiology and Trait Sensation Seeking in Predicting Trait Aggression Measures (N = 128)

Variable	*B*	*SE*	β	
Model 1- Outcome: Physical Aggression				
Step 1				
Age	.46	.45	.08	
Gender (0 = Male, 1 = Female)	-6.65	1.24	-.44**	
Income	-.10	.50	-.02	$F(3, 124) = 9.81$, $p < .001$, $R^2 = .19$
Step 2 with HR				
Age	.58	.46	.10	
Gender (0 = Male, 1 = Female)	-6.33	1.28	-.42**	
Income	-.21	.50	-.03	
MC-Baseline HR	-.01	.05	-.02	
MC-Thrill Adventure Seeking	-.23	.23	-.08	
MC-Baseline HR x MC-Thrill Adventure Seeking	.03	.02	.12	$F(6, 121) = 5.42$, $p < .00$, $\Delta R^2 = .02$
Step 2 with RMSSD				
Age	.47	.46	.09	
Gender (0 = Male, 1 = Female)	-6.69	1.27	-.44**	
Income	-.11	.50	-.02	
MC-Baseline RMSSD	.00	.02	-.02	
MC-Thrill Adventure Seeking	-.26	.23	-.09	
MC-Baseline RMSSD x MC-Thrill Adventure Seeking	.00	.01	-.01	$F(6, 121) = 5.05$, $p < .001$, $\Delta R^2 = .01$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 2- Outcome: Physical Aggression				
Step 1				
Age	.46	.45	.08	
Gender (0 = Male, 1 = Female)	-6.65	1.24	-.44**	
Income	-.10	.50	-.02	$F(3, 124) = 9.81$, $p < .001$, $R^2 = .19$
Step 2 with HR				
Age	.43	.46	.08	
Gender (0 = Male, 1 = Female)	-6.22	1.26	-.41**	
Income	-.06	.51	-.01	
MC-Baseline HR	-.03	.06	-.06	
MC-Experience Seeking	.33	.30	.09	
MC-Baseline HR x MC-Experience Seeking	.05	.03	.18*	$F(6, 121) = 6.02$, $p < .001$, $\Delta R^2 = .04$
Step 2 with RMSSD				
Age	.37	.46	.07	
Gender (0 = Male, 1 = Female)	-6.57	1.27	-.43**	
Income	.00	.51	.00	
MC-Baseline RMSSD	.00	.02	.01	
MC-Experience Seeking	.32	.30	.09	
MC-Baseline RMSSD x MC-Experience Seeking	-.01	.01	-.06	$F(6, 121) = 5.12$, $p < .001$, $\Delta R^2 = .01$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 3- Outcome: Physical Aggression				
Step 1				
Age	.46	.45	.08	
Gender (0 = Male, 1 = Female)	-6.65	1.24	-.44**	
Income	-.10	.50	-.02	$F(3, 124) = 9.81$, $p < .001$, $R^2 = .19$
Step 2 with HR				
Age	.05	.44	.01	
Gender (0 = Male, 1 = Female)	-6.67	1.18	-.44**	
Income	-.12	.47	-.02	
MC-Baseline HR	-.02	.04	-.03	
MC-Disinhibition	.84	.19	.35**	
MC-Baseline HR x MC- Disinhibition	.01	.01	.05	$F(6, 121) = 8.95$, $p < .001$, $\Delta R^2 = .12$
Step 2 with RMSSD				
Age	.04	.43	.01	
Gender (0 = Male, 1 = Female)	-6.73	1.18	-.44**	
Income	-.14	.47	-.02	
MC-Baseline RMSSD	.00	.01	.00	
MC-Disinhibition	.80	.19	.33**	
MC-Baseline RMSSD x MC- Disinhibition	-.01	.01	-.06	$F(6, 121) = 8.97$, $p < .001$, $\Delta R^2 = .12$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 4- Outcome: Physical Aggression				
Step 1				
Age	.46	.45	.08	
Gender (0 = Male, 1 = Female)	-6.65	1.24	-.44**	
Income	-.10	.50	-.02	$F(3, 124) = 9.81$, $p < .001$, $R^2 = .19$
Step 2 with HR				
Age	.48	.44	.09	
Gender (0 = Male, 1 = Female)	-5.83	1.24	-.38**	
Income	-.04	.48	-.01	
MC-Baseline HR	-.02	.04	-.04	
MC-Boredom Susceptibility	.83	.30	.22**	
MC-Baseline HR x MC- Boredom Susceptibility	.05	.02	.18*	$F(6, 121) = 7.88$, $p < .001$, $\Delta R^2 = .09$
Step 2 with RMSSD				
Age	.52	.43	.09	
Gender (0 = Male, 1 = Female)	-6.10	1.23	-.40**	
Income	.06	.48	.01	
MC-Baseline RMSSD	.00	.02	.02	
MC-Boredom Susceptibility	.92	.30	.25**	
MC-Baseline RMSSD x MC- Boredom Susceptibility	-.02	.01	-.18*	$F(6, 121) = 7.79$, $p < .001$, $\Delta R^2 = .09$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 5- Outcome: Verbal Aggression				
Step 1				
Age	.13	.29	.04	
Gender (0 = Male, 1 = Female)	-2.43	.80	-.26**	
Income	.36	.32	.10	$F(3, 124) = 3.45$, $p = .019$, $R^2 = .08$
Step 2 with HR				
Age	.14	.30	.04	
Gender (0 = Male, 1 = Female)	-2.44	.84	-.26**	
Income	.34	.33	.09	
MC-Baseline HR	.01	.03	.03	
MC-Thrill Adventure Seeking	-.14	.15	-.08	
MC-Baseline HR x MC-Thrill Adventure Seeking	.01	.01	.03	$F(6, 121) = 1.89$, *ns*, $\Delta R^2 = .01$
Step 2 with RMSSD				
Age	.16	.30	.05	
Gender (0 = Male, 1 = Female)	-2.30	.82	-.25**	
Income	.36	.32	.10	
MC-Baseline RMSSD	.01	.01	.07	
MC-Thrill Adventure Seeking	-.13	.15	-.07	
MC-Baseline RMSSD x MC-Thrill Adventure Seeking	.00	.00	-.03	$F(6, 121) = 1.96$, *ns*, $\Delta R^2 = .01$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 6- Outcome: Verbal Aggression				
Step 1				
Age	.13	.29	.04	
Gender (0 = Male, 1 = Female)	-2.43	.80	-.26**	
Income	.36	.32	.10	F(3, 124) = 3.45, p = .019, R^2 = .08
Step 2 with HR				
Age	.10	.30	.03	
Gender (0 = Male, 1 = Female)	-2.39	.84	-.26**	
Income	.38	.34	.10	
MC-Baseline HR	.00	.03	.01	
MC-Experience Seeking	.10	.20	.04	
MC-Baseline HR x MC-Experience Seeking	.01	.02	.06	F(6, 121) = 1.81, *ns*, ΔR^2 = .01
Step 2 with RMSSD				
Age	.11	.30	.03	
Gender (0 = Male, 1 = Female)	-2.26	.83	-.24**	
Income	.39	.34	.11	
MC-Baseline RMSSD	.01	.01	.09	
MC-Experience Seeking	.10	.20	.05	
MC-Baseline RMSSD x MC-Experience Seeking	.00	.01	-.05	F(6, 121) = 1.91, *ns*, ΔR^2 = .01

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 7- Outcome: Verbal Aggression				
Step 1				
Age	.13	.29	.04	
Gender (0 = Male, 1 = Female)	-2.43	.80	-.26**	
Income	.36	.32	.10	$F(3, 124) = 3.45$, $p = .019$, $R^2 = .08$
Step 2 with HR				
Age	-.05	.29	-.02	
Gender (0 = Male, 1 = Female)	-2.56	.79	-.28**	
Income	.41	.31	.11	
MC-Baseline HR	.00	.03	.01	
MC-Disinhibition	.41	.13	.27**	
MC-Baseline HR x MC- Disinhibition	-.02	.01	-.17*	$F(6, 121) = 4.32$, $p = .001$, $\Delta R^2 = .10$
Step 2 with RMSSD				
Age	-.06	.29	-.02	
Gender (0 = Male, 1 = Female)	-2.42	.79	-.26*	
Income	.42	.31	.11	
MC-Baseline RMSSD	.01	.01	.08	
MC-Disinhibition	.44	.13	.30**	
MC-Baseline RMSSD x MC- Disinhibition	.01	.00	.10	$F(6, 121) = 3.95$, $p = .001$, $\Delta R^2 = .09$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 8- Outcome: Verbal Aggression				
Step 1				
Age	.13	.29	.04	
Gender (0 = Male, 1 = Female)	-2.43	.80	-.26**	
Income	.36	.32	.10	$F(3, 124) = 3.45$, $p = .019$, $R^2 = .08$
Step 2 with HR				
Age	.14	.29	.04	
Gender (0 = Male, 1 = Female)	-1.92	.82	-.21*	
Income	.46	.32	.12	
MC-Baseline HR	.01	.03	.02	
MC-Boredom Susceptibility	.63	.20	.28**	
MC-Baseline HR x MC- Boredom Susceptibility	-.01	.01	-.04	$F(6, 121) = 3.51$, $p = .003$, $\Delta R^2 = .07$
Step 2 with RMSSD				
Age	.16	.29	.05	
Gender (0 = Male, 1 = Female)	-1.86	.81	-.20*	
Income	.45	.31	.12	
MC-Baseline RMSSD	.01	.01	.05	
MC-Boredom Susceptibility	.60	.20	.27**	
MC-Baseline RMSSD x MC- Boredom Susceptibility	.00	.01	-.04	$F(6, 121) = 3.55$, $p = .003$, $\Delta R^2 = .07$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 9- Outcome: Anger				
Step 1				
Age	.17	.36	.04	
Gender (0 = Male, 1 = Female)	-1.15	.98	-.11	
Income	.35	.39	.08	F(3, 124) = .76, *ns*, R^2 = .02
Step 2 with HR				
Age	.22	.36	.06	
Gender (0 = Male, 1 = Female)	-1.02	1.02	-.09	
Income	.32	.40	.07	
MC-Baseline HR	-.02	.04	-.06	
MC-Thrill Adventure Seeking	-.27	.18	-.13	
MC-Baseline HR x MC-Thrill Adventure Seeking	.00	.02	.00	F(6, 121) = .85, *ns*, ΔR^2 = .02
Step 2 with RMSSD				
Age	.22	.36	.06	
Gender (0 = Male, 1 = Female)	-.89	.99	-.08	
Income	.35	.39	.08	
MC-Baseline RMSSD	.02	.01	.13	
MC-Thrill Adventure Seeking	-.27	.18	-.13	
MC-Baseline RMSSD x MC-Thrill Adventure Seeking	.00	.01	-.02	F(6, 121) = 1.14, *ns*, ΔR^2 = .04

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 10- Outcome: Anger				
Step 1				
Age	.17	.36	.04	
Gender (0 = Male, 1 = Female)	-1.15	.98	-.11	
Income	.35	.39	.08	F(3, 124) = .76, *ns*, R^2 = .02
Step 2 with HR				
Age	.23	.37	.06	
Gender (0 = Male, 1 = Female)	-.97	1.02	-.09	
Income	.30	.41	.07	
MC-Baseline HR	-.03	.04	-.08	
MC-Experience Seeking	-.01	.24	-.02	
MC-Baseline HR x MC-Experience Seeking	.00	.02	.02	F(6, 121) = .49, *ns*, ΔR^2 = .01
Step 2 with RMSSD				
Age	.22	.36	.06	
Gender (0 = Male, 1 = Female)	-.91	1.00	-.08	
Income	.35	.40	.08	
MC-Baseline RMSSD	.02	.01	.13	
MC-Experience Seeking	-.04	.24	-.02	
MC-Baseline RMSSD x MC-Experience Seeking	.00	.01	.04	F(6, 121) = .80, *ns*, ΔR^2 = .02

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 11- Outcome: Anger				
Step 1				
Age	.17	.36	.04	
Gender (0 = Male, 1 = Female)	-1.15	.98	-.11	
Income	.35	.39	.08	$F(3, 124) = .76$, *ns*, $R^2 = .02$
Step 2 with HR				
Age	.05	.36	.01	
Gender (0 = Male, 1 = Female)	-1.06	.98	-.10	
Income	.37	.39	.08	
MC-Baseline HR	-.03	.04	-.08	
MC-Disinhibition	.37	.16	.21*	
MC-Baseline HR x MC- Disinhibition	-.02	.01	-.12	$F(6, 121) = 1.72$, *ns*, $\Delta R^2 = .06$
Step 2 with RMSSD				
Age	.02	.36	.00	
Gender (0 = Male, 1 = Female)	-.95	.98	-.09	
Income	.39	.39	.09	
MC-Baseline RMSSD	.02	.01	.14	
MC-Disinhibition	.38	.16	.22*	
MC-Baseline RMSSD x MC- Disinhibition	.00	.01	.04	$F(6, 121) = 1.75$, *ns*, $\Delta R^2 = .06$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 12- Outcome: Anger				
Step 1				
Age	.17	.36	.04	
Gender (0 = Male, 1 = Female)	-1.15	.98	-.11	
Income	.35	.39	.08	$F(3, 124) = .76$, *ns*, $R^2 = .02$
Step 2 with HR				
Age	.23	.36	.06	
Gender (0 = Male, 1 = Female)	-.65	1.02	-.06	
Income	.39	.39	.09	
MC-Baseline HR	-.02	.04	-.07	
MC-Boredom Susceptibility	.37	.25	.14	
MC-Baseline HR x MC- Boredom Susceptibility	.00	.02	-.01	$F(6, 121) = .86$, *ns*, $\Delta R^2 = .02$
Step 2 with RMSSD				
Age	.22	.35	.06	
Gender (0 = Male, 1 = Female)	-.66	1.01	-.06	
Income	.41	.39	.09	
MC-Baseline RMSSD	.02	.01	.14	
MC-Boredom Susceptibility	.32	.25	.12	
MC-Baseline RMSSD x MC- Boredom Susceptibility	.00	.01	-.06	$F(6, 121) = 1.12$, *ns*, $\Delta R^2 = .04$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 13- Outcome: Hostility				
Step 1				
Age	.16	.45	.03	
Gender (0 = Male, 1 = Female)	-2.06	1.23	-.15	
Income	.28	.49	.05	$F(3, 124) = 1.05$, *ns*, $R^2 = .03$
Step 2 with HR				
Age	.22	.45	.04	
Gender (0 = Male, 1 = Female)	-1.93	1.24	-.14	
Income	.22	.48	.04	
MC-Baseline HR	-.02	.04	-.03	
MC-Thrill Adventure Seeking	-.70	.22	-.27**	
MC-Baseline HR x MC-Thrill Adventure Seeking	.00	.02	.02	$F(6, 121) = 2.32$, $p < .05$, $\Delta R^2 = .08$
Step 2 with RMSSD				
Age	.22	.44	.04	
Gender (0 = Male, 1 = Female)	-1.90	1.21	-.14	
Income	.26	.48	.05	
MC-Baseline RMSSD	.01	.00	.05	
MC-Thrill Adventure Seeking	-.71	.22	-.28**	
MC-Baseline RMSSD x MC-Thrill Adventure Seeking	-.01	.01	-.07	$F(6, 121) = 2.45$, $p = .028$, $\Delta R^2 = .08$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 14- Outcome: Hostility				
Step 1				
Age	.16	.45	.03	
Gender (0 = Male, 1 = Female)	-2.06	1.23	-.15	
Income	.28	.49	.05	$F(3, 124) = 1.05$, *ns*, $R^2 = .03$
Step 2 with HR				
Age	.33	.46	.07	
Gender (0 = Male, 1 = Female)	-1.91	1.26	-.14	
Income	.05	.51	.07	
MC-Baseline HR	-.03	.05	-.07	
MC-Experience Seeking	-.51	.30	-.16	
MC-Baseline HR x MC-Experience Seeking	.01	.03	.03	$F(6, 121) = 1.10$, *ns*, $\Delta R^2 = .03$
Step 2 with RMSSD				
Age	.29	.45	.06	
Gender (0 = Male, 1 = Female)	-1.96	1.25	-.14	
Income	.07	.51	.01	
MC-Baseline RMSSD	.01	.02	.06	
MC-Experience Seeking	-.51	.30	-.16	
MC-Baseline RMSSD x MC-Experience Seeking	.00	.01	-.03	$F(6, 121) = 1.10$, *ns*, $\Delta R^2 = .03$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 15- Outcome: Hostility				
Step 1				
Age	.16	.45	.03	
Gender (0 = Male, 1 = Female)	-2.06	1.23	-.15	
Income	.28	.49	.05	$F(3, 124) = 1.05$, *ns*, $R^2 = .03$
Step 2 with HR				
Age	.05	.46	.01	
Gender (0 = Male, 1 = Female)	-1.97	1.24	-.14	
Income	.31	.49	.06	
MC-Baseline HR	-.03	.04	-.07	
MC-Disinhibition	.37	.20	.17[a]	
MC-Baseline HR x MC- Disinhibition	-.02	.02	-.13	$F(6, 121) = 1.55$, *ns*, $\Delta R^2 = .05$
Step 2 with RMSSD				
Age	-.01	.46	.00	
Gender (0 = Male, 1 = Female)	-2.00	1.25	-.14	
Income	.34	.50	.06	
MC-Baseline RMSSD	.01	.01	.07	
MC-Disinhibition	.40	.20	.18[a]	
MC-Baseline RMSSD x MC- Disinhibition	.01	.01	.07	$F(6, 121) = 1.27$, *ns*, $\Delta R^2 = .03$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$, [a] $p < .06$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 16- Outcome: Hostility				
Step 1				
Age	.16	.45	.03	
Gender (0 = Male, 1 = Female)	-2.06	1.23	-.15	
Income	.28	.49	.05	F(3, 124) = 1.05, *ns*, R^2 = .03
Step 2 with HR				
Age	.22	.46	.04	
Gender (0 = Male, 1 = Female)	-1.65	1.29	-.12	
Income	.31	.50	.06	
MC-Baseline HR	-.03	.05	-.05	
MC-Boredom Susceptibility	.27	.31	.08	
MC-Baseline HR x MC- Boredom Susceptibility	-.02	.02	-.08	F(6, 121) = .81, *ns*, ΔR^2 = .01
Step 2 with RMSSD				
Age	.17	.45	.03	
Gender (0 = Male, 1 = Female)	-1.71	1.29	-.12	
Income	.31	.50	.06	
MC-Baseline RMSSD	.01	.02	.05	
MC-Boredom Susceptibility	.21	.31	.06	
MC-Baseline RMSSD x MC- Boredom Susceptibility	.00	.01	.02	F(6, 121) = .68, *ns*, ΔR^2 = .01

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 17- Outcome: Impulsive Aggression				
Step 1				
Age	-.50	1.47	-.03	
Gender (0 = Male, 1 = Female)	-3.39	4.03	-.08	
Income	-.77	1.62	-.04	F(3, 124) = .36, *ns*, R^2 = .01
Step 2 with HR				
Age	-.38	1.51	-.02	
Gender (0 = Male, 1 = Female)	-3.08	4.20	-.07	
Income	-.84	1.64	-.05	
MC-Baseline HR	-.06	.15	-.04	
MC-Thrill Adventure Seeking	-.99	.76	-.12	
MC-Baseline HR x MC-Thrill Adventure Seeking	.00	.07	.00	F(6, 121) = .51, *ns*, ΔR^2 = .02
Step 2 with RMSSD				
Age	-.52	1.48	-.03	
Gender (0 = Male, 1 = Female)	-3.93	4.12	-.09	
Income	-.83	1.62	-.05	
MC-Baseline RMSSD	-.03	.05	-.06	
MC-Thrill Adventure Seeking	-1.07	.75	-.13	
MC-Baseline RMSSD x MC-Thrill Adventure Seeking	.00	.02	.01	F(6, 121) = .57, *ns*, ΔR^2 = .02

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 18- Outcome: Impulsive Aggression				
Step 1				
Age	-.50	1.47	-.03	
Gender (0 = Male, 1 = Female)	-3.39	4.03	-.08	
Income	-.77	1.62	-.04	F(3, 124) = .36, *ns*, R^2 = .01
Step 2 with HR				
Age	-.74	1.51	-.05	
Gender (0 = Male, 1 = Female)	-2.85	4.16	-.06	
Income	-.23	1.67	-.01	
MC-Baseline HR	-.08	.15	-.05	
MC-Experience Seeking	1.43	1.00	.14	
MC-Baseline HR x MC-Experience Seeking	-.02	.08	-.03	F(6, 121) = .59, *ns*, ΔR^2 = .02
Step 2 with RMSSD				
Age	-.85	1.49	-.05	
Gender (0 = Male, 1 = Female)	-3.70	4.11	-.08	
Income	-.17	1.67	-.01	
MC-Baseline RMSSD	-.03	.05	-.06	
MC-Experience Seeking	1.40	.99	.13	
MC-Baseline RMSSD x MC-Experience Seeking	.01	.03	.05	F(6, 121) = .61, *ns*, ΔR^2 = .02

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 19- Outcome: Impulsive Aggression				
Step 1				
Age	-.50	1.47	-.03	
Gender (0 = Male, 1 = Female)	-3.39	4.03	-.08	
Income	-.77	1.62	-.04	F(3, 124) = .36, *ns*, R^2 = .01
Step 2 with HR				
Age	-.97	1.52	-.06	
Gender (0 = Male, 1 = Female)	-2.95	4.11	-.07	
Income	-.89	1.62	-.05	
MC-Baseline HR	-.10	.15	-.06	
MC-Disinhibition	1.11	.66	.16	
MC-Baseline HR x MC- Disinhibition	.03	.05	.06	F(6, 121) = .79, *ns*, ΔR^2 = .03
Step 2 with RMSSD				
Age	-1.09	1.50	-.07	
Gender (0 = Male, 1 = Female)	-4.13	4.10	-.09	
Income	-.61	1.63	-.03	
MC-Baseline RMSSD	-.03	.05	-.05	
MC-Disinhibition	1.18	.67	.17	
MC-Baseline RMSSD x MC- Disinhibition	.02	.02	.06	F(6, 121) = .76, *ns*, ΔR^2 = .03

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$, [a] $p < .06$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 20- Outcome: Impulsive Aggression				
Step 1				
Age	-.50	1.47	-.03	
Gender (0 = Male, 1 = Female)	-3.39	4.03	-.08	
Income	-.77	1.62	-.04	F(3, 124) = .36, *ns*, R^2 = .01
Step 2 with HR				
Age	-.36	1.49	-.02	
Gender (0 = Male, 1 = Female)	-1.69	4.22	-.04	
Income	-.69	1.63	-.04	
MC-Baseline HR	-.10	.15	-.06	
MC-Boredom Susceptibility	1.33	1.02	.12	
MC-Baseline HR x MC- Boredom Susceptibility	.04	.07	.06	F(6, 121) = .63, *ns*, ΔR^2 = .02
Step 2 with RMSSD				
Age	-.48	1.47	-.03	
Gender (0 = Male, 1 = Female)	-2.81	4.18	-.06	
Income	-.55	1.62	-.03	
MC-Baseline RMSSD	-.03	.05	-.05	
MC-Boredom Susceptibility	1.49	1.02	.14	
MC-Baseline RMSSD x MC- Boredom Susceptibility	-.02	.02	-.06	F(6, 121) = .68, *ns*, ΔR^2 = .02

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 21- Outcome: Premeditated Aggression				
Step 1				
Age	1.41	1.52	.08	
Gender (0 = Male, 1 = Female)	-7.55	4.24	-.16	
Income	-3.26	1.66	-.17	$F(3, 124) = 2.75$, $p = .046$, $R^2 = .06$
Step 2 with HR				
Age	1.41	1.52	.08	
Gender (0 = Male, 1 = Female)	-7.55	4.24	-.16	
Income	-3.26	1.66	-.17	
MC-Baseline HR	-.16	.15	-.10	
MC-Thrill Adventure Seeking	-1.21	.77	-.14	
MC-Baseline HR x MC-Thrill Adventure Seeking	.11	.07	.15	$F(6, 121) = 2.56$, $p = .023$, $\Delta R^2 = .05$
Step 2 with RMSSD				
Age	.95	1.50	.06	
Gender (0 = Male, 1 = Female)	-8.45	4.18	-.18	
Income	-2.73	1.65	-.14	
MC-Baseline RMSSD	.07	.05	.12	
MC-Thrill Adventure Seeking	-1.29	.77	-.15	
MC-Baseline RMSSD x MC-Thrill Adventure Seeking	-.01	.02	-.02	$F(6, 121) = 2.25$, $p = .043$, $\Delta R^2 = .04$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 22- Outcome: Premeditated Aggression				
Step 1				
Age	1.41	1.52	.08	
Gender (0 = Male, 1 = Female)	-7.55	4.24	-.16	
Income	-3.26	1.66	-.17	$F(3, 124) = 2.75$, $p = .046$, $R^2 = .06$
Step 2 with HR				
Age	.55	1.51	.03	
Gender (0 = Male, 1 = Female)	-7.39	4.17	-.16	
Income	-2.22	1.67	-.12	
MC-Baseline HR	-.22	.15	-.13	
MC-Experience Seeking	2.17	.99	.19*	
MC-Baseline HR x MC-Experience Seeking	.15	.08	.16	$F(6, 121) = 2.96$, $p = .010$, $\Delta R^2 = .07$
Step 2 with RMSSD				
Age	.28	1.50	.02	
Gender (0 = Male, 1 = Female)	-7.74	4.12	-.16	
Income	-1.99	1.67	-.11	
MC-Baseline RMSSD	.09	.05	.16	
MC-Experience Seeking	2.18	.99	.20*	
MC-Baseline RMSSD x MC-Experience Seeking	-.04	.03	-.12	$F(6, 121) = 2.95$, $p = .010$, $\Delta R^2 = .07$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 23- Outcome: Premeditated Aggression				
Step 1				
Age	1.41	1.52	.08	
Gender (0 = Male, 1 = Female)	-7.55	4.24	-.16	
Income	-3.26	1.66	-.17	$F(3, 124) = 2.75$, $p = .046$, $R^2 = .06$
Step 2 with HR				
Age	.03	1.50	.00	
Gender (0 = Male, 1 = Female)	-8.54	4.08	-.18	
Income	-3.06	1.61	-.16	
MC-Baseline HR	-.17	.15	-.10	
MC-Disinhibition	1.60	.65	.21*	
MC-Baseline HR x MC- Disinhibition	.12	.05	.20*	$F(6, 121) = 3.64$, $p = .002$, $\Delta R^2 = .09$
Step 2 with RMSSD				
Age				
Gender (0 = Male, 1 = Female)	.08	1.51	.01	
Income	-8.30	4.11	-.18	
MC-Baseline RMSSD	-2.95	1.64	-.16	
MC-Disinhibition	.08	.05	.14	
MC-Baseline RMSSD x MC- Disinhibition	1.41	.68	.19	$F(6, 121) = 3.07$, $p = .008$, $\Delta R^2 = .07$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$, [a] $p < .06$.

Table 7
Continued

Variable	*B*	*SE*	β	
Model 24- Outcome: Premeditated Aggression				
Step 1				
Age	1.41	1.52	.08	
Gender (0 = Male, 1 = Female)	-7.55	4.24	-.16	
Income	-3.26	1.66	-.17	$F(3, 124) = 2.75$, $p = .046$, $R^2 = .06$
Step 2 with HR				
Age	1.05	1.48	.06	
Gender (0 = Male, 1 = Female)	-5.85	4.19	-.12	
Income	-2.42	1.62	-.13	
MC-Baseline HR	-.17	.15	-.10	
MC-Boredom Susceptibility	3.11	1.01	.27	
MC-Baseline HR x MC- Boredom Susceptibility	.04	.07	.05	$F(6, 121) = 3.39$, $p = .004$, $\Delta R^2 = .08$
Step 2 with RMSSD				
Age	.97	1.46	.06	
Gender (0 = Male, 1 = Female)	-6.19	4.16	-.13	
Income	-2.24	1.61	-.12	
MC-Baseline RMSSD	.06	.05	.12	
MC-Boredom Susceptibility	3.00	1.01	.26*	
MC-Baseline RMSSD x MC- Boredom Susceptibility	-.02	.02	-.06	$F(6, 121) = 3.42$, $p = .004$, $\Delta R^2 = .08$

Note. MC = Mean-Centered; HR = Heart Rate; * $p < .05$, ** $p < .01$

Table 8
Independent Samples T-Tests Comparing the Low and High Arousal Experimental Groups on Trait Sensation Seeking, Trait Aggression, Physical, Physiological, and Laboratory Measures (N = 128)

Variable	*t*-value	*df*	No Arousal Mean	High Arousal Mean
Baseline HR	2.24*	126	75.92	71.02
Baseline RMSSD	-1.37	126	51.18	60.45
Treadmill Task HR	-11.71**	126	87.02	121.81
Treadmill Task RMSSD	6.12**	126	30.08	11.28
Driving Game Task HR	-.08	126	75.68	75.85
Driving Game RMSSD	.18	126	49.90	48.86
Hot Sauce Task HR	.53	126	83.05	81.90
Hot Sauce Task RMSSD	-.73	126	40.32	43.95
Thrill Adventure Seeking	-.33	126	6.94	7.08
Experiencing Seeking	-.08	126	4.31	4.33
Disinhibition	-.37	126	4.31	4.49
Boredom Susceptibility	-1.55	126	2.11	2.60
Physical Aggression	-1.61	126	16.45	18.37
Verbal Aggression	.11	126	12.54	12.46
Anger	-.14	126	14.15	14.27
Hostility	.32	126	19.12	18.78
Impulsive Aggression	.47	126	22.88	21.23
Premeditated Aggression	.21	126	25.13	24.34
Height (inches)	.19	126	652	65.08
Weight (weight)	.02	126	143.52	143.44
Predicted $VO_{2\ Max}$	-1.18	126	46.96	48.18
Driving Game Points	1.28	126	619.12	568.78
Hot Sauce Weight	.54	126	.22	.19

Note. HR = heart rate; *df* = degrees of freedom; * $p < .05$, ** $p < .01$.

Table 9

Hierarchical Linear Regressions: State Sensation Seeking as a Mediator between Arousal Group and State Aggression (N = 128)

Variable	*B*	*SE*	β	
Model 1a-Outcome: Hot Sauce Weight				
Step 1				
Spicy	-.01	.03	-.02	
Gender (0 = Male, 1 = Female)	-.14	.05	-.25**	
Baseline HR	.00	.00	-.11	
$VO_{2\ Max}$	.00	.00	-.02	
Income	-.04	.02	-.17*	$F(5, 122) = 3.18$, $p < .05$, $R^2 = .12$
Step 2				
Spicy	-.01	-.03	-.02	
Gender (0 = Male, 1 = Female)	-.14	-.05	-.24*	
Baseline HR	.00	.00	-.12	
$VO_{2\ Max}$	.00	.00	-.02	
Income	-.04	-.02	-.17*	
Arousal Group (0 = No, 1 = High)	-.03	-.05	-.06	$F(6, 121) = 2.71$, $p < .05$, $\Delta R^2 = .00$
Step 3				
Spicy	-.01	.03	-.02	
Gender (0 = Male, 1 = Female)	-.14	.06	-.24*	
Baseline HR	.00	.00	-.13	
$VO_{2\ Max}$	.00	.00	-.02	
Income	-.04	.02	-.18*	
Arousal Group (0 = No, 1 = High)	-.03	.05	-.06	
Driving Game Points	.00	.00	.03	$F(7, 120) = 2.33$, $p < .05$, $\Delta R^2 = .00$

Note. HR = Heart Rate; Spicy = "Please rate how spicy you think someone else would think the hot sauce is." * $p < .05$, ** $p < .01$.

Table 9

Continued

Model 1b- Outcome: Driving Game Points				
Step 1				
Spicy	- 22.42	23.69	-.09	
Gender (0 = Male, 1 = Female)	13.51	48.99	.03	
Baseline HR	1.34	1.62	.08	
$VO_{2\ Max}$	2.21	3.62	.06	
Income	18.25	18.08	.09	$F(5, 122) = .71$, *ns*, $R^2 = .03$
Step 2				
Spicy	-21.76	23.62	-.08	
Gender (0 = Male, 1 = Female)	11.61	48.86	.02	
Baseline HR	1.79	1.65	.10	
$VO_{2\ Max}$	1.79	1.65	.10	
Income	17.84	18.02	.09	
Arousal Group (0 = No, 1 = High)	54.18	40.60	.12	$F(6, 121) = .89$, *ns*, $\Delta R^2 = .01$

Note. HR = Heart Rate; Spicy = "Please rate how spicy you think someone else would think the hot sauce is." * $p < .05$, ** $p < .01$.

Table 10

Hierarchical Linear Regressions: Testing the Interaction between Baseline Physiology and State Sensation Seeking in Predicting State Aggression Measures (N = 128)

Variable	*B*	*SE*	β	
Outcome: Hot Sauce Weight				
Step 1				
Spicy	-.01	.03	-.03	
Gender (0 = Male, 1 = Female)	-.16	.05	-.28**	
Income	-.04	.02	-.17[a]	F(3, 124) = 4.76, p = .004, R^2 = .10
Step 2 with HR				
Spicy	.00	.03	-.02	
Gender (0 = Male, 1 = Female)	-.14	.05	-.24*	
Income	-.04	.02	-.19*	
MC-Baseline HR	.00	.00	-.11	
MC-Driving Game Points	.00	.00	.04	
MC-Baseline HR x MC-Driving Game Points	.00	.00	-.12	F(6, 121) = 2.97, p =.010, ΔR^2 = .03
Step 2 with RMSSD				
Spicy	.00	.03	-.01	
Gender (0 = Male, 1 = Female)	-.14	.05	-.23*	
Income	-.04	.02	-.19*	
MC-Baseline RMSSD	.00	.00	.20*	
MC-Driving Game Points	.00	.00	.03	
MC-Baseline RMSSD x MC-Driving Game Points	.00	.00	.16	F(6, 121) = 3.41, p .004, ΔR^2 = .04

Note. Spicy = "Please rate how spicy you think someone else would think the hot sauce is." MC = Mean-Centered; HR = Heart Rate; * p < .05, ** p <.01.

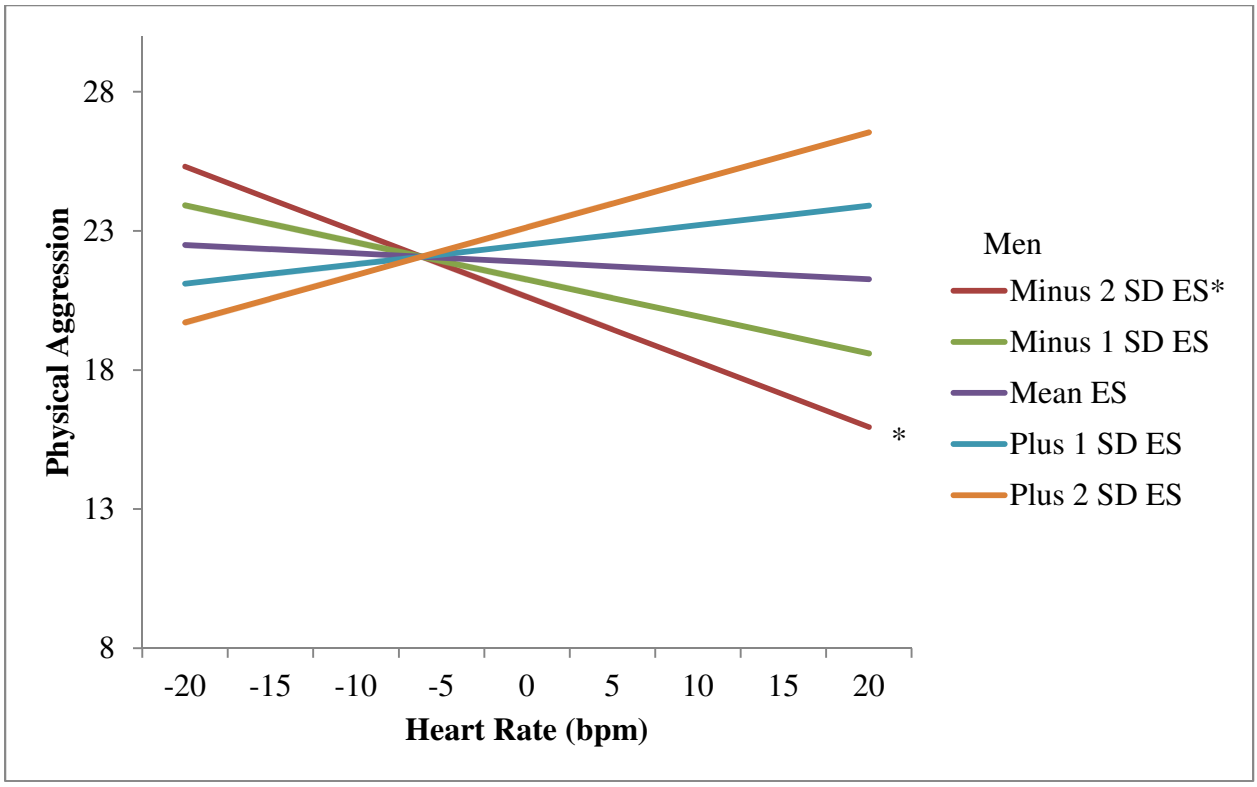

Figure 1. The interaction between heart rate and experience seeking in predicting physical aggression for men.

The simple regression equations and tests for simple slope significance were as follows. Significant simple regression equations are denoted in the graph with an asterisk (*).
-2 *SD* $\hat{y} = 20.629 + (-.234)\ X_c$, $t = -2.076$, $p = .040$
-1 *SD* $\hat{y} = 21.253 + (-.133)X_c$, $t = -1.834$, $p = .069$
Mean $\hat{y} = 21.877 + (-.031)X_c$, $t = -.689$, $p = .492$
+1 *SD* $\hat{y} = 22.501 + (.070)X_c$, $t = 1.222$, $p = .224$
+2 *SD* $\hat{y} = 23.125 + (.171)X_c$, $t = 1.829$, $p = .070$

Note: ES = Experience Seeking.

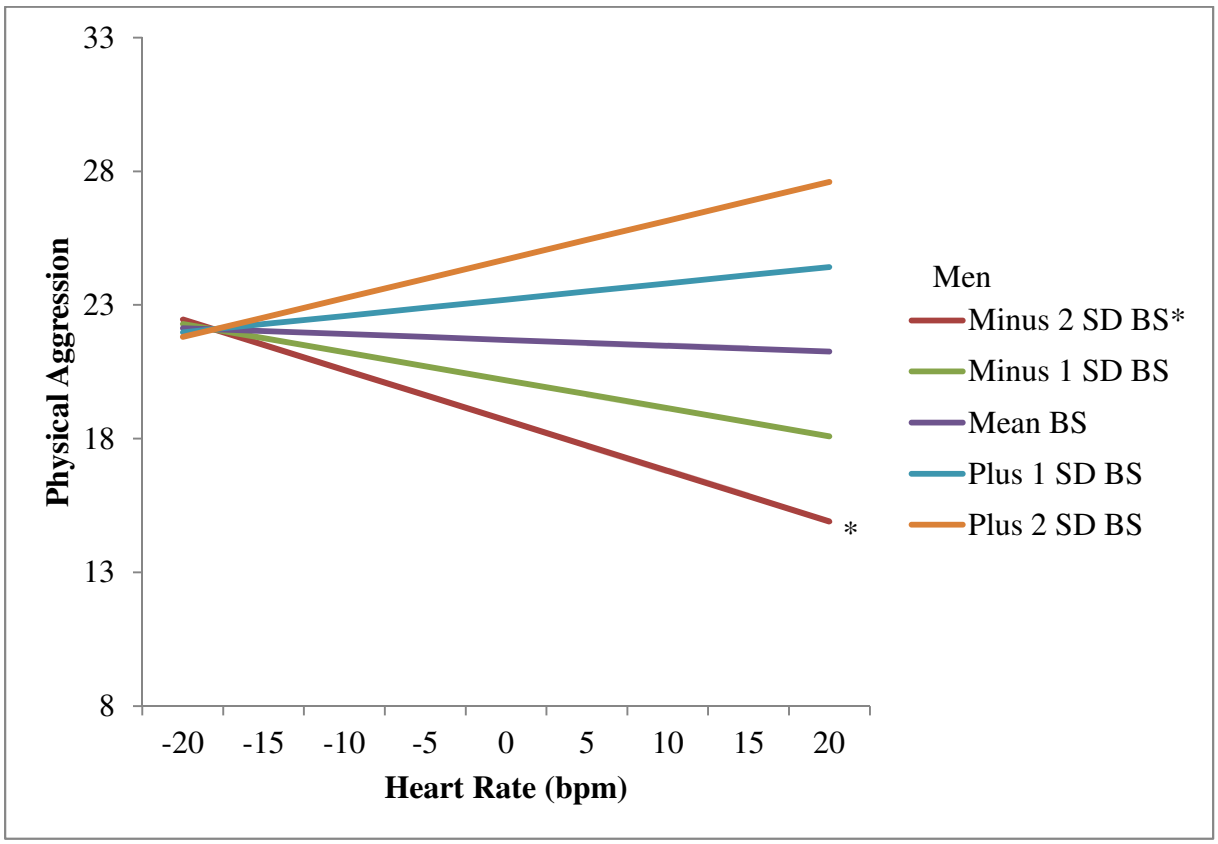

Figure 2. The interaction between heart rate and boredom susceptibility in predicting physical aggression for men.

The simple regression equations and tests for simple slope significance were as follows. Significant simple regression equations are denoted in the graph with an asterisk (*).
-2 *SD* $\hat{y}$ = 18.680 + (-.189)X_c, *t* =-2.103, *p* =.038
-1 *SD* $\hat{y}$ = 20.187 + (-.105)X_c, *t* =-1.751, *p* =.082
Mean $\hat{y}$ = 21.693 + (-.022)X_c, *t* = -.511, *p* =.610
+*1 SD* $\hat{y}$ = 23.200 + (.061)X_c, *t* =1.155, *p* =.250
+2 *SD* $\hat{y}$ = 24.706 + (.145)X_c, *t* =-1.803, *p* =.074

Note: BS = Boredom Susceptibility.

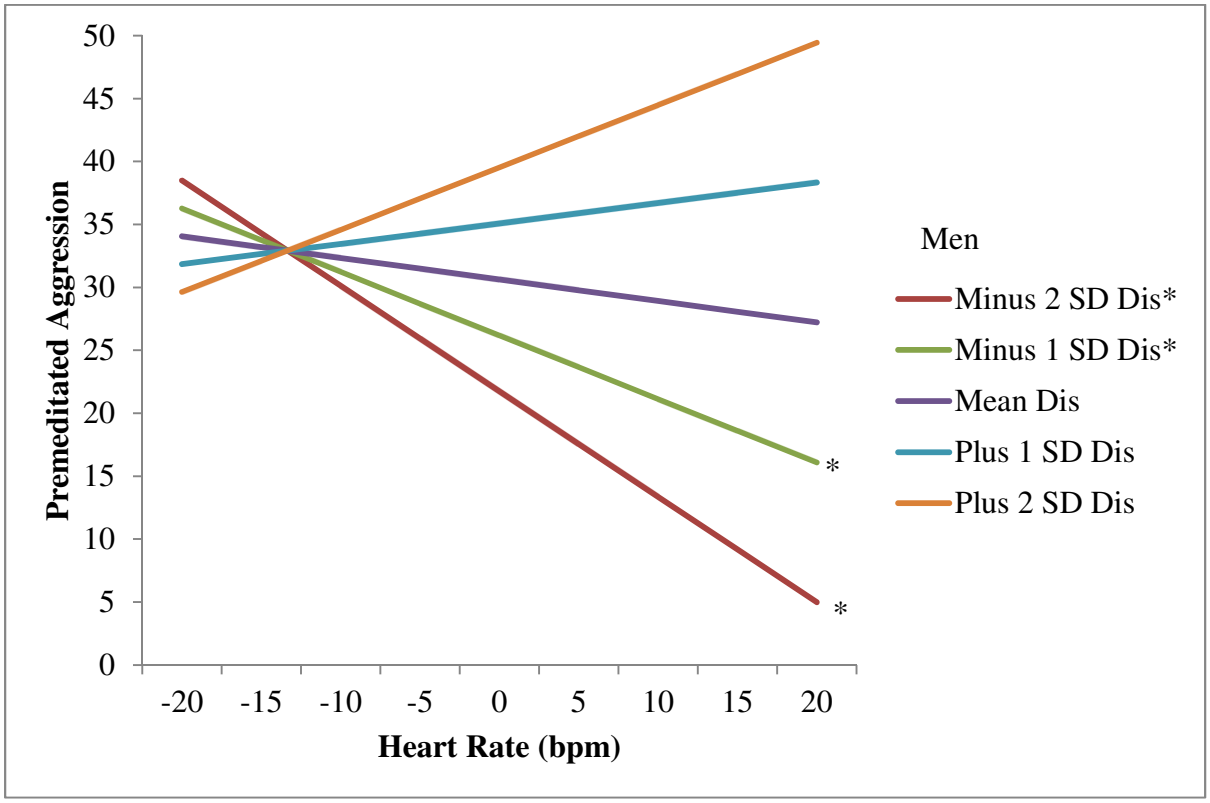

Figure 3. The interaction between heart rate and disinhibition in predicting premeditated aggression for men.

The simple regression equations and tests for simple slope significance were as follows. Significant simple regression equations are denoted in the graph with an asterisk (*).
-2 *SD* $\hat{y} = 21.729 + (-.838)X_c$, $t = -2.655$, $p = .009$
-1 *SD* $\hat{y} = 26.179 + (-.505)X_c$, $t = -2.489$, $p = .014$
Mean $\hat{y} = 30.629 + (-.171)X_c$, $t = -1.18$, $p = .240$
+1 *SD* $\hat{y} = 35.080 + (.162)X_c$, $t = .813$, $p = .418$
+2 *SD* $\hat{y} = 39.530 + (.495)X_c$, $t = 1.5923$, $p = .114$

Note: Dis = Disinhibition.

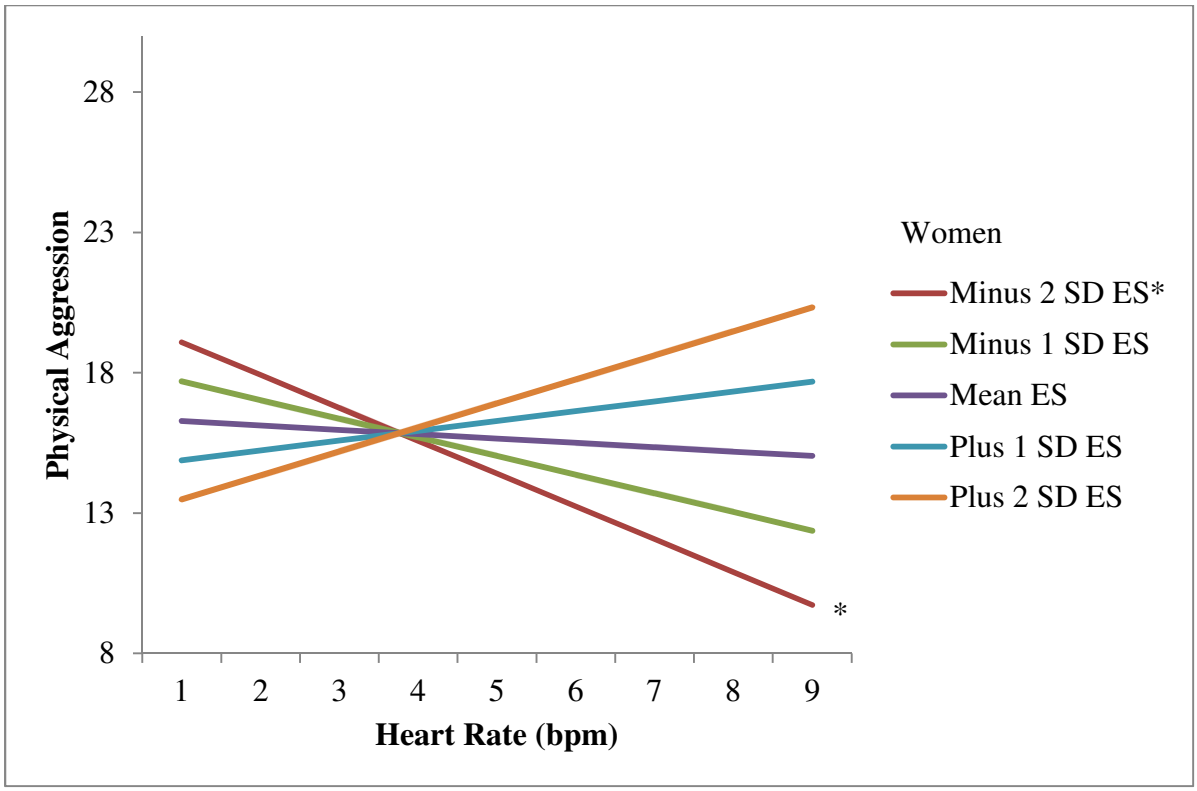

Figure 4. The interaction between heart rate and experience seeking in predicting physical aggression for women.

The simple regression equations and tests for simple slope significance were as follows. Significant simple regression equations are denoted in the graph with an asterisk (*).
2 *SD* $\hat{y}$ = 14.408 + (-.234) X_c, t = -2.076, p = .040
-1 *SD* $\hat{y}$ = 15.032 + (-.133)X_c, t = -1.834, p = .069
Mean $\hat{y}$ = 15.656 + (-.031)X_c, t = -.689, p = .492
+1 *SD* $\hat{y}$ = 16.280 + (.070)X_c, t = 1.222, p = .224
+2 *SD* $\hat{y}$ =16.904 + (.171)X_c, t = 1.829, p = .070

Note: ES = Experience Seeking.

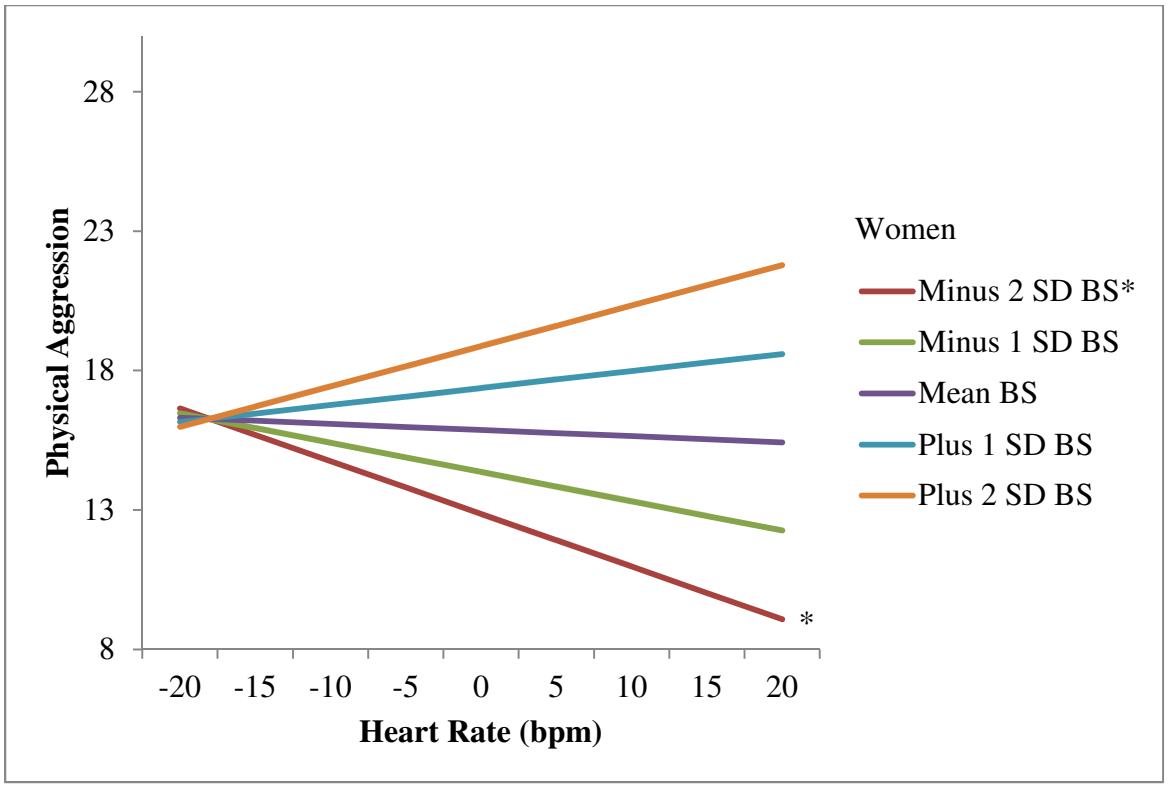

Figure 5. The interaction between heart rate and boredom susceptibility in predicting physical aggression for women.

The simple regression equations and tests for simple slope significance were as follows. Significant simple regression equations are denoted in the graph with an asterisk (*).
-2 *SD* $\hat{y} = 12.854 + (-.189)X_c$, $t = -2.103$, $p = .038$
-1 *SD* $\hat{y} = 14.361 + (-.105)X_c$, $t = -1.751$, $p = .082$
Mean $\hat{y} = 15.867 + (-.022)X_c$, $t = -.511$, $p = .610$
+*1 SD* $\hat{y} = 17.374 + (.061)X_c$, $t = 1.155$, $p = .250$
+2 *SD* $\hat{y} = 18.88 + (.145)X_c$, $t = -1.803$, $p = .074$

Note: BS = Boredom Susceptibility.

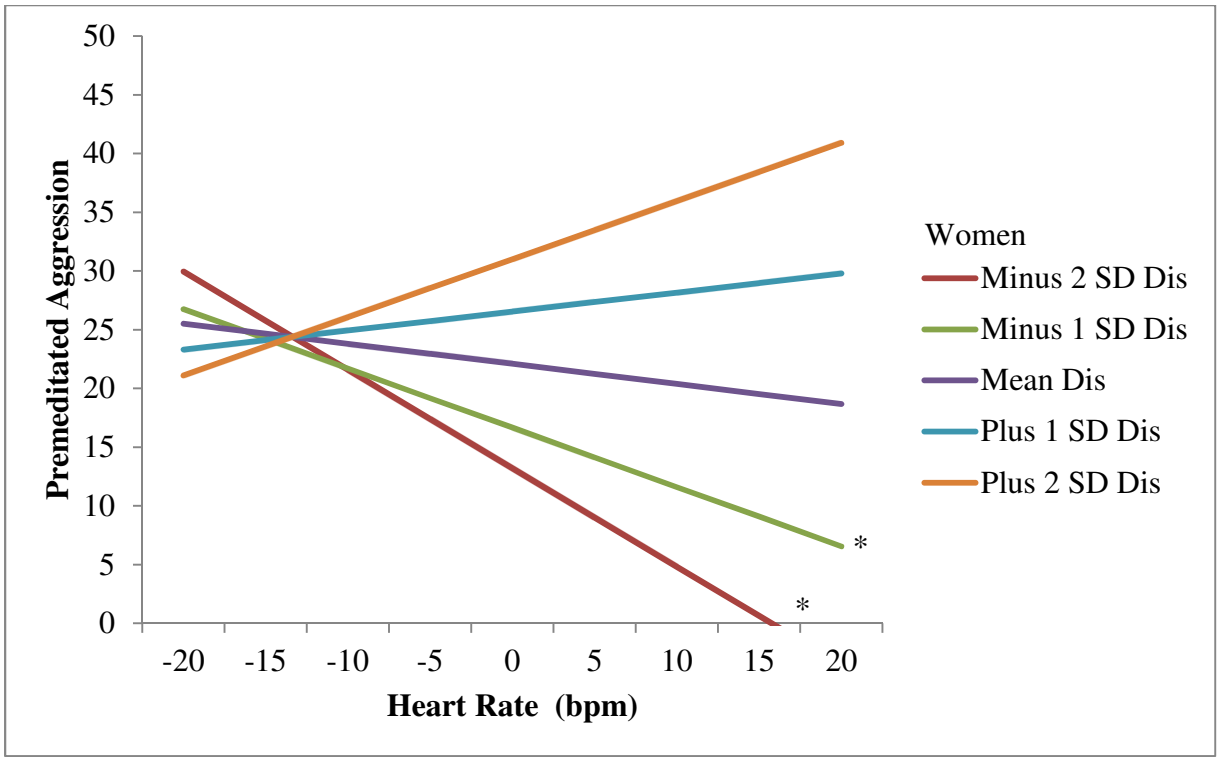

Figure 6. The interaction between heart rate and disinhibition in predicting premeditated aggression for women.

The simple regression equations and tests for simple slope significance were as follows. Significant simple regression equations are denoted in the graph with an asterisk (*).
-2 *SD* $\hat{y} = 13.194 + (-.838)X_c$, $t = -2.655$, $p = .009$
-1 *SD* $\hat{y} = 16.644 + (-.505)X_c$, $t = -2.489$, $p = .014$
Mean $\hat{y} = 22.094 + (-.171)X_c$, $t = -1.18$, $p = .240$
+1 *SD* $\hat{y} = 26.545 + (.162)X_c$, $t = .813$, $p = .418$
+2 *SD* $\hat{y} = 30.995 + (.495)X_c$, $t = 1.5923$, $p = .114$

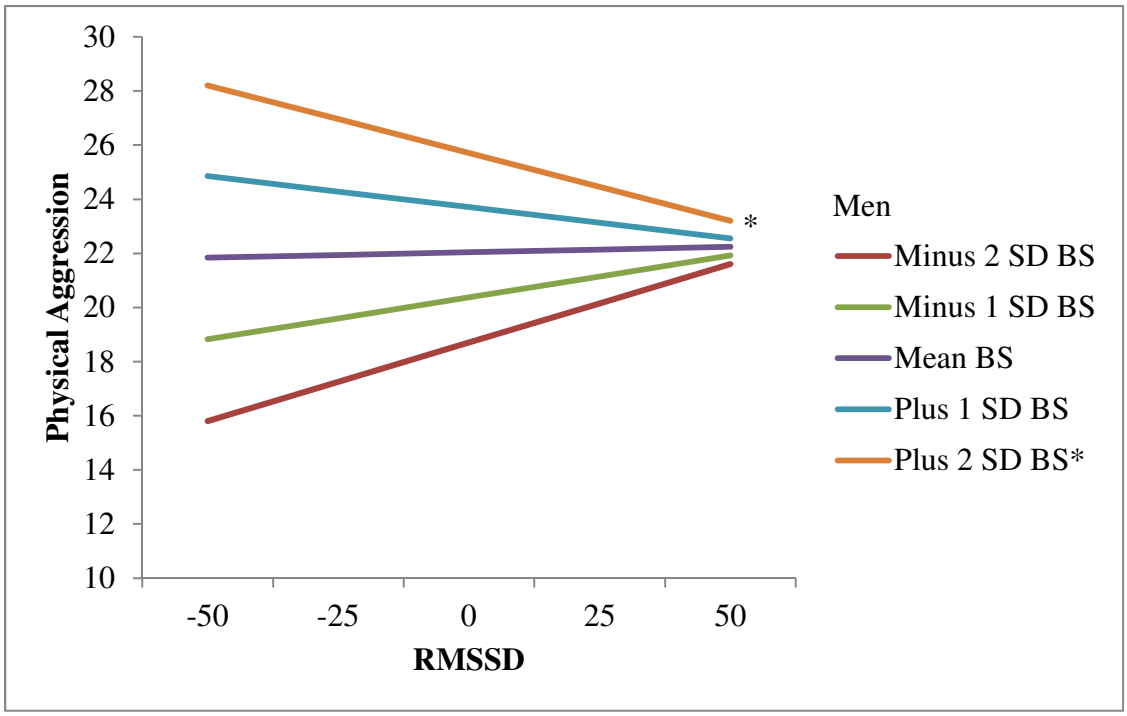

Figure 7. The interaction between RMSSD and boredom susceptibility in predicting physical aggression for men.

The simple regression equations and tests for simple slope significance were as follows. Significant simple regression equations are denoted in the graph with an asterisk (*).
-2 *SD* $\hat{y} = 18.705 + (.058)X_c$, $t = 1.728$, $p = .086$
-1 *SD* $\hat{y} = 20.372 + (.031)X_c$, $t = 1.370$, $p = .173$
Mean $\hat{y} = 22.040 + (.004)X_c$, $t = .281$, $p = .779$
+1 *SD* $\hat{y} = 23.707 + (-.023)X_c$, $t = -1.449$, $p = .150$
+2 *SD* $\hat{y} = 25.375 + (-.050)X_c$, $t = -2.049$, $p = .043$

Note: BS = Boredom Susceptibility.

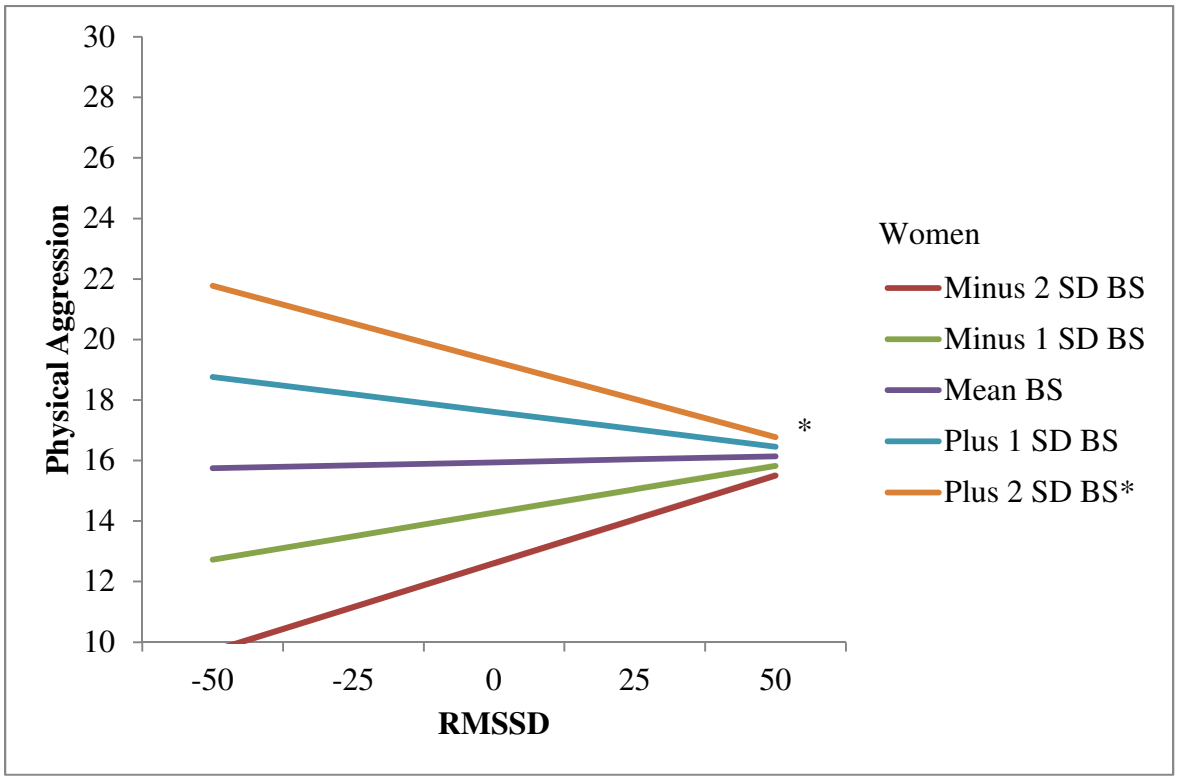

Figure 8. The interaction between RMSSD and boredom susceptibility in predicting physical aggression for women.

The simple regression equations and tests for simple slope significance were as follows. Significant simple regression equations are denoted in the graph with an asterisk (*).
-2 *SD* $\hat{y} = 12.608 + (.058)X_c$, $t = 1.728$, $p = .086$
-1 *SD* $\hat{y} = 14.275 + (.031)X_c$, $t = 1.370$, $p = .173$
Mean $\hat{y} = 15.943 + (.004)X_c$, $t = .281$, $p = .779$
+1 *SD* $\hat{y} = 17.61 + (-.023)X_c$, $t = -1.449$, $p = .150$
+2 *SD* $\hat{y} = 19.278 + (-.050)X_c$, $t = -2.049$, $p = .043$

Note: BS = Boredom Susceptibility.

Appendix A

Demographic Questionnaire

1. Today's Date (mm/dd/yyyy)_____
2. Enter your name. _____
3. Enter your VT PID. _____
4. What is your email address? _____
5. Enter your phone number. _____
6. Enter your Hokie passport ID number. _____
7. What is your age? _____years
8. What is your birthdate? (mm/dd/yyyy) _____
9. What is your sex?

   ☐Male

   ☐Female

   ☐Transgendered
10. What is your major? _____
11. Are you an undergraduate or graduate student?

    ☐Undergraduate

    ☐Graduate

    Other: _____
12. Which ☐of the following **best** describes your race/ethnicity?

    ☐Caucasian/White

    ☐African American/Black/African Origin

    ☐Hispanic/Latino(a)

    ☐Asian American/Asian Origin/Pacific Islander

    ☐Middle Eastern

    ☐American Indian/Alaska Native

    ☐Bi-racial/Multi-racial

    ☐Other (specify); _____
13. Which of the following best describes the majority of people who live within comfortable walking distance of the place where you are **originally from**?

    ☐Wealthy

    ☐Upper middle class/professionals

    ☐Middle class

    ☐Lower middle class

    ☐Blue-collar, working class

    ☐Poor, working class

    ☐Poor, unemployed

14. Which of the following numbers best describe the total annual income of the household where you **grew up**?

    ☐Less than $10,000

    ☐$10,000-$25,000

    ☐$25,000-$50,000

    ☐$50,000-$75,000

    ☐$75,000-$100,000

    ☐More than $100,000

Appendix B

Health Questionnaire

1) **Do you regularly engage in exercise? □ No □Yes**
   1a) If yes, how many days in a month do you exercise?
   _____
   1b) If yes, how many minutes do you exercise for on each occasion?
   _____
   1c) If yes, what is the most common type of exercise activity you engage in?
   _____
   _____
   1d) If yes, what are some other types of exercise activities you frequently engage in?
   _____
   _____

   1e) How would you describe your level of exertion when you do exercise from 1 to 5?

1	2	3	4	5
Light		Medium		Hard

2) **Has there ever been a time when you could not exercise on a regular basis because of a medical issue? □ No □Yes**
   2a) If yes, please explain in detail:
   _____
   _____
   _____

3) **Are you confident that you could currently engage in moderate exercise, such as jogging or speed walking, for approximately 30 minutes? □ No □Yes**

4) **Do you have a personal history of any of the following? Please check all that apply to you.**
   □ a heart attack
   □ heart surgery
   □ cardiac catheterization
   □ coronary angioplasty (PTCA)
   □ pacemaker/implantable cardiac defibrillator/rhythm disturbance
   □ heart valve disease
   □ heart failure
   □ heart transplantation
   □ congenital heart disease

5) **Indicate if you have experienced any of the following symptoms in the past 12 months. Please check all that apply.**
   □ You experience chest discomfort with exertion.
   □ You experience unreasonable breathlessness.
   □ You experience dizziness, fainting or blackouts.
   □ You take heart medications.

6) **Indicate if any of the following currently describe you.**
   □ You have diabetes requiring insulin.
   □ You have asthma or other lung disease.
   □ You have burning or cramping sensations in your lower legs when walking short distances.
   □ You have musculoskeletal problems that limit your physical activity.
   □ You have concerns about the safety of exercise.
   □ You take Beta blocker medications (e.g., medications for blood pressure, heart issues).

7) **Are you currently taking any medications? □ No □Yes**
   6a) If yes, what medication
   _____
   _____
   6b) If yes, what is the dosage?
   _____
   _____
   6c) If yes, why are you taking that medication?
   _____
   _____

8) **Do you have any known allergies? □ No □Yes**
   7a) If yes, what allergies do you have? Please be specific.
   _____
   _____

9) **Are you allergic to any food? □ No □Yes**
   8a) If yes, what food are you allergic to? Please be specific.
   _____
   _____

10) **Have you ever had a head injury? □ No □Yes**
    9a) If yes, please explain.
    _____
    _____
    _____

11) **Have you ever been knocked unconscious for longer than 5 minutes? □ No □Yes**
    8a) If yes, please explain.
    _____
    _____
    _____

Appendix C

Perceived Functional Ability

Suppose you were going to exercise continuously on an indoor track for 1 mile. Which exercise pace is just right for you – **not too easy** and **not too hard**?

Circle the appropriate number (any number, 1 to 13).

1 Walking at a *slow* pace (18 minutes per mile or more)
2
3 Walking at a *medium* pace (16 minutes per mile)
4
5 Walking at a *fast* pace (14 minutes per mile)
6
7 Jogging at a *slow* pace (12 minutes per mile)
8
9 Jogging at a *medium* pace (10 minutes per mile)
10
11 Jogging at a *fast* pace (8 minutes per mile)
12
13 Running at *fast* pace (7 minutes per mile or less)

How fast could cover a distance of 3-miles and **NOT** become breathless or overly fatigued? Be realistic.

Circle the appropriate number (any number, 1 to 13).

1 I could walk the entire distance at a *slow* pace (18 minutes per mile or more)
2
3 I could walk the entire distance at a *medium* pace (16 minutes per mile)
4
5 I could walk the entire distance at a *fast* pace (14 minutes per mile)
6
7 I could jog the entire distance at a *slow* pace (12 minutes per mile)
8
9 I could jog the entire distance at a *medium* pace (10 minutes per mile)
10
11 I could jog the entire distance at a *fast* pace (8 minutes per mile)
12
13 I could run the entire distance at a *fast* pace (7 minutes per mile or less)

Appendix D

Physical Activity Rating

Select the number that **best describes** your overall level of physical activity for the previous 6 months:

0 = avoid walking or exertion (e.g., always use elevator, drive when possible instead of walking)

1 = light activity: walk for pleasure, routinely use stairs, occasionally exercise sufficiently to cause heavy breathing for exercise)

2 = moderate activity: 10 to 60 minutes per week of moderate activity, such as golf, horseback riding, calisthenics, table tennis, bowling, weight lifting, yard work, cleaning house, walking for exercise).

3 = moderate activity: over 1 hour per week of moderate activity as described above).

4 = vigorous activity: run less than 1 mile per week or spend less than 30 minutes per week in comparable activity, such as running or jogging, lap swimming, cycling, rowing, aerobics, skipping rope, running in place, or engaging in vigorous aerobic-type activity, such as soccer, basketball, tennis, racquetball, or handball).

5 = vigorous activity: run 1 mile to less than 5 miles per week or spend 30 minutes to less than 60 minutes per week in comparable physical activity as described above.

6 = vigorous activity: run 5 miles to less than 10 miles per week or spend 1 hour to less than 3 hours per week in comparable physical activity as described above.

7 = vigorous activity: run 10 miles to less than 15 miles per week and spend 3 hours to less than 6 hours per week in comparable physical activity as described above.

8 = vigorous activity: run 15 miles to less than 20 miles per week or spend 6 hours to less than 7 hours per week in comparable physical activity as described above.

9 = vigorous activity: run 20 to 25 miles per week or spend 7 to 8 hours per week in comparable physical activity as described above.

10 = vigorous activity: run over 25 miles per week or spend over 8 hours per week in comparable physical activity as described above.

Appendix E

Sensation Seeking Scale

Directions: Each of the items below contains two choices, A and B. Please circle the letter of the choice which most describes your likes or the way you feel. In some cases you may find items in which both choices describe your likes or feelings. Please choose the one which better describes your likes or feelings. In some cases you may find items in which you do not like either choice. In these cases mark the choice you dislike least. Do not leave any items blank.

It is important you respond to all items with only one choice, A or B. We are interested only in your likes or feelings, not in how others feel about these things or how one is supposed to feel. There are not right or wrong answers as in other kinds of tests. Be frank and give your honest appraisal of yourself.

1. A I like "wild" uninhibited parties.
   B I prefer quiet parties with good conversation.

2. A There are some movies I enjoy seeing a second or even a third time.
   B I can't stand watching a movie I've seen before.

3. A I often wish I could be a mountain climber.
   B I can't understand people who risk their necks climbing mountains.

4. A I dislike all body odors.
   B I like some of the earthy body smells.

5. A I get bored seeing the same old faces.
   B I like the comfortable familiarity of everyday friends.

6. A I like to explore a strange city or section of town by myself, even if it means getting lost.
   B I prefer a guide when I am in a place I don't know well.

7. A I dislike people who do or say things just to shock or upset other people.
   B When you can predict almost everything a person will do and say he or she must be a bore.

8. A I usually don't enjoy a movie or a play where I can predict what will happen in advance.
   B I don't mind watching a movie or play where I can predict what will happen in advance.

9. A I have tried marijuana or would like to.
   B I would never smoke marijuana.

10. A I would not like to try any drug which might produce strange and dangerous effects on me.
    B I would like to try some of the new drugs that produce hallucinations.

11. A A sensible person avoids activities that are dangerous.
    B I sometimes like to do things that are a little frightening.

12. A I dislike "swingers" (people who are uninhibited and free about sex).
    B I enjoy the company of real "swingers."

13. A I find that stimulants make me uncomfortable.
    B I often like to get high (drinking liquor or smoking marijuana).

14. A I like to try new foods that I have never tasted before.
    B I order the dishes with which I am familiar, so as to avoid disappointment and unpleasantness.

15. A I enjoy looking at home movies, travel slides, or home videos.
    B Looking at someone's home movies, travel slides, or home videos bores me tremendously.

16. A I would like to take up the sport of water-skiing.
    B I would not like to take up water-skiing.

17. A I would like to try surf-board riding.
    B I would not like to try surf-board riding.

18. A I would like to take off on a trip with no pre-planned or definite routes, or timetable.
    B When I go on a trip I like to plan my route and timetable fairly carefully.

19. A I prefer the "down-to-earth" kinds of people as friends.
    B I would like to make friends in some of the "far-out" groups like artists or "punks."

20. A I would not like to learn to fly an airplane.
    B I would like to learn to fly an airplane.

21. A I prefer the surface of the water to the depths.
    B I would like to go scuba diving.

22. A I would like to meet some persons who are homosexual (men or women).
    B I stay away from anyone I suspect of being "gay" or "lesbian."

23. A I would like to try parachute jumping.
    B I would never want to try jumping out of a plane with or without a parachute.

24. A I prefer friends who are excitingly unpredictable.
    B I prefer friends who are reliable and predictable.

25. A I am not interested in experience for its own sake.
    B I like to have new and exciting experiences and sensations even if they are a little frightening, unconventional, or illegal.

26. A The essence of good art is in its clarity, symmetry of form and harmony of colors.
    B I often find beauty in the “clashing” colors and irregular forms of modern paintings.

27. A I enjoy spending time in the familiar surroundings of home.
    B I get very restless if I have to stay around home for any length of time.

28. A I like to dive off the high board.
    B I don’t like the feeling I get standing on the high board (or I don’t go near it at all).

29. A I like to date members of the opposite sex who are physically exciting.
    B I like to date members of the opposite sex who share my values.

30. A Heavy drinking usually ruins a party because some people get loud and boisterous.
    B Keeping the drinks full is the key to a good party.

31. A The worst social sin is to be rude.
    B The worst social sin is to be a bore.

32. A A person should have considerable sexual experience before marriage.
    B It’s better if two married persons begin their sexual experience with each other.

33. A Even if I had the money I would not care to associate with flighty rich persons in the 'jet set.'
    B I could conceive of myself seeking pleasures around the world with the “jet set.”

34. A I like people who are sharp and witty even if they do sometimes insult others.
    B I dislike people who have their fun at the expense of hurting the feelings of others.

35. A There is altogether too much portrayal of sex in movies.
    B I enjoy watching many of the “sexy” scenes in the movies.

36. A I feel best after taking a couple of drinks.
    B Something is wrong with people who need liquor to feel good.

37. A People should dress according to some standards of taste, neatness, and style.
    B People should dress in individual ways even if the effects are sometimes strange.

38. A Sailing long distances in small sailing crafts is foolhardy.
    B I would like to sail a long distance in a small but seaworthy sailing craft.

39. A I have no patience with dull or boring persons.
    B I find something interesting in almost every person I talk with.

40. A Skiing fast down a high mountain slope is a good way to end up on crutches.
    B I think I would enjoy the sensations of skiing very fast down a high mountain slope.

Appendix F

Aggression Questionnaire

Instructions: Using the 5 point scale shown below, indicate how uncharacteristic or characteristic each of the following statements is in describing you. Place your rating in the box to the right of the statement.

1 = extremely uncharacteristic of me
2 = somewhat uncharacteristic of me
3 = neither uncharacteristic nor characteristic of me
4 = somewhat characteristic of me
5 = extremely characteristic of me

1. Once in a while, I can't control the urge to strike another person.
2. I tell my friends openly when I disagree with them.
3. I flare up quickly but get over it quickly.
4. I am sometimes eaten up with jealousy.
5. Given enough provocation, I may hit another person.
6. I often find myself disagreeing with people.
7. When frustrated, I let my irritation show.
8. At times, I feel I have gotten a raw deal out of life.
9. If somebody hits me, I hit back.
10. When people annoy me, I may tell them what I think of them.
11. I sometimes feel like a powder keg ready to explode.
12. Other people always seem to get the breaks.
13. I get into fights a little more than the average person does.
14. I can't help getting into arguments when people disagree with me.
15. I am an even-tempered person.
16. I wonder why sometimes I feel so bitter about things.
17. If I have to resort to violence to protect my rights, I will.
18. My friends say that I'm somewhat argumentative.
19. Some of my friends think I'm a hothead.
20. I know that "friends" talk about me behind my back.
21. There are people who pushed me so far that we came to blows.
22. Sometimes, I fly off the handle for no good reason.
23. I am suspicious of overly friendly strangers.
24. I can think of no good reason for ever hitting a person.
25. I have trouble controlling my temper.
26. I sometimes feel that people are laughing at me behind my back.
27. I have threatened people I know.
28. When people are especially nice, I wonder what they want.
29. I have become so mad that I have broken things.

Appendix G

Impulsive/Premeditated Aggression Scales (IPAS)

When people become frustrated, angry or enraged they express that anger in a variety of ways. Considering your aggressive acts over the last 6 months please answer the following questions. An aggressive act is defined as striking and/or verbally insulting another person or breaking/throwing objects because you were angry or frustrated.

Your possible answers are:

Strongly Agree = **SA**, Agree = **A**, Neutral = **N**, Disagree = **D**, Strongly Disagree = **SD**

	SA	**A**	**N**	**D**	**SD**
1. I planned when and where my anger was expressed.	O	O	O	O	O
2. I felt my outbursts were justified.	O	O	O	O	O
3. When angry I reacted without thinking.	O	O	O	O	O
4. I typically felt guilty after the aggressive acts.	O	O	O	O	O
5. I was in control during the aggressive acts.	O	O	O	O	O
6. I feel my actions were necessary to get what I wanted.	O	O	O	O	O
7. I usually can't recall the details of the incidents well.	O	O	O	O	O
8. I understood the consequences of the acts before I acted.	O	O	O	O	O
9. I feel I lost control of my temper during the acts.	O	O	O	O	O
10. Sometimes I purposely delayed the acts until a later time.	O	O	O	O	O
11. I felt pressure from others to commit the acts.	O	O	O	O	O
12. I wanted some of the incidents to occur.	O	O	O	O	O
13. I feel some of the incidents went too far.	O	O	O	O	O
14. I think the other person deserved what happened to them during some of the incidents.	O	O	O	O	O
15. I became agitated or emotionally upset prior to the acts.	O	O	O	O	O
16. The acts led to power over others or improved social status for me.	O	O	O	O	O
17. I was under the influence of alcohol or other drugs during the acts.	O	O	O	O	O
18. I knew most of the persons involved in the incidents.	O	O	O	O	O
19. I was concerned for my personal safety during the acts.	O	O	O	O	O
20. Some of the acts were attempts at revenge.	O	O	O	O	O
21. I feel I acted out aggressively more than the average person over the last six months.	O	O	O	O	O
22. I was confused during the acts.	O	O	O	O	O
23. Prior to the incidents I knew an altercation was going to occur.	O	O	O	O	O
24. My behavior was too extreme for the level of provocation.	O	O	O	O	O

25. My aggressive outbursts were usually directed at a specific person.	O	O	O	O	O
26. I consider the acts to have been impulsive.	O	O	O	O	O
27. I was in a bad mood the day of the incident.	O	O	O	O	O
28. The acts were a “release” and I felt better afterwards.	O	O	O	O	O
29. I am glad some of the incidents occurred.	O	O	O	O	O
30. Anything could have set me off prior to the incidents.	O	O	O	O	O

Appendix H

Taste Preference Inventory

Please rate your preference for following tastes from 1 (extreme dislike) to 7 (extreme like).

	Extreme Dislike						**Extreme Like**
Spicy	1	2	3	4	5	6	7
Sweet	1	2	3	4	5	6	7
Tangy	1	2	3	4	5	6	7
Sour	1	2	3	4	5	6	7
Salty	1	2	3	4	5	6	7

Appendix I

Exercise and Caffeine Questionnaire

1) Have you consume caffeinate in the past hour? ☐ No ☐Yes

2) Have you consumed nicotine containing products in the past hour? ☐ No ☐Yes

3) Have you exercised in the past hour? ☐ No ☐Yes

Appendix J

Rating of Perceived Exertion

During the exercise test, we want you to pay close attention to how hard you feel the exercise work rate is. This feeling should reflect your total amount of exertion and fatigue, combining all sensations and feelings of physical stress, effort, and fatigue. Don't concern yourself with any one factor such as leg pain, shortness of breath or exercise intensity, but try to concentrate on your total, inner feeling of exertion. Try not to underestimate or overestimate your feelings of exertion; be as accurate as you can.

Rate from 1 to 7:

1 Very, very light
2 Very light
3 Fairly light
4 Somewhat hard
5 Hard
6 Very hard
7 Very, very hard

Appendix K

Hot Sauce Follow-Up

Please rate how much you <u>enjoyed</u> the hot sauce.

1	2	3	4	5
not at all		somewhat		very much

Please rate how <u>spicy you</u> thought the hot sauce was.

1	2	3	4	5
not at all spicy		somewhat spicy		very spicy

Please rate how <u>spicy</u> you think <u>someone else</u> would think the hot sauce is.

1	2	3	4	5
not at all spicy		somewhat spicy		very spicy

Appendix L

Informed Consent Form I

Study Title: Mood and Food Preference: The Role of Exercise

Investigators: Laura Wilson, M.A.
Angela Scarpa, Ph.D.

I. Purpose of this research

As the first part of a two-part study, the purpose of this study is to examine the effects of exercise on mood and food preference in college students.

II. Procedures

You will be asked to complete a questionnaire about your background, mood, health, and food preferences. If you decide to participate, you will be asked to respond to an online questionnaire expected to last between 30 to 45 minutes. Based on your responses to the measures, you may or may not be contacted for participation in the second portion of the study. In the event that you are eligible for the second part of the study, you will be contacted by email and will be eligible for additional extra credit. If any stressful or difficult issues arise at any time during the completion of the questionnaires, emergency contact phone numbers will be listed on the main webpage.

III. Risks

There will be minimal discomfort associated with the completion of the questionnaires.

IV. Benefits

Your participation in this study will help advance the understanding of the effects of exercise on mood and food preferences in college men.

V. Confidentiality

Any information you provide will be confidential. You will be asked to provide your name, phone number, and e-mail address solely for the purpose of obtaining extra credit and being contacted for the second study. A participant number will be assigned to your responses and only this number will be associated with your information for purposes of data analyses and writing of results. Please note that although the responses to the questionnaire require a password for entry and completion for the questionnaire, this does not guarantee complete confidentiality in the event the responses are intercepted inappropriately from the internet.

At no time will the researchers release identifying information from this study to anyone other than those working on the study without your written consent. However, confidentiality may be broken if you express intent to harm yourself or someone else, in which case the researchers are

legally obligated to inform the appropriate authorities. In such a case, you will be informed of the need to do so, and are encouraged to contact the Cook Counseling Center (231-6557) or the Psychological Services Center (231-6914). Research findings may be published or presented for scientific purposes, but your identity will not be revealed in the description or publication of this research.

VI. Compensation

You may receive one extra credit point for the psychology class you are currently enrolled in. If you are not currently enrolled in a psychology class, please speak with your professor about alternative methods of receiving extra credit.

VII. Freedom to Withdraw

You are free to withdraw from this study at any time. However, if you choose to withdraw, you will not receive the extra credit.

VIII. Participant Responsibilities

I voluntarily agree to participate in this study and complete the questionnaires associated with this phase of the current research study.

IX. Participant Permission

I have read and understand the informed consent and conditions of this project. I have had my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project. If I participate, I may withdraw at any time without penalty. I agree to abide by the rules of this project.

_____

Participant Signature Date

By entering your personal information and completing the online questionnaire, you are giving consent to participate in this study. If you do not wish to participate, simply exit the survey now.

Should I have any further questions about this research or its conduct, I will contact:

_____

Laura Wilson
Lawilso3@vt.edu
757-434-2790

_____
Angela Scarpa, Ph.D.
ascarpa@vt.edu
540-231-2615

_____
David Moore, Ph.D.
IRB Chair
mooredv@vt.edu
540-231-4991

_____
David Harrison, Ph.D.
Psychology Human Subjects Committee Chair
dwh@vt.edu
540-231-4422

Appendix M

Informed Consent Form II

Study Title: Mood and Food Preference: The role of Exercise

Investigators: Laura Wilson, M.A.
Angela Scarpa, Ph.D.

I. Purpose of this research

As the second part of a two-part study, the purpose of this study is to examine the effects of exercise on mood and food preference in college men.

II. Procedures

You will be asked to complete a series of tasks in which you will participate in a food preference test, driving computer game, and will walk on a treadmill. During these tasks, heart rate measures will be recorded from electrodes placed on your skin. A male experimenter will provide a tutorial to show you how to place the electrode strap around your torso. You will also be asked to complete a series of questionnaires about your emotional experiences. This study is expected to last about 1 hour.

III. Risks

There will be minimal discomfort associated with the completion of the questionnaires and tasks. There may be some mild discomfort from walking on the treadmill or wearing the electrode strap; however, the discomfort is expected to be comparable to everyday activities, such as walking on campus.

IV. Benefits

Your participation in this study will help advance the understanding of the effects of exercise on mood and food preferences in college men.

V. Confidentiality

Any information you provide will be confidential. You will be asked to provide your name, phone number, and e-mail address solely for the purpose of obtaining extra credit. A participant number will be assigned to your responses and only this number will be associated with your information for purposes of data analyses and writing of results. Please note that although the responses to the questionnaire require a password for entry and completion for the questionnaire, this does not guarantee complete confidentiality in the event the responses are intercepted inappropriately from the internet.

At no time will the researchers release identifying information from this study to anyone other than those working on the study without your written consent. However, confidentiality may be broken if you express intent to harm yourself or someone else, in which case the

researchers are legally obliged to inform the appropriate authorities. In such a case, you will be informed of the need to do so, and are encouraged to contact the Cook Counseling Center (231-6557) or the Psychological Services Center (231-6914). Research findings may be published or presented for scientific purposes, but your identity will not be revealed in the description or publication of this research.

VI. Compensation

You may receive two extra credit point for the psychology class you are currently enrolled in. If you are not currently enrolled in a psychology class, please speak with your professor about alternative methods of receiving extra credit. Alternatively, you may be entered into a raffle to win a $50 gift certificate from Amazon. The drawing will be held at the end of data collection.

VII. Freedom to Withdraw

You are free to withdraw from this study at any time. However, if you choose to withdraw, you will not receive the extra credit.

VIII. Participant Responsibilities

I voluntarily agree to participate in this study and complete the questionnaires and and tasks associated with this phase of the current research study.

IX. Participant Permission

I have read and understand the informed consent and conditions of this project. I have had my questions answered. I hereby acknowledge the above and give my voluntary consent for participation in this project. If I participate, I may withdraw at any time without penalty. I agree to abide by the rules of this project.

_____

Participant Signature Date

Should I have any further questions about this research or its conduct, I will contact:

_____

Laura Wilson
Lawilso3@vt.edu
757-434-2790

_____

Angela Scarpa, Ph.D.
ascarpa@vt.edu
540-231-2615

_____

David Moore, Ph.D.
IRB Chair
mooredv@vt.edu
540-231-4991

_____

David Harrison, Ph.D.
Psychology Human Subjects Committee Chair
dwh@vt.edu
540-231-4422

Appendix N

Distress Question

Please answer the following questions regarding your current emotional state from participating in the research study.

I would rate the impact of the questions I have answered and the activities I completed on the following scale, with 1 representing no effect, and 5 representing a significant impact such as causing significant sadness, distress, or depression.

☐1	☐2	☐3	☐4	☐5
No Effect				Significant Impact (Sadness, Distress, Depression)

APPENDIX O

DEBRIEFING PROCESS

At the completion of data collection, the researchers send the following email to all participants who completed Phase II of the current study:

Thank you again for participating in "A Study of Mood and Food Preferences: The Role of Exercise Part II." I am contacting you because the study has been completed and I wanted to provide you with some additional information about the study. As many of you know, researchers strive to obtain valid, reliable, and practical information. Because of this, it is sometimes necessary to not reveal the true purposes of aspects of studies to ensure that participants are honest and behave naturally. In the current study, there are several aspects of the study I would like to clarify. The true purpose of the study was to examine how increasing participants' heart rate would affect decision-making during both a driving game and a food task. The driving game measured sensation seeking or level of risk taking. The food task measured the participant's propensity to provide spicy food to another person. Although you were told during the study that there was another participant who would be eating the food sample, this participant was fictitious. Again, all of these decisions were made to help participants behave as honestly as possible. This study was reviewed and approved by Virginia Tech's IRB. If you have any concerns about the content of this email, please do not hesitate to contact the researchers (Laura Wilson at lawilso3@vt.edu or Angela Scarpa at ascarpa@vt.edu). You can also contact the IRB chair (Dr. Moore at moored@vt.edu) or the Psychology Human Subjects Committee Chair (Dr. Harrison or dwh@vt.edu).

Thank you,
Laura Wilson