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EXAMINING THE ASSOCIATIONS BETWEEN BODY MASS INDEX, REJECTION SENSITIVITY, AND STRESS-REACTIVITY FOLLOWING SOCIAL EXCLUSION

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ABSTRACT

The prevalence of obesity in America has escalated dramatically over the last half-century, and research suggests that it will become even more ubiquitous in the coming decade. Although the biological consequences of obesity are well understood, there is a dearth in our comprehension of how social and psychological factors may contribute to poor health outcomes for overweight and obese individuals. For this thesis, secondary data analyses were conducted from The Social Interactions and Health Project (n=120), where data from a two-group randomized control experiment titled "Cyberball" was used to examine whether differences in Body Mass Index (BMI) and rejection sensitivity (the anxious expectation and anticipation for rejection) moderated stress-reactivity (change in heart rate and cortisol level) following social exclusion. Six regression models were computed to analyze the effects of BMI and rejection sensitivity on change in heart rate and cortisol level for participants who were randomly assigned to the Cyberball exclusion condition. BMI was a statistically significant predictor for change in cortisol following social exclusion ($\beta = -0.005$, $p=0.036$). However, rejection sensitivity and the interaction between BMI and rejection sensitivity were not statistically significant predictors of change in heart rate or cortisol level following social exclusion. Specifically, there was a decrease in cortisol levels following social exclusion, suggesting that BMI predicts blunted stress-reactivity following social exclusion. Overall, the results suggest that overweight and obese individuals may be at risk of blunted physiological reactions following social exclusion. When coupling these blunted physiological reactions with the biological complications of obesity, a synergistic effect may exist where a combination of biological and physical factors results in worsened health outcomes for overweight and obese individuals.

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Chapter 1

Introduction

Obesity

The prevalence of obesity in the United States is widespread in both children and adults. Obesity is evaluated according to the widely accepted Body Mass Index (BMI) measure, which is calculated by dividing the individual's weight in kilograms by the square of his or her height in meters (Nuttall, 2015). The BMI scale ranges from underweight to morbid obesity, where individuals with a BMI under 18.5 are considered underweight, 18.5 to 25 are considered normal weight, 25 to 29 are overweight, 30-39 are obese, and 40 and above are morbidly obese (WHO Consultation on Obesity, 2000). In 2016, the prevalence of overweight and obesity status (i.e. BMI greater than 25) in adults was 39.6%, while the prevalence of overweight and obesity status (i.e. BMI greater than 25) in children (ages 2-19 years old) was 18.5% (Hales, Fryar, Carroll, Freedman, & Ogden, 2018). Alarmingly, the prevalence of obesity in American adults increased 7% between 2008 to 2016 (Hales et al., 2018). Future projections of the prevalence of overweight and obesity status in America suggest that just over four out of every five Americans will have a BMI that is above 25 by the year 2030 (Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008). These future projections for the prevalence of obesity in America indicate that obesity will be almost ubiquitous among American adults approximately a decade from now. Obesity is affected by a variety of etiologically diverse factors that range from adiposity abundance to metabolic issues (Hu, 2008). BMI has been verified as an acceptable measurement

of body fatness due to its strong correlation with absolute body fat and percent body fat (Gallagher et al., 1996). Currently, in the United States there are twice as many people with a BMI between 25 to 40 than there are individuals with a normal weight BMI of 18.5 to 25 (Hales et al., 2018).

There is an extensive amount of literature that elucidates the associations between obesity and the development of chronic diseases (Hu, 2008). There is an established link between obesity and the development of cardiovascular risk factors such as elevated blood pressure, high density lipoprotein (HDL) cholesterol, elevated fasting glucose, and increased triglyceride levels in the bloodstream (Spiegelman, Israel, Bouchard, & Willett, 1992). These findings coincide with the conclusions from the Framingham Heart Study, which found that overweight and obese individuals were more likely to develop hypertension, hypercholesterolemia, diabetes, and overt cardiovascular diseases (Isomaa et al., 2001). Additionally, researchers have also linked obesity with the development of sleep apnea (Vgontzas et al., 2000), osteoarthritis (Losina et al., 2011), and cancer progression (Calle, Rodriguez, Walker-Thurmond, & Thun, 2003). Other studies have determined that as individuals become more obese, the links between obesity and chronic diseases such as type 2 diabetes, hypertension, coronary heart disease, and gallbladder disease become even more significant (Willett, Dietz, & Colditz, 1999). When considering the current status and future projections of the prevalence of obesity in the U.S., it is distressing that many Americans will be at risk of developing chronic diseases that are associated with obesity.

There is a substantial financial cost placed on the United States healthcare system to address the medical needs of overweight and obese individuals. These costs are attributed to the premature mortality, morbidity of chronic illness, and the decrease in the quality of life for obese individuals (Hu, 2008). Obese individuals strain the healthcare system as they require an

additional supply of ambulatory care, hospitalization, pharmacotherapy, laboratory tests, and long-term care (Wolf & Colditz, 1998). A meta-analysis found that in 2014 there was approximately $150 billion spent to address the medical needs of obese Americans (Kim & Basu, 2016). With an increase in the prevalence of obesity in America, researchers estimate that in 2030, approximately $960 billion, or one out of every 6 dollars spent on healthcare in total, will be spent on direct health care costs attributed to obesity (Wang et al., 2008). Obesity has significant relevance towards biobehavioral health research because of the health and economic consequences it has towards such a large percent of the United States population.

Weight Stigma

There is a plethora of research that consistently highlights a clear bias against people who are overweight and obese (Puhl & Brownell, 2001), and that Americans have prejudicial inclinations towards these individuals (Carr & Friedman, 2005). The stigmatization of overweight and obese individuals intrigues social scientists since many believe that weight prejudice may be the last socially accepted form of prejudice in society (Stunkard & Sorensen, 1993), and is independent of race, gender, and age (Carr & Friedman, 2005). Weight bias seems to be a unique type of bias in that there is no in-group protection because obese individuals also show biases towards other overweight or obese peers (Wang, Brownell, & Wadden, 2004). Additionally, weight bias is unlike gender or racial biases because it is perceived as something that can be monitored by the individual (Crandall, 1994), which results in many overweight and obese individuals feeling as if this stigmatization is deserved (Feather, 1996). Contrary to conventional wisdom, empirical evidence does not support the belief that obesity is fully

controlled by the individual (see Vartanian & Smyth, 2013). Other studies have documented that the experience of weight stigmatization is even more severe for individuals who are obese or morbidly obese (Miller, Rothblum, Barbour, Brand, & Felicio, 1990), and in some cases there is evidence showing that obesity becomes a "master status" for individuals who are morbidly obese (Carr & Friedman, 2005). This finding indicates that for some morbidly obese individuals, others perceive their weight status as the sole determinant of their society identity (Carr & Friedman, 2005).

People who are overweight or obese are often stereotyped as being lazy, undetermined, self-indulgent, and their abilities are underestimated (Latner, Stunkard, & Wilson, 2005). Researchers observed that overweight and obese individuals experience weight stigma across an array of public settings, including in work settings (O'Brien et al., 2008), from health professionals (Schwartz, Chambliss, Brownell, Blair, & Billington, 2012), in television shows and movies (Himes & Thompson, 2007), from physical education teachers and other students (O'Brien, Hunter, & Banks, 2007), in public health messages (Lewis et al., 2010), and advertisements (Geier, Schwartz, & Brownell, 2003). At a more personal level, the most frequent sources of weight bias derive from experiences with family members and physicians (Puhl & Brownell, 2006).

The effects of weight stigma have pronounced psychosocial consequences for overweight and obese individuals due to their perceived isolation. These feelings of isolation result in significant coping and emotional responses, which result in stress management and ultimately health outcomes. Biobehavioral health researchers are interested in weight stigma because psychosocial stressors can be coupled with the biological factors that affect overweight and obese individual's health outcomes.

Rejection Sensitivity

Rejection sensitivity is the tendency in which an individual anxiously awaits, perceives, and answers to social rejection (Downey & Feldman, 1996). Rejection sensitivity affects how people behave in social interactions, and individuals who are rejection sensitive react intensely to social rejection as it threatens the human fundamental need for acceptance (Baumeister & Leary, 1995). The rejection sensitivity model is explained as a spectrum where individuals can either be high in rejection sensitivity (i.e., have anxious expectations of social rejection), or low in rejection sensitivity (i.e., are unconcerned with the possibility of being rejected; Downey & Feldman, 1996). Individuals high in rejection sensitivity are likely to perceive even neutral environments as rejecting (Downey & Feldman, 1996), and the need to regain social acceptance results in an anxiety that induces a variety of emotional responses (i.e., anger, hostility; Ayduk, Gyurak, & Luerssen, 2008; Romero-Canyas & Downey, 2005). The anticipation of rejection may vary in instances such as when individuals may expect rejection from a specific individual or group, and may also depend on the identity one maintains in certain situations (Levy, Ayduk, & Downey, 2001).

Rejection sensitivity can be viewed as a Defensive Motivational System (DMS) which causes individuals to overreact to social rejection (Romero-Canyas, Downey, Berenson, Ayduk, & Kang, 2010). Studies have shown that individuals high in rejection sensitivity have their DMS become automatically activated in response to cues of social rejection, but signs of acceptance and belonging do not activate the DMS (Downey, Mougios, Ayduk, London, & Shoda, 2004). The DMS can become maladaptive if it is activated for non-exclusionary neutral situations (Romero-Canyas et al., 2010), and examples include the creation of a self-fulfilling prophecy that results in additional ostracism (Downey, Freitas, Michaelis, & Khouri, 1998).

This intense anticipation of rejection derives from the pioneering early work of Bowlby, who found that children who do not receive adequate support and care from their parents during a period of rejection are likely to develop an anticipation that they will be rejected by others in the future (Bowlby, 1980). As these insecurely-attached children mature, they will try to avoid future situations where rejection is a likely outcome (Downey & Feldman, 1996). The experiences during childhood that evoke these feelings of anxiety include exposure towards family violence, emotional neglect, harsh discipline, and conditional love from one's caregivers (Downey, Bonica, & Rincon, 1999). Research has shown that rejection sensitivity seems to peak during adolescence, where it then decreases as these individuals enter adulthood (Hafen, Spilker, Chango, Marston, & Allen, 2014). From a social perspective, the overexaggerated expectation of rejection results negative pattern in the quality of relationships (Downey et al., 1998), where individuals who are sensitive to rejection report higher incidences of relationship issues (Downey, Lebolt, Rincón, & Freitas, 1998). These individuals struggle with maintaining short-term friendships due to inconsistent behaviors which can range from being hostile, aggressive, disconnected, and even submissive (Downey et al., 1998).

Similar to the psychosocial repercussions associated with weight stigma, rejection sensitivity is an important research component of biobehavioral health because it is associated with psychological distress and magnified emotional responses. This can be highlighted in studies that exhibit how rejection sensitivity may serve as a moderator to physiological reactivity as a result of defensive physiological reactions following rejection (Downey et al., 2004; Gyurak & Ayduk, 2007). Most importantly, some individuals are already more vulnerable to rejection due to socially-related threats (i.e. weight stigma), and the repeated rejection they may endure may contribute to heightened expectations of rejection. Rejection sensitivity has become a focus

in biobehavioral health because the biopsychosocial model can explain how specific populations of individuals are vulnerable to unfavorable health outcomes as a result of social factors that interact with one's psychology and personality.

Stress-Reactivity

Psychological stress is the phenomena in which stimuli become too overwhelming for an individual's coping mechanisms, and ultimately can lead to maladaptive coping responses (Cohen, Kessler, & Gordon, 1995). Although a majority of stressful experiences are reported to only last minutes to hours, research on stress and how individuals respond to stressful situations intrigues scientists due to its relevance towards health implications. Stress reactivity has been carefully operationalized by the work of Lazarus and Folkman, who theorized Cognitive Appraisal. In this theory, stress is defined as the subjection to stimuli that are perceived to be harmful, threatening, or challenging, and the outcome of distress leads to the formation of coping strategies targeted towards the presented stimulus (Lazarus & Folkman, 1984). They found that the individual's appraisal of the environment derived from two main components: the beliefs and values of the individual, and the demands and resources associated with the individual's environment (Lazarus, 1991). Cognitive Appraisal begins with primary appraisal, where an individual determines whether or not the stimulus has significance towards his or her well-being. Then, the process of secondary appraisal occurs, where that individual then evaluates if his/her coping strategies, situational variables, and other resources will aid them in overcoming the stimulus.

Research on physiological reactivity to socially threatening stimuli is comprehensive. The two main physiological mechanisms that encompass stress reactivity are the sympatho-adrenal-medullary (SAM) axis and the hypothalamus-pituitary-adrenal (HPA) axis, where both can be activated by physical and psychological stimuli (Kirschbaum, Pirke, & Hellhammer, 1993). Specifically in this context, the Fight or Flight hypothesis states that social rejection cues can be interpreted as physical pain, which then induces an elevated response of the autonomic nervous system by releasing cortisol (Blackhart, Eckel, & Tice, 2007). The HPA and SAM axes function by elevating cortisol, heart rate, and blood pressure when individuals are exposed to stimuli that evoke physiological stress reactivity (Smith & Jordan, 2015). In the presence of a socially threatening stimulus, the SAM mechanism increases blood flow (by elevating heart rate), blood pressure, sweating, and pupil dilation, broadly consistent with an evolutionary advantage to provide the body appropriate resources in order to overcome the threat (Bitsika, Sharpley, Sweeney, & McFarlane, 2014). Therefore, change in heart rate has been verified as an effective measure of stress reactivity.

The activation of the HPA axis begins with the stimulation of the hypothalamus that results in the secretion of corticotropin-releasing factor, causing the pituitary gland to release the adrenocorticotropic hormone, where finally the adrenal glands are stimulated and release cortisol (Sapolsky, Romero, & Munck, 2000). The role that cortisol plays in modulating stress makes it a verifiable measurement of stress reactivity (Kirschbaum, Kudelka, Gaab, Schommer, & Hellhammer, 1999). Cortisol serves an essential role in raising glucose levels in the bloodstream to allow for optimal metabolic functioning to help the individual to overcome the stressor (Lovallo & Thomas, 2000). Cortisol also serves additional physiological relevance as it can

suppress the immune system, reduce inflammation, and activate catecholamines within the SAM mechanism to provide additional help in reducing the threat (Dickerson & Kemeny, 2004).

Research on the effects of stress reactivity show that outcomes have both short and long-term consequences regarding health. The theory of allostatic load introduced my McEwen states that repeated activation of the physiological mechanisms that cope with stress result in "wear and tear" on the body in the long term (McEwen, 2003), and can even result in damages to physical health (Adler & Snibbe, 2003). An individual with a high allostatic load will likely have a better chance of developing diseases or psychopathy in their future (Juster et al., 2011; McEwen, 2003). The literature on the long-term effects of cortisol elevation and increases in cardiovascular reactivity coincides with the findings of allostatic load. Studies have found a positive correlation exists between cardiovascular reactivity from stress and future issues regarding cardiovascular health (Chida & Steptoe, 2010). These cardiovascular complications include the development of hypertension (Matthews, Woodall, & Allen, 1993), atherosclerosis, and increased left ventricular mass and hypertrophy of the heart (Georgiades, Lemne, De Faire, Lindvall, & Fredrikson, 1997). Similarly, the Reactivity Hypothesis postulates that individuals who exhibit excessive reactions to acute stress are significantly more likely to experience damage to organ systems and have poorer health outcomes (Obrist, 1976). Furthermore, prolonged activation of the HPA axis results in elevated blood cortisol levels which are associated with decreased lymphocyte and cytokine production, damage to neurons in the hippocampus, increased immune system suppression, and the development of chronic diseases such as diabetes and hypertension (Boomershine, Wang, & Zwilling, 2001).

Research on stress has become increasingly critical to behavioral scientists for its commonality in everyday life and its relationship with current and long-term health

repercussions. Biobehavioral health has direct associations with stress research because individual subpopulations may be affected by stressful biological, social, or psychological stimuli that may interact to influence both short and long term health outcomes of specific populations. Ultimately, the subjection to stressful stimuli can lead to exaggerated stress responses that have significant effects on health outcomes.

Social Exclusion

Social exclusion occurs when an individual is left out or isolated from others, and it can be a result of either intentional or unintentional aims (Twenge, Baumeister, Tice, & Stucke, 2001). Rejection is analogous to the experience of social exclusion; however, it is known as the explicit and intentional form of social exclusion (MacDonald & Leary, 2005). Studies on social exclusion typically use the term "ostracism", which is operationalized as the sequence of events that result from the experience of one being rejected or excluded (Williams, 2007b). While social exclusion, rejection, and ostracism all relate to the similar experience of being left out, there are no substantial psychological differences between these domains (Williams, 2007b). Therefore, for the purpose of this study, the term social exclusion will encompass the collective experiences of both rejection and ostracism.

There are several competing theories that explain why the experience of social exclusion results in emotional distress. For example, social exclusion can evoke hurt feelings and negative moods such as hostility and anxiety, which can then be associated with psychological stress-reactivity (Leary & Spinger, 2001). Baumeister and Leary theorized the Belongingness Hypothesis, which states that belonging is essential for human behavior, cognition, and affect

(Baumeister & Leary, 1995). The evolution of human behavior suggests that there is a drive for individuals to feel accepted in their groups in order to obtain the survival and reproductive benefits associated with group living (Bernstein & Claypool, 2012). A related theory called the Need-Threat Model asserts that individuals react maladaptively in response to social exclusion as it affects the four fundamental needs of humans: self-esteem, meaningful existence, belonging, and control (Williams, 2009).

Another theory of social exclusion is the Social Pain Theory, which incorporates how social animals have developed physiological mechanisms to cope with threats towards inclusion (MacDonald & Leary, 2005). As inclusion is associated with survival and reproduction (Baumeister & Leary, 1995), social exclusion activates a physical pain system which results in changes in physiology (Price, 2000). The physical pain system causes social pain to be perceived as physical pain, and this was confirmed by a groundbreaking experiment which found that brain regions associated with the perception of physical pain were employed during the perception of social exclusion (Eisenberger, Gable, & Lieberman, 2007).

Williams and Sommer's first study on social exclusion consisted of a ball-tossing paradigm where two confederates excluded a participant by only throwing between one another (Williams & Sommer, 1997). Recent studies measuring the effects of social exclusion now use a computer-based program titled "Cyberball" to create the perception of social exclusion without the need for confederates (Williams, Cheung, & Choi, 2000). The findings from various Cyberball studies have consistently demonstrated that being excluded by the computer simulated confederates resulted in feelings of rejection (see Zadro, Williams, & Richardson, 2004).

The experience of social exclusion is common, and ecological momentary assessments have found that it may even be experienced on a daily basis (Williams, Wheeler, & Harvey,

2001). This is a critical finding as ecological momentary assessments are used to examine how daily social interactions can associate with momentary health biomarkers (Bernstein, Zawadzki, Juth, Benfield, & Smyth, 2017). As a result of its prevalence, social exclusion has become a subject of interest for biobehavioral researchers. Social exclusion has also become a focal point in biobehavioral health research because it can evoke emotional responses that may jeopardize health outcomes for individuals who are excluded often or are supersensitive to rejection.

Chapter 2
Literature Review

Associations between Obesity, Rejection Sensitivity, Social Exclusion, and Stress-Reactivity

The purpose of this thesis is to examine how BMI and rejection sensitivity interact to affect stress-reactivity following social exclusion. Previous studies have recommended that future research should investigate specific psychological components that contribute to weight bias (Himmelstein, Belsky, & Tomiyama, 2015), and that this understanding may lead to the development of psychological interventions for individuals who are overweight and obese (Jansen, 2010). The following literature review discusses the associations between BMI, rejection sensitivity, social exclusion, and behavioral responses to stress-reactivity. This literature review will elucidate the associations between BMI, rejection sensitivity, and stress-reactivity, and also identify the theoretical and empirical gaps in the literature that this thesis will strive to address.

There is a discernable connection between weight status, especially when considering obese individuals, and social rejection. Although social exclusion can be experienced as frequently as one per day (Williams et al., 2001), it is very clear that obese and overweight individuals are much more vulnerable to rejection compared to normal weight individuals (Lewis et al., 2011). Some evidence suggests that overweight and obese individuals underestimate how often and likely they are to be subjected to social rejection from others (Strauss & Pollack, 2003). Overweight and obese individuals are likely to experience interpersonal strain following rejection (Puhl & Brownell, 2006), which can ultimately resort to the adoption of comforting

activities in attempt to cope with these social stressors (Andreyeva, Puhl, & Brownell, 2008; Puhl & Heuer, 2009).

There is consensus between studies that explain the association between obesity and rejection sensitivity. One study found that the intensity of weight stigmas toward overweight and obese individuals resulted in unfavorable academic, psychological, and health consequences (McClure Brenchley & Quinn, 2016). Correspondingly, research has supported that weight-based rejection sensitivity may even be categorized within its own measurement of sensitivity due to its relevance in overweight and obese individuals (McClure Brenchley & Quinn, 2016). With the rejection sensitivity model hypothesizing that repeated experiences of social rejection from caregivers results in a heightened sensitivity to future rejection (Pietrzak, Downey, Ayduk, & Baldwin, 2005), it is interesting to note that the most recurrent source of weight stigmatization reported by overweight and obese individuals is from their own family members and close relatives (Puhl, Moss-Racusin, Schwartz, & Brownell, 2008). It is important to reiterate that rejection sensitivity derives from early childhood experiences of rejection, and when considering the intensity of the family induced weight stigma, this may illustrate a connection between rejection sensitivity and obesity. Ultimately, this may account for the maladaptive coping responses observed in overweight and obese individuals following social rejection that result in relationship dissatisfaction (Downey & Feldman, 1996), depressive symptoms (Norona, Roberson, & Welsh, 2016), and aggressive behaviors (Galliher & Bentley, 2010).

There also exists some literature suggesting that rejection sensitivity may be a plausible predictor of occurrence and responses to social exclusion when not considering the weight status of the individual. For example, research determined that the perception of the stimulus, rather than the stimulus itself, was the determinant for how individuals used Cognitive Appraisal to

identify and react to stimuli in the environment (Lazarus, 1999). Individuals who are highly sensitive to exclusion are more likely to be especially vigilant towards socially threatening stimuli, are more prone to reacting to these experiences, and have intensified emotional reactions (Romero-Canyas et al., 2010). In some cases, individuals high in rejection sensitivity even interpret relatively neutral and ambiguous stimuli as exaggerated episodes of social rejection (Romero-Canyas & Downey, 2013). This heightened sensitivity to neutral stimuli has also been found to activate the Social Self-Preservation system, which triggers psychological, physiological, and behavioral changes in order to compensate for the distress associated with social exclusion (Dickerson, Gruenewald, & Kemeny, 2004). Additionally, individuals who are rejection sensitive tend to activate their defensive motivational system when socially excluded (Downey et al., 2004), which functions in protecting the individual from social threats (i.e. social exclusion; Lang, Bradley, & Cuthbert, 1990).

Research effectively illustrates how rejection sensitivity and social exclusion induce stress-reactivity for those that are excluded, rejected, and ostracized. This coincides with the hypothesis that stress responses can be elicited due to both physical and non-physical (psychological) stressors (Selye, 1956). More recent studies have even concluded that social exclusion results in emotional distress (Williams, 2007a), and can even be interpreted as physical pain (Eisenberger et al., 2007). The research demonstrates that individuals may exhibit different volumes of cardiovascular and cortisol reactivity to psychological stressors (Chida & Steptoe, 2010). Perceived social rejection (i.e. being left out of a conversation) has been associated with higher levels of cortisol secretion (Blackhart et al., 2007), and the "fight or flight" response has been associated with perceived rejection (Bass, Stednitz, Simonson, Shen, & Gahtan, 2014). There is an immense amount of literature connecting heightened stress-reactivity responses (i.e.

elevated cortisol, increases in heart rate) to long-term health complications and the development of chronic diseases (Carroll et al., 2012).

Gaps in the Associations between Obesity, Rejection Sensitivity, Social Exclusion, and Stress-Reactivity

Research evaluating BMI and rejection sensitivity's association with stress-reactivity to social exclusion is limited because of diversity in the various studies when considering populations, research designs, and the interpretations of these results. There are consistent conclusions for individual associations between obesity, rejection sensitivity, weight stigma, stress-reactivity, and social exclusion when studied separately or in a limited fashion. However, there also is a lack of research studying the effects of obesity and rejection sensitivity as plausible moderators to stress-reactivity following social exclusion within a single study.

The suggestions from social scientists are usually catered towards strengthening obesity epidemiology research (Hu, 2008), improving social rejection research (Bass et al., 2014), further the understanding of the psychological and physiological effects of weight stigma (Himmelstein, Belsky, & Tomiyama, 2015), and advancing research on the psychological processes of overweight and obese individuals (Schvey, Puhl, & Brownell, 2011).

Obesity epidemiology focuses on the determinants and consequences of obesity, and then constructs interventions that will allow these overweight and obese individuals to have more promising health outcomes. Although there is a consensus amongst studies regarding overweight and obese individuals increased caloric intake following exclusion (Epel et al., 2004), there is need to clarify the psychological and psychosocial rationale that explains why these individuals resort to these specific maladaptive coping responses (Salvy et al., 2011). Additionally, bridging

the gap in our current understanding of social rejection will reveal how the psychological outcomes of normal weight individuals compares to overweight and obese individuals, and how these differences explain the variance in stress-reactivity and behavioral coping.

Purpose of Thesis

The objective of this thesis is to further understand how psychological differences contribute to stress-reactivity following social exclusion. Although there have been previous Cyberball studies that have analyzed rejection sensitivity as a moderator of stress-reactivity, none have analyzed a relationship between BMI and rejection sensitivity as a predictor of change in heart rate and cortisol level as indicators of stress-reactivity following social exclusion (Beekman, Stock, & Marcus, 2016). There is a need to evaluate how individual differences contribute to the physiological reactivity and maladaptive behavioral responses (i.e., increased caloric intake, avoidance of exercise) that contribute to the synergistic effect when considering the increasing prevalence of overweight and obesity status in the United States. Therefore, the goal of this thesis is to examine how BMI and rejection sensitivity could play a role in the process of how social exclusion affects stress-reactivity to enhance our comprehension of why individuals cope differently following rejection.

The thesis is a secondary data analyses on the Social Interactions and Health Project. The Social Interactions and Health Project was the dissertation of Dr. Sulamunn Coleman, and it analyzed how narcissism influenced stress-reactivity to social exclusion. Using the data from this dissertation, the primary aim of this thesis is to determine if BMI and rejection sensitivity associate as an interaction with stress-reactivity following social exclusion. To measure stress

reactivity, changes in physiology were measured as change in heart rate and cortisol level. This theoretical model is illustrated in **Figure 1**.

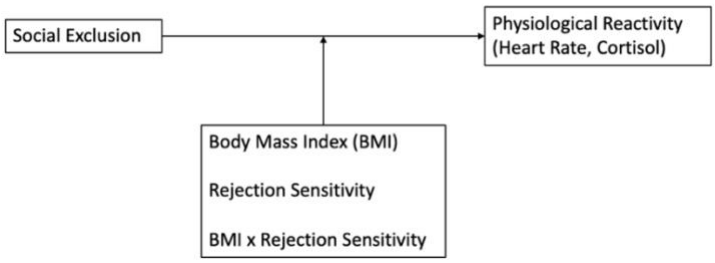


Figure 1. Theoretical Model of Study Aims

Secondary Data Analyses

The Social Interactions and Health Project utilized the Cyberball virtual ball toss game to measure the relationship between narcissism and stress-reactivity following social exclusion. Cyberball is a computerized version of the previously used in-person ball-tossing paradigm, which consisted of two confederates passing the ball to one another while excluding the participant from receiving the ball. The Cyberball game was created to address the issues of the in-person ball-toss game as it was too upsetting for participants and also eliminated the need to have confederates present and trained (Williams & Jarvis, 2006). Using a two-group randomized controlled experiment, participants were either assigned to the Cyberball inclusion or exclusion condition. In this computerized game of ball toss, the participants are convinced through several manipulations that they are playing the game with two other players (who are located in separate rooms), although in reality the two other players are pre-programmed simulations.

In this design, participants who were randomly assigned to the inclusion condition (control group for social exclusion) received the ball equally amongst the other two players for the duration of the game (approximately five minutes, or 30-50 throws). Participants who were randomly assigned to the exclusion condition (experimental group for social exclusion) received two throws at the beginning of the game but did not receive the ball for the remainder of the game (approximately five minutes, or 30-50 throws). Studies that have used the Cyberball program have found that social rejection can elicit activation of the autonomic nervous system (Iffland, Sansen, Catani, & Neuner, 2014), and also discovered that the Cyberball exclusion condition was associated in a larger caloric intake following the episode of social exclusion (Salvy et al., 2011).

Stress-reactivity following social exclusion was measured as change in heart rate and cortisol level both during and following the game. The Cyberball paradigm is an effective method for analyzing the effects of social exclusion due to its laboratory controlled setting. With the two randomized groups being identical other than the pre-programmed passing of the ball, Cyberball allows for optimal analysis of the interplay of BMI and rejection sensitivity and how they affect stress-reactivity to social exclusion. In order to probe the primary aims of this thesis research, this secondary data analysis tested the following primary hypotheses:

Hypothesis 1A: higher BMI will be associated with significant change in cardiovascular reactivity (i.e., increased heart rate) following social exclusion

Hypothesis 1B: higher BMI will be associated with significant change in cortisol reactivity (i.e., increased cortisol) following social exclusion

Hypothesis 2A: higher rejection sensitivity will be associated with significant change in cardiovascular reactivity (i.e., increased heart rate) following social exclusion

Hypothesis 2B: higher rejection sensitivity will be associated with significant change in cortisol reactivity (i.e., increased cortisol) following social exclusion

Hypothesis 3A: Individuals high in BMI and high in rejection sensitivity will exhibit significant change in cardiovascular reactivity (i.e., increased heart rate) following social exclusion

Hypothesis 3B: Individuals high in BMI and high in rejection sensitivity will exhibit significant change in cortisol reactivity (i.e., increased cortisol) following social exclusion

Chapter 3

Methods

Participants and Recruitment

The procedure for Dr. Sulamunn Coleman's Social Interactions and Health Study was approved by The Pennsylvania State University Institutional Review Board (IRB). Participants were recruited and then were screened. Each participant completed an informed consent form before starting the experiment's protocol (**Appendix A** includes recruitment and screening information). Addendum consent was registered with IRB to obtain verbal consent from participants regarding the screening questionnaire (since it was completed prior to receiving the informed consent information) so that information from the screening form could be used for data analysis. Specifically, it was essential to control for participants who were taking estrogen-containing contraceptives at the time of the study because this would affect cortisol reactivity. The process of recruitment and randomization are outlined in **Figure 2**.

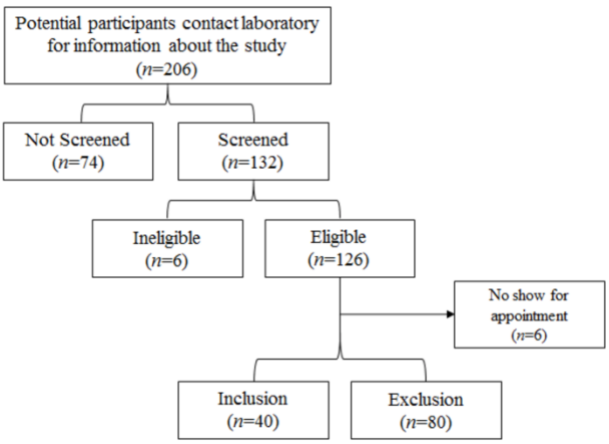


Figure 2. Flow Diagram of the Recruitment and Randomization Procedure

The Social Interactions and Health Project was conducted between August 2017 and April 2018. Participants were recruited through two main ways: flyers were posted on announcement boards in popular buildings across Penn State's University Park Campus, and very brief announcements were made in some approved undergraduate classes. Both recruitment methods informed students that they were invited to participate in a study that "examined how interacting with others during an online computer game influenced biological and psychological reactions". Interested students were told to contact The Stress, Health, and Daily Experiences (SHADE) Laboratory to learn more about the study (n=206) and were then screened to determine their eligibility for the Social Interactions and Health Project (n=132). The screening procedure determined that individuals were not eligible to participate in the study if they were: not a current student at Penn State, not between the ages of 18 and 24, previously involved in a research study that involved a game of ball-toss, diagnosed with a pervasive developmental disorder that would limit his or her ability to grasp the study, diagnosed with an endocrine disorder (e.g. Addison's Disease or Cushing's Disease) that would affect cortisol stress-reactivity, unable to answer questionnaires, unable to distinguish between simple shapes on a computer screen due to visual impairments, and unable or unwilling to abstain from: alcohol for twelve hours, nicotine and caffeine for two hours, exercise for two hours, or consuming food sixty minutes, prior to the time of their appointment.

Participants who passed the screening questionnaire (n=126) were then separated into two Cyberball conditions, which were inclusion and exclusion groups. Every appointment in this study was scheduled after 12:00 pm in order to account for the diurnal variation pattern that characterizes the body's release of cortisol (Kidd, Carvalho, & Steptoe, 2014). In addition, the

literature from previous studies found that there are smaller relative change in cortisol observed during morning laboratory procedures, perhaps as this is when the body has significantly more cortisol in circulation (Dickerson & Kemeny, 2004).

In order to guarantee that there would be an adequate sample size for testing the predictors of stress-reactivity to social exclusion unequal randomization was used: 80 participants were assigned to the exclusion condition while 40 participants were assigned to the inclusion condition. Throughout the study, there was a total of six participants who were disenrolled from the study as they failed to appear during their scheduled appointment. The total final sample of participants (n=120) was 67.5% female (M_{age}=20.12, SD= 1.330).

Secondary Data Analyses Within the Social Interactions and Health Project

As this thesis is a secondary data analysis of The Social Interactions and Health Project, it is important to recognize that the variables analyzed in this study are only a subset of those from the main study. The Social Interactions and Health Project included a variety of questionnaires that could be categorized as being either individual difference questionnaires or affective reactivity questionnaires. The questionnaires used in Dr. Coleman's dissertation that were superfluous to the study aims and hypotheses of this secondary data analysis are included in **Appendix B**, **Appendix C**, and **Appendix D**. The remaining questionnaires used in this thesis are explained below in the subsequent paragraphs.

Demographic Information and Individual Difference Questionnaires

Demographic Information. Appendix B contains several questionnaires that were used in this study to examine differences in demographic information between the participants in the inclusion and exclusion conditions. These questionnaires were completed at baseline (prior to the Cyberball game), and the order in which they are presented in the appendices coincides with the order in which they were answered in the study. The demographic variables collected in the individual differences questionnaires included: gender, age, ethnicity, race, family income, and existing health conditions (an open-ended response). It was necessary to ask participants what his or her biological sex was in order to calibrate the heart rate monitor so it would collect accurate data. There were no participants who identified as Transgender/Non-Binary genders that did not have their gender coincide with their biological sex. Thus, in this study all participants will be labeled and analyzed according to his or her sex.

Body Mass Index. During the screening procedure (**Appendix A** contains the screening form), participants reported their estimated height (inches) and weight (pounds). This self-reported information was converted into BMI by multiplying weight (in pounds) by 703 and then dividing by inches squared. This conversion was required as the standard BMI equation is calculated by dividing weight (kilograms) by height (meters) squared (WHO Consultation on Obesity, 2000).

Rejection Sensitivity. The Social Interactions and Health Project used an 8-item version of Downey and Feldman's Rejection Sensitivity Questionnaire (RSQ). The RSQ measures an individual's sensitivity to rejection from peers or significant others (Downey & Feldman, 1996). It also measures how anxious individuals are towards future anticipations of rejection (Downey & Feldman, 1996). The RSQ has been used in many social exclusion studies since the it has been

proven to have reliable internal consistency (Pietrzak et al., 2005). This 8-item version of the RSQ illustrates a realistic scenario that a college student may experience (e.g., "You ask a friend to do you a big favor"). Participants were asked to specify how concerned or anxious they would be about the other person's response on a scale of 1 (very unconcerned) to 6 (very concerned), in addition to how they think the other person would likely respond favorably on a scale of 1 (very unlikely) to 6 (very likely). The score for each of the 8 questions in the RSQ is calculated by multiplying the first component of the question (the concern for rejection) by the second component of the question (the inverse of acceptance expectancy). In the Social Interactions and Health Project's data, the RSQ exhibited acceptable internal consistency (α=0.75).

Heart Rate (HR). Heart rate data was collected for the entirety of the study (from baseline questionnaires until after post-Cyberball questionnaires) using the Polar® RS800CX Heart Rate Monitoring (HRM) System (Polar Electro Oy, 2013). This HRM system consists of three pieces that allow the participant's heart rate to be measured during the experiment: a sensor, a strap, and a watch. The sensor attaches to the strap facing upwards, where the strap is then adjusted to wrap around one's torso where the electrodes (covered in either Buh-Bump electrode gel or water) contact with the participant's skin. The HR data is collected and stored on the watch, which indicates to the experimenter if data is being collected. The Polar® HRM System was used because other studies confirmed that it reliably measures R-R intervals that correspond to the time in-between heart beats (Gamelin, Berthoin, & Bosquet, 2016). The "moderate" activity level was established to be a minimum of 45 beats per minute (bpm) to a maximum of 190 bpm. The data collected from each participant was transferred from the HRM watch into a .hrm computer file, that was then analyzed using the Kubios Heart Rate Variability (HRV) software (Tarvainen, Niskanen, Lipponen, Ranta-aho, & Karjalainen, 2014). The Kubios

HRV software is essential for analyzing the heart rate data since it uses technical algorithms to fix the outliers or artifacts that may have registered during data collection. This artifact-correction software ensured that all HR data collected was adjusted to plausible ranges. The correction algorithm was used on its "medium setting", which included using the "smooth priors" method to cut out the undesired trend components ($\lambda = 500$, Fc=0.035 Hz). Subsequently, Kubios HRV's "time-domain" feature was used to calculate average heart rate during the 5-minute baseline prior to Cyberball, and also the first five minutes of Cyberball. The difference between the 5-minute baseline average and the Cyberball average represents the heart rate reactivity component of stress-reactivity. It is important to note that there were no missing data for either the baseline or Cyberball HRM periods; therefore, all of the 120 participants recorded a value for change in heart rate.

Cortisol. Standard Salivettes® were used to collect the saliva samples. Salivettes are plastic tubes that have a single piece of synthetic gauze within them which absorbs saliva when placed in the participant's mouth (Sarstedt AG & Co., 2015). Previous studies that measured cortisol level as an indicator of stress-reactivity found that cortisol levels peak approximately 25-30 minutes following the onset of a stressor (Kirschbaum & Hellhammer, 1994). As a result, the two saliva collections in this protocol were a baseline collection (prior to Cyberball), and a second collection that was 25 minutes after completion of Cyberball. During collection, the participants were told to place the gauze in their mouth, specifically between their teeth and cheek, for two minutes. Then, participants were directed to spit the saturated gauze back into the collection tube without using their hands (to prevent contamination). The saliva samples were stored at -18ºC (0ºF) in a Danby® Chest Freezer (Danby®, 2016) in The SHADE Lab where they were ultimately analyzed at the Penn state Biomarker Core Laboratory. During the duration

of the study, the oldest samples (first participants) were stored in the SHADE Lab freezer for approximately 8 months. During analysis each Salivette was thawed, centrifuged, and tested in duplicate (each well contained 25 µL of saliva). For samples containing trace amounts of saliva, it was determined that samples with less than 50 µL were tested in singlet (n=8), whereas samples with less than 25 µL were considered as incomplete or missing (n=22). A high-sensitivity salivary cortisol enzyme immunoassay kit (lot #1804502; Salimetrics® LLC, 2016) was used as the commercial application to analyze all saliva samples. The Salimetrics® report stated an intra-assay precision of 4.6% (for the mean of 20 duplicates, n=5), and an inter-assay precision of 6% (for the mean of 20 duplicates, n=5). The samples with substantial saliva content had a coefficient of variation (CV) of ≤ 5% for the optical density reading, and ≤15% for the calculated cortisol duplicate. Results that had a CV of ≥15% were considered to be reportable if the absolute difference between the two pairs was ≤0.030 µg/dL. Each assay plate was run under both high and low control conditions, where they were then returned to an inter-assay CV of 3.7% (n=7) and 4.0% (n=7). Within the entire study, not a single test was repeated, and there was a total of 211 reportable duplicate tests that averaged an inter-assay CV of 4.9%. Change in cortisol as an indication of stress-reactivity were calculated by subtracting the log10-transformed baseline sample from the log10-transformed post-Cyberball sample. Overall, the change in cortisol level was calculable for 86% of the participants in the exclusion condition (69/80 participants).

Procedure

On the day of a scheduled appointment participants were given two specific orders that influenced them into believing that they would be interacting with real people during the study. Participants were told that it was crucial that they arrived on time as it was necessary for all people to be present to begin the study. They were also instructed to avoid talking to other participants while waiting outside of the SHADE Lab in order to maintain privacy and confidentiality between themselves and the other participants. To help ensure that participants abided to these conditions (and further enhance believability), they were reminded of these orders in the reminder email that was sent to everyone 24 hours prior to their scheduled appointment.

The protocol of the study is outlined in **Figure 3**, and the experiment's checklist and protocol script are included in **Appendix E**. At the time of the scheduled appointment, a research assistant (RA) welcomed the participant outside the room they were told to arrive at. The RA first asked for the participant's name, and then checked the name off of the clipboard. The procedure was designed such that the RA revealed enough of the clipboard to the participant while checking off their name so that the participant could clearly see that there were two other participants scheduled for that appoint, where one was checked off (already arrived), and one was not checked off (did not arrive to the study yet). The RA then led the participant to the room assigned for them, where the other RA (the experimenter) was waiting for them. Prior to closing the door of the room, the first RA told the experimenter that they were going to wait in the hallway for the last participant (who was unchecked on the clipboard since they were running late) to arrive. The experimenter then closed the door and reiterated to the participant that they can proceed, hoping that the late participant would arrive shortly. The experimenter initiated the

study with the same list of "day-of-screening" questions that were previously presented over the phone during the recruitment and screening procedure. These questions ensured that the participant was not in a psychological or physiological state or condition that would misconstrue data collection. In the following order, the experimenter asked the participant if they were feeling healthy, well, and alert, and had abstained from: consuming alcohol for at least 12 hours, caffeine, nicotine, and exercise for at least 2 hours, and eating for at least one hour, prior to the time of the study. If the participant abided to the four items in the screening questionnaire, the experimenter proceeded by explaining the information regarding informed consent.

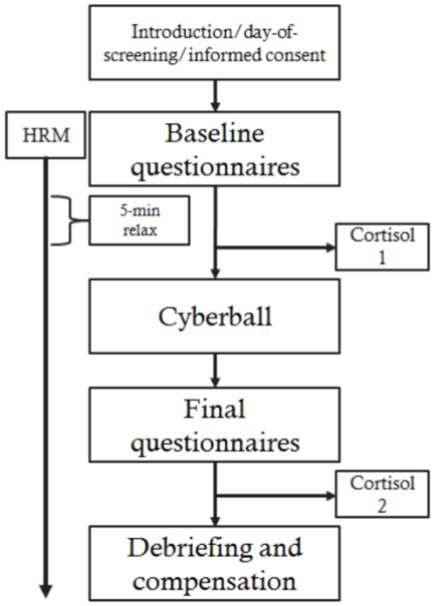


Figure 3. Flow Diagram of The Experimental Protocol

After obtaining the informed consent from the participant, the experimenter transitioned into explaining how the Polar® RS800CX HRM collected data during the study. The experimenter outlined the three components of the HRM system (the sensor, strap, and watch), and then left the room while closing the door behind them, so that the participant could have

privacy when fastening the HRM under their his/her clothing. The participant then re-opened the door (to allow the experimenter back into the room), where the experimenter then recorded a one-minute sample of HR data to verify if the HRM system was working properly. If the data collection was operating correctly, the participant would then begin completing the baseline questionnaires (demographic information, baseline affect, and covariates) on the laptop in the room. After completing the baseline surveys, the participant was instructed to sit quietly for five minutes in order to obtain a five-minute baseline resting heart rate. Thereafter, the participant provided a baseline saliva sample.

After collecting the baseline saliva sample, the experimenter told the participant that they were going to leave the room and verify that the other two participants (especially the one who was late) had also just taken the baseline saliva sample and were going to be ready for the ball-toss game. The experimenter would then go to an empty room where the other RA was expecting them. When arriving, the RA set a timer for three minutes while the experimenter returned to the room that the participant was in. When re-entering the participant's room, the experimenter clarified that the late participant was only a few minutes from taking their baseline saliva sample, and that an RA would inform them when they were ready to begin the game (at the expiration of the 3-minute timer). During the time spent waiting, the experimenter outlined the Cyberball game to the participant. The experimenter emphasized that the participant should thoroughly read the Cyberball game description before pressing the button that would start the game. It was critical to inform the participant that only the age and sex of the other players would be visible to him/her, and that only his/her age and sex would be visible to the other players to maintain privacy and confidentiality. By the time the experimenter explained the game and the participant read the instructions, the three-minute timer set by the other RA expired. This resulted in the RA

knocking on the door to inform the experimenter and participant that the last participant recorded their baseline saliva sample, and all participants were now ready to begin. The participant was then given the okay to log into the Cyberball game, where they saw players on the left and right sides of the screen. The two other players were labeled as "male, 20" and "female, 21" so that the participants in the exclusion condition did not attribute the exclusion because of age or sex purposes. The Cyberball game lasted for approximately 5 minutes, which is between 30 and 50 throws.

The completion of Cyberball was followed by a 25-minute waiting period before collecting the final saliva sample. To fill this period of waiting, the participant completed the post-Cyberball questionnaires (needs threat, manipulation check, additional manipulation enhancement, and the aggressive cognition word task). After the 25 minutes had passed, the participant was instructed to submit the word completion task even if they had not completed it to its entirety. Immediately after this, the participant provided the final saliva sample. The HR data collection in the study was terminated when the experimenter turned off the HRM watch and left the room to give the participant privacy while removing the HRM system. When allowed back inside the room, the experimenter debriefed the study to the participant by first asking the participant what they believed the purpose of the study was. The experimenter then revealed the nature of the experimental manipulation (that the other players were pre-programmed simulations of the Cyberball software) and compensated the participant $10 for the hour of participation. Finally, the participant was asked to preserve the reality of the manipulation from others by telling the participant that the Social Interactions and Health study would be an ongoing project throughout the year.

Data Analysis

All analyses were conducted using IBM SPSS Statistics Version 25. In this software, descriptive statistics and correlations were completed for all variables specific to the data analysis. There were six linear regression models computed using the linear regression function of SPSS. Each regression model was calculated in order to address each of the six hypotheses in this thesis. For each regression, the statistical significance was set at $\alpha = 0.05$. For the change in cortisol variable, the participants with incalculable measurements (n=11) were excluded from these regression models.

Chapter 4

Results

Descriptive Statistics and Bivariate Correlations

Descriptive statistics and bivariate correlations can be found in **Table 1**. The self-reported BMI in this study ranged from 15.98 to 36.61, with a mean BMI of 23.06. For rejection sensitivity, the range for the RSQ was 1.50 to 18.63, with an average RSQ score of 9.45. For outcome variables of physiological reactivity, change in heart rate had a minimum value of -19.84 beats per minute and a maximum value of 9.73 beats per minute, with an overall mean of -3.38 beats per minute. With regard to change in cortisol, there was a range between -0.181 µg/dL to 0.138 µg/dL with a mean of -0.16 µg/dL. There were no statistically significant correlations between any of the predictor or outcome variables.

Table 1. Descriptive Statistics and Bivariate Correlations

Variable	1	2	3	4
1. BMI	-			
2. RSQ	0.06	-		
3. Change in Heart Rate	0.00	0.08	-	
4. Change in Cortisol	0.14	0.02	0.07	-
Mean	23.06	9.45	-3.38	-0.17
Standard Deviation	3.32	3.72	4.37	0.06

Note: N= 120 for all variables except Change in Cortisol (N=105); Cyberball condition exclusion condition=1; * $p < .05$

Regression Models 1A and 1B: BMI and Stress-Reactivity Following Social Exclusion

The results from Models 1A and 1B can be located in **Table 2**, while Model 1B is depicted in **Figure 4.** For Model 1A, BMI was not a statistically significant predictor of change

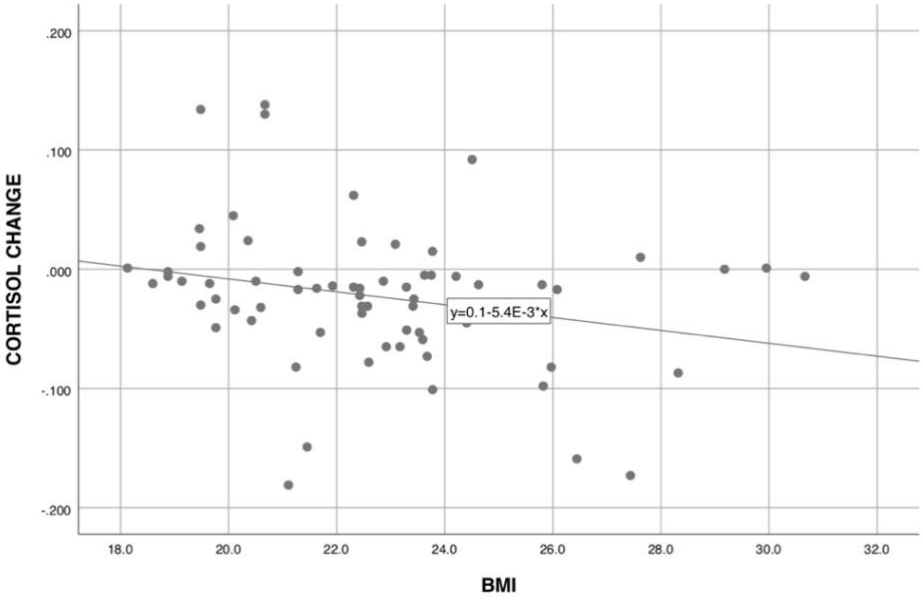
in heart rate following social exclusion (β=-0.10, p=0.37). However, there was a statistically significant effect observed in Model 1B, as BMI was a significant predictor of change in cortisol following social exclusion (β=-0.26, p=0.03). This significant result is featured in **Figure 4**.

Table 2. BMI as a Predictor of Change in Heart Rate and Cortisol Level Following Social Exclusion

Hypotheses	B	SE	β	t	p
Model 1A: BMI and Change in Heart Rate Following Social Exclusion					
Constant	-0.24	3.59	-	-0.67	0.95
BMI	-0.14	0.16	-0.10	-0.90	0.37
Model 1B: BMI and Change in Cortisol Following Social Exclusion					
Constant	0.10	0.06	-	1.78	0.08
BMI	-0.01	0.00	-0.26	-2.20	0.03*

Note: N= 120 for all variables except Change in Cortisol (N=105); Cyberball condition coded as exclusion condition=1; * p < .05

Figure 4. BMI as a Predictor of Change in Cortisol



Regression Models 2A and 2B: Rejection Sensitivity and Stress-Reactivity Following Social Exclusion

The results from Models 2A and 2B can be located in **Table 3**. In Model 2A, rejection sensitivity is not a statistically significant predictor of change in heart rate following social exclusion (β=0.10, p=0.37). Similarly, Model 2B highlights that rejection sensitivity is not a statistically significant predictor of change in cortisol following social exclusion (β=-0.11, p=0.37).

Table 3 Rejection Sensitivity as a Predictor of Change in Heart Rate and Cortisol Level Following Social Exclusion

Hypotheses	B	SE	β	t	p
Model 2A: Rejection Sensitivity and Change in Heart Rate Following Social Exclusion					
Constant	-4.52	1.28	-	-3.53	0.00
RSQ	0.11	0.13	0.10	0.903	0.37
Model 2B: Rejection Sensitivity and Change in Cortisol Following Social Exclusion					
Constant	-0.01	0.02	-	-0.26	0.80
RSQ	0.00	0.00	-0.11	-0.91	0.37

Note: N= 120 for all variables except Change in Cortisol (N=105); Cyberball condition coded as exclusion condition=1; * p < .05

Regression Models 3A and 3B: The Interaction between BMI and Rejection Sensitivity and Stress-Reactivity Following Social Exclusion

The results from Models 3A and 3B can be located in **Table 4**. These models include the two-way interaction between BMI and RSQ, and how they associate with change in heart rate and cortisol level following social exclusion. In Model 3A, the interaction between BMI and rejection sensitivity was not a statistically significant predictor of change in heart rate following social exclusion (β=1.28, p=0.22). Furthermore, within Model 3A, neither BMI (β =-0.52,

p=0.16), or rejection sensitivity (β=-1.16, p=0.26) were statistically significant predictors of change in heart rate within Model 3A. In Model 3B, the interaction between BMI and rejection sensitivity was not a statistically significant predictor of change in cortisol following social exclusion (β=1.53, p=0.16). However, within Model 3B, there is persistent evidence that BMI is a significant predictor of change in cortisol following social exclusion (β=-0.81, p=0.05). In Model 3B, rejection sensitivity remained a statistically insignificant predictor of change in heart rate following social exclusion (β=-1.60, p=0.13).

Table 4. The Interaction Between BMI and Rejection Sensitivity as a Predictor of Change in Heart Rate and Cortisol Level Following Social Exclusion

Hypotheses	B	SE	β	t	p
Model 3A: The Interaction between BMI and Rejection Sensitivity and Change in Heart Rate Following Social Exclusion					
Constant	11.92	11.61	-	1.03	0.31
BMI	-0.72	0.51	-0.52	-1.42	0.16
RSQ	-1.30	1.14	-1.16	-1.14	0.26
BMIxRSQ	0.06	0.05	1.28	1.23	0.22
Model 3B: The Interaction between BMI and Rejection Sensitivity and Change in Cortisol Following Social Exclusion					
Constant	0.39	0.19	-	2.00	0.05
BMI	-0.02	0.01	-0.81	-2.02	0.05*
RSQ	-0.03	0.02	-1.60	-1.53	0.13
BMIxRSQ	0.00	0.00	1.53	1.41	0.16

Note: N= 120 for all variables except Change in Cortisol (N=105); Cyberball condition coded as exclusion condition=1; * p < .05

Chapter 5
Discussion

In this secondary data analysis, the association between BMI and rejection sensitivity was examined using data from The Social Interactions and Health Project. In the study, participants were excluded in a game of virtual ball toss titled "Cyberball", where physiological reactivity was measured as change in heart rate and cortisol. It was hypothesized that BMI would predict elevated change in heart rate and cortisol level following social exclusion, rejection sensitivity would predict elevated change in heart rate and cortisol level following social exclusion, and high BMI and high rejection sensitivity would predict elevated change in heart rate and cortisol level following social exclusion.

The results indicate that the only significant interaction observed was the relationship between BMI and change in cortisol following social exclusion. Intriguingly, the significant association shows the opposite directionality of what was theorized in this experiment as the results explain that high BMI associates with decreases in cortisol level following social exclusion. The hypotheses in this study were based on previous research which illustrated heightened cortisol reactivity following social exclusion (Dickerson et al., 2004). Therefore, this significant finding is surprising because the results exhibit blunted responses to psychosocial stressors instead of an activation of the sympathetic HPA and SAM mechanisms which resulted in greater changes in physiological reactivity in previous studies (Dickerson et al., 2004; Iffland et al., 2014).

Blunted physiological responses have become a topic of interest for biobehavioral health scientists because recent studies have found decreases in stress-reactivity following psychosocial evaluative threats (Douglas Carroll, Ginty, Whittaker, Lovallo, & de Rooij, 2017; Moor, Crone, & van der Molen, 2010). The most prolific theory of blunted physiological responses is explained by the work of Porges's Polyvagal Theory (Porges, 2003, 2009). In this theory, there is a nervous system response above the alert-level of the sympathetic Fight or Flight response called "Freezing", which utilizes the dorsal vagal system (Porges, 2009). Although the sympathetic Fight or Flight response is characterized by panic, concern, and anxiety, the overwhelming nature of a freezing response is distinguished by feelings of dissociation, helplessness, and numbness (Porges, 2009). The dorsal vagal system functions as a brake on both the HPA and SAM mechanisms, and ultimately results in decreases in both heart rate and cortisol level (Porges, 2003). The unexpected rejection that participants in the Cyberball exclusion condition experienced coincides with the transient slowing of the heart proposed by the Polyvagal Theory (Porges, 2009). The purpose of the dorsal vagal system is to allow the individual to exercise self-soothing behaviors that will allow them to cope with the overwhelming stimuli (Thayer & Lane, 2009). Therefore, these hurt feelings can be associated with the unexpected experience of rejection of Cyberball, and could even be linked to the similar feelings of physical pain processing as evidenced in fMRI studies (Eisenberger, Lieberman, & Williams, 2018; Heilman et al., 2008).

Additional research also highlights some findings that may strengthen the relationship between BMI and blunted physiological responses. An essential aspect of the blunting response is that it is believed to be the result of previous psychosocial stressors. Research shows that individuals with stressful developmental experiences, such as peer-related social stressors, are

positively correlated with blunted physiological reactions (Ouellet-Morin et al., 2011). Considering how weight stigma is experienced by overweight and obese individuals, it is interesting to see that prejudices and stigmas in the form of psychosocial threats could potentially align with these similar psychosocial stressors that result in the observance of blunted physiological responses in overweight individuals. Furthermore, weight status may introduce a physical activity component of analysis when probing individual differences between high BMI and low BMI individuals. Physical activity and physiological reactivity contribute to some differences in results; however, most of the conclusions align with the notion that physically fit individuals have better stress-reactivity and stress management than individuals who are less physically active (Rimmele et al., 2007). Specifically, individuals who are more physically fit have lower heart rate responses (Rimmele et al., 2007), and lower cortisol level following identical psychosocial threats (Rimmele et al., 2009). Spalding and colleagues confirmed that exercises such as aerobic training were confirmed to be a method of decreasing physiological reactivity following psychosocial stressors (Spalding, Lyon, Steel, & Hatfield, 2004). Therefore, it can be reasoned that individual differences in physiology as a result of exercise status are unlikely a predictor of the blunted physiological responses to Cyberball. Thus, the association between BMI and blunted cortisol reactions in this thesis could be partially explained by The Polyvagal Theory.

Previously, blunted physiological reactions to psychosocial stressors was viewed as an adaptive response considering the poor outcomes associated with heightened physiological reactivity. Nevertheless, recent studies have concluded that blunted physiological reactions result in adverse health consequences. The brain regions activated during blunted physiological responses are associated with obesity (Carroll, Phillips, & Der, 2008), smoking (Al-Absi, 2006),

alcohol and drug addiction (Brenner & Beauchaine, 2011), depression (Brinkmann, Schubach, Joye, & Gendolla, 2009), poor self-reported health (de Rooij & Roseboom, 2010), and eating disorders (Ginty, Phillips, Higgs, Heaney, & Carroll, 2012). As a result of these poor health outcomes, researchers now believe that the current understanding of the Reactivity Hypothesis should be revised to an inverted-U Model (Carroll, Lovallo, & Phillips, 2009). This model would now illustrate how both blunted physiological responses and exaggerated physiological responses result in adverse health consequences, while average physiological reactivity results in optimal and preferred health outcomes (Carroll, Lovallo, & Phillips, 2009).

Limitations

There are several key limitations to this research design that restrict the applicability of this statistically significant finding such as self-reported BMI, gender demographics, and the use of the Rejection Sensitivity Questionnaire. With a female representation of 70.2% in the final sample, there was not a sufficient male representation in order to have the power to analyze gender as a moderator in the relationships between BMI, rejection sensitivity, and stress-reactivity to social exclusion. This gender moderation would have been an important aspect of the data analyses as there is literature-based evidence in support of there being gender-specific outcomes regarding cardiovascular and cortisol reactivity to social exclusion (Stroud, Salovey, & Epel, 2002). Notwithstanding, this limitation has been an issue in previous studies that have examined blunted responses to social stressors (Moor et al., 2010). Although the findings in this study do reveal a significant interaction between BMI and cortisol reactivity following social exclusion, it would be beneficial to further understand how males and females respond

differently in order to evaluate which gender may be at risk of the most pronounced stress-reactivity. Another significant limitation in this study was that BMI was self-reported by the participant during the screening protocol instead of being measured by the research assistant or experimenter on the day of the appointment. Self-Reported BMI tends to be an issue in weight studies because there are consistent findings that show that participants tend to report inaccurate values of their height and weights. For example, studies on weight perception have found that participants are more likely to underreport their weight, and specifically males are almost five times more likely to underestimate their weight than reporting their actual weight (Park, 2011). The most important limitation of self-reported BMI is that it largely misrepresents the actual proportion of obese individuals in a sample due to the prevalence of weight underestimation (Gosse, 2014). This is an issue since overweight and obese individuals are the subjects of interest in a majority of weight related studies. The last significant limitation to this secondary data analysis is the use of the Rejection Sensitivity Questionnaire that was used in The Social Interactions and Health Project. Although this questionnaire has been verified as a valid measurement of rejection sensitivity (Pietrzak et al., 2005), it would have been more appropriate to use the Weight-Based Rejection Sensitivity Questionnaire (WB-RSQ) that measures how people anxiously anticipate rejection due to their physical appearance (McClure Brenchley & Quinn, 2016). The replacement of the WB-RSQ for the RSQ in this study would likely yield more intriguing results since the questions used in this survey are more catered towards weight stigma than the generalized questions featured in the RSQ. For example, the WB-RSQ asks questions such as “Imagine that it is your birthday, and your friends decide to take you out to a buffet for dinner. You are in the buffet line and you put all of your favorite foods on your plate. You see a thin woman next to you glance at you and your plate”, “Imagine that you are at work,

and someone brings in a box of donuts for the office to share. As you are leaning to pick one up, your coworker walks by and comments on the number of calories in the donuts", and "Imagine that you are at the grocery store, and you are purchasing chips, ice cream, and soda for a party you are throwing" (McClure Brenchley & Quinn, 2016). Overall, this limitation is characteristic of the use of secondary data analyses because the RSQ was used by Dr. Sulamunn Coleman in his Social Interactions and Health Project.

Future Directions

While this research design examined how BMI and rejection sensitivity influence stress-reactivity to social exclusion, the broader implications of this research question regard how individuals with high BMI utilize maladaptive coping responses in response to stress. Although BMI may predict blunted cortisol reactivity, there is a need to use future experimentation to deduce whether or not overweight and obese individuals have significant behavioral changes in response to stress. Future experimentation should be tailored by incorporating measures of behavior changes following the implementation of the Cyberball exclusion condition in order to evaluate whether or not overweight and obese individuals adopt maladaptive coping behaviors after experiencing stress. Through experimentation it has been observed that overweight and obese individuals resort to maladaptive coping responses in wake of socially threatening stimuli such as weight stigma. Overweight and obese individuals respond with greater food consumption than their normal weight counterparts (Salvy et al., 2011; Schvey et al., 2011), and that is may even be positively correlated with cortisol reactivity (Epel et al., 2004). This maladaptive binge eating could be explained by the activation of the reward system seen in humans and animals

(Adam & Epel, 2007), and even the an Escape Theory which explains that cognitive narrowing allows individuals to focus on the sensation of eating instead of the agony of rejection (Heatherton & Baumeister, 1991). It is also postulated that emotional responses following social exclusion moderate increased food intake since negative moods have been found to be associated with loss of autonomy when eating (Telch & Agras, 1996; Vohs & Heatherton, 2000). In addition to maladaptive eating behaviors, there is also evidence showing that in response to weight stigmas and rejection, individuals who are overweight and obese are likely to avoid exercising and dieting because they believed that these experiences would result in further stigmatization and rejection from others (Myers & Rosen, 1999; Vartanian & Novak, 2011; Vartanian, Pinkus, & Smyth, 2018). The relationship between BMI, rejection sensitivity, and stress reactivity following social exclusion only has relevance if it can then be associated with changes in behavior that ultimately will predict worsened health outcomes for overweight and obese individuals in the long-term.

Collectively, the research suggests that overweight and obese individuals are likely to have a synergistic effect in regard to their maladaptive coping responses following social exclusion when it is coupled with the established health risks associated with obesity. Blunted physiological responses following Cyberball can be coordinated with the health detriments caused by elevated weight statuses, and as a result, create a two-fold layering of consequences that can affect the health outcomes of these individuals due to both changes in physiology following social stressors, in addition to biological complications affiliated with obesity. Overall, the findings of blunted physiological reactivity following social exclusion relate to other studies that show adverse reactions to social exclusion elicited in the Cyberball social exclusion paradigm (Eisenberger et al., 2018; Salvy et al., 2011; Williams & Jarvis, 2006; Zadro et al.,

2004). With overweight and obese individuals experiencing biases in various public arenas, it is also important to note a correlation in the literature that shows that overweight and obese individuals are facing an increase in social stressors that is positively correlated with the prevalence of obesity (Puhl et al., 2008). Therefore, this synergistic effect may become even more pronounced with the current obesity predictions for the coming decade. Future research on obesity, rejection sensitivity, and stress-reactivity following social exclusion has relevance towards biobehavioral health as it can help elucidate how the biopsychosocial model explains how overweight and obese individuals have a combination of biological, psychological, and social factors that interplay in ultimately affecting short and long-term health outcomes.

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Appendices

Appendix A: Recruitment and Screening Materials

Appendix B: Demographic Information and Individuals Difference Questionnaires

Appendix C: Measures of Affective Reactivity

Appendix D: Measures of needs threat, manipulation checks and enhancement, and aggressive cognition

Appendix E: Experiment Checklist and Protocol Script

Appendix A: Recruitment and Screening Materials

Class announcement script

"Hello everyone. My name is _____ and I am a research assistant in the Stress, Health, and Daily Experiences Laboratory in the Biobehavioral Health Department here at Penn State. Our lab is looking for volunteers to participate in a study that examines how individuals respond physically and psychologically to social interactions. In the study, you will play a short computer game with other participants for about 5 minutes while we monitor your heart rate and collect 2 saliva samples. Most healthy students are eligible to participate. If you are over 18 and would be interested in earning $10 dollars per hour for roughly 1 hour of participation, please call our lab for more information. Our lab number, which is at the bottom of the slide in yellow and bold, is (814) 865-9473, and our email is 'shade.research.lab@gmail.com'. Thanks you for your attention!"

** Make sure to thank the professor for allowing you to make the announcement before you leave **

Intake form, phone screening script, and screening form

FIRST

INTAKE FORM

"Hello, SHADE laboratory, this is _____ speaking, how may I help you?

1. Is the person calling about participating in a study?

YES (continue with #2) **NO** (make comments on a sticky note for designated person**)**

2. Which study are you calling about?

Note: If the person is calling about "National Parks and Health," inform them that the study is no longer running and recruitment has ended. Thank them and hang up. If the person is calling about "Social Interactions and Health," continue below.

2a. <u>If you ARE trained</u> to recruit for Social Interactions and Health, place this form in the Intake Binder under the "Completed SIH" tab and continue with the General Screening Script and Screening form for the appropriate study (**Section labeled "Second"**).

2b. <u>If you are NOT trained</u> to recruit for the study the person is interested in, continue below:

"Unfortunately, I am not trained to recruit people for that particular study. Would it be alright if I collected some contact information to forward to a research assistant who is?"

<u>If yes</u>, collect the following contact information:

Name: _____

Phone number: _____

Best day/time to reach by phone: _____

"Okay, great. Thank you for your contact information and interest in _____. A research assistant who is trained to recruit people for that study will return your call within a couple of days to describe the study in more detail and determine whether you are eligible to participate. Do you have any further questions? Have a nice day.

<u>If no</u>, continue below:

"Okay. Thank you for calling the SHADE Laboratory. Please feel free to call back if you have any further questions."

SECOND

GENERAL SCREENING SCRIPT

This is the script for informing the participant, over the phone, about general details of the study in order to see if they are interested.

RESEARCH ASSISTANT

Do you have a few minutes for me to go over some general screening questions and to outline the study you would be participating in?

Yes: *Great,*

(Continue with General Screening Script and then go over Screening Form).

No: *No problem. Is there a more convenient time to call back?*

(Write down preferred call back time Call and Email Log under the "Calls to Return/Attempted" tab)

RESEARCH ASSISTANT

The Stress, Health, and Daily Experiences Lab, also known as SHADE lab, is affiliated with Dr. Smyth in the BBH Department at PSU. Generally speaking, the SHADE lab is interested in how daily experiences relate to health and well-being among individuals. The study that you are calling about is investigating how individual people respond to each other while interacting in a digital environment.

I will first briefly describe the study and then, if you are interested in participating, will go over a list of screening questions to determine your eligibility.

Do you have any questions so far?

Yes: (Answer accordingly and then continue with script)

No: (Continue with script)

RESEARCH ASSISTANT

Our study is called Social Interactions and Health, in which we will explore the relationship between social interactions during basic computerized gameplay and physiological reactivity. If you choose to participate in this study you will answer a series of questionnaires and play a basic computer game with two other participants for about 5 minutes while we measure your physiological reactivity. In order to measure your physiological reactivity, you will be asked to provide saliva samples and wear a heart rate monitor. We will have to ask for your height and weight in order to allow the heart rate monitor to properly record your heart rate. Upon completion of this study, you will receive monetary compensation in the amount of $10 per hour, and this study takes about 1 hour to complete. Does this sound like something you would like to participate in?

Yes: *Great, I will now ask you a series of screening questions to determine whether or not you are able to participate. Do you have any questions before we begin?*

(Answer accordingly and then continue with screening)

No: *Okay. Thank you for calling in. Have a nice day.*

**** Go over Screening Form (Section labeled "THIRD") ****

SCREENING FORM

THIRD

I am now going to ask a few questions to get some basic information about you.

What is your name? _____

What is your date of birth? _____How old are you? _____ **(if < 18 or >24, excluded)**

What is your address? _____

What is your phone number? _____

What is your email address? _____

What is your height and weight? H_____ W_____

What is your biological sex? (Circle one) M F

Now I am going to ask you some questions that will determine if you are eligible for this study. Please answer them with a "Yes" or "No" response. **(Bolded responses = participant is excluded)**

1) Do you fluently speak English? YES **NO**

2) Have you ever participated in a research study in which you were required to play a computer game with other participants? (**If YES, have the caller describe the game. If Cyberball, continue with screening then exclude**) **YES** NO

3) (for females only) Are you currently taking any estrogen-containing contraceptive pills? **(If YES, make a note in comments)** YES NO

4) Do you have any endocrine disorders such as Addison's disease or Cushing's Disease? **YES** NO

5) Do you have any visual impairments that would prevent you from being able to distinguish between simple shapes on a computer screen? **YES** NO

6) Do you have any cardiovascular disorders that may affect a heart rate monitor, such as irregular heartbeat, rapid heartbeat, or abnormally slow heartbeat? **(If YES, make note in comments)** YES NO

7) Have you ever been diagnosed with a pervasive developmental disorder or other cognitive impairment, such as autism or mental retardation? **YES** NO

8) Are you willing to go 12 hours without drinking alcohol prior to the time you would come in for the study? YES **NO**

9) Are you willing to not exercise 2 hours prior to the time you would come in for the study? YES **NO**

10) Are you willing to go without caffeine for 2 hours prior to the time you would come in for the study? YES **NO**

11) Are you willing to go 60 minutes without eating food prior to the time you would come in for the study? YES **NO**

12) Do you smoke? YES NO

If YES: How often do you smoke? _____

Would you be willing to refrain from smoking 2 hours prior to the study? _____

13) Where did you learn about this study? Flyer location/Class Announcement? _____

Comments:

Return to "General Screening Script" (Section labeled "FOURTH")

FOURTH

**** Check "Participant Tracker Log" tab in the "Call Log" binder for *caller's name and phone number* to see if they've already participated. If they are a repeat, read the "Ineligible participant" script and <u>do not schedule them</u>. ****

If the participant is eligible: (Continue with the General Screening Script)

If the participant is NOT eligible: *Unfortunately, you are not eligible to participate in our study. We are starting studies throughout the semester and with your permission we will keep your information on file and contact you if a future study would be more suitable for you. Is it alright for us to keep your information on file?*

Yes: *Great, we will contact you if we begin a study that you may be eligible for. Thank you for calling in. Have a nice day.*

No: *Okay. Thank you for calling in and have a nice day.*

General Screening Script (Continued):

It looks like you are eligible to participate in our study. Do you have a few more minutes for me to go over more details and schedule a visit?

Yes: (Continue with script)

No: *Okay when would we be a more convenient time for us to call you back?*

(Write down preferred call back time in call log)

RESEARCH ASSISTANT

Okay, are you familiar with how to get to the Biobehavioral Health Building?

Yes: (Continue with script)

No: (Give directions as needed) **(Refer to Directions to Shade Lab sheet if necessary: See Section 2.02 of Screening and Scheduling Binder or 2.06 of Project Book)**

RESEARCH ASSISTANT

When you come in to the BBH building for the study you will come to room 024 which is located in the basement. You will be interacting with other participants during the study, so it is important that you arrive on time. We also ask that you refrain from conversation with anyone waiting near room 024 in order to maintain confidentiality between yourself and the other participants. As I mentioned earlier, you will be answering questionnaires, and we will also be measuring your heart rate using a heart rate monitor as well as collecting two different saliva samples. For the heart rate monitor, it is best if you wear a loose fitting shirt. (If female, also suggest wearing a sports bra). *If you don't have any questions, we can now schedule a time for you to come in for your visit.*

**** Schedule the participant visit (If you don't know how to do this, consult Section 1.01 of Screening and Scheduling or 2.01 of Project Book) ****

Alright we will see you on <u>[DATE]</u> at <u>[TIME]</u>. We will send a reminder email the day before your scheduled time. If you do not reply to the email by the end of the day, we will call and either remind you in person or leave a voicemail. Thanks for calling in and have a great day!

Appendix B: Demographic Information and Individuals Difference Questionnaires

Demographic Information

1. Gender: __ Male __ Female __ Transgender/Non-binary

2. Age_____

3. Please answer both parts of this question.

3a. Ethnicity: __ Hispanic or Latino __ Not Hispanic or Latino

3b. Race: (You may choose more than one)

__ American Indian or Alaska Native

__ Asian

__ Black or African American

__ Native Hawaiian or other Pacific Islander

__ White

__ Other

4. What is your average yearly income before taxes? (Including parents' income)

__ Less than 10,000 __$10,000-$19,999 __$20,000-$29,999 __$30,000-$39,999
__$40,000-$49,999 __$50,000-$74,999 __$75,000-$99,999
__$100,000-$149,000 __$150,000 and over

5. Please list any illnesses or medical conditions you have been diagnosed with:

RSES: Below is a list of statements dealing with your GENERAL feelings about yourself. Indicate how much you agree or disagree with each statement.	Strongly disagree	Disagree	Agree	Strongly Agree
On the whole, I am satisfied with myself.	○	○	○	○
At times, I think I am no good at all.	○	○	○	○
I feel that I have a number of good qualities.	○	○	○	○
I am able to do things as well as most other people.	○	○	○	○
I feel I do not have much to be proud of.	○	○	○	○
I certainly feel useless at times.	○	○	○	○
I feel that I am a person of worth, at least on an equal plane with others.	○	○	○	○
I wish I could have more respect for myself.	○	○	○	○
All in all, I am inclined to feel that I am a failure.	○	○	○	○
I take a positive attitude toward myself.	○	○	○	○

RSQ: Each of the items below describes things college students sometimes ask of other people. Please imagine that you are in each situation. You will be asked to answer the following questions:

A) How concerned or anxious would you be about how the other person would respond?
B) How do you think the other person would be likely to respond?

1. You ask your parents for help in deciding what programs to apply to.

	Very unconcerned 1	2	3	4	5	Very concerned 6
A) How concerned or anxious would you be over whether or not your parents would want to help you?	○	○	○	○	○	○
	Very unlikely 1	2	3	4	5	Very likely 6
B) I would expect that they would want to help me.	○	○	○	○	○	○

2. You approach a close friend to talk after doing or saying something that seriously upset him/her.

	Very unconcerned 1	2	3	4	5	Very concerned 6
A) How concerned or anxious would you be over whether or not your friend would want to talk with you?	○	○	○	○	○	○
	Very unlikely 1	2	3	4	5	Very likely 6
B) I would expect that he/she would want to talk with me to try to work things out.	○	○	○	○	○	○

3. After graduation, you can't find a job and ask your parents if you can live at home for a while.

	Very unconcerned 1	2	3	4	5	Very concerned 6
A) How concerned or anxious would you be over whether or not your parents would want you to come home?	○	○	○	○	○	○
	Very unlikely 1	2	3	4	5	Very likely 6
B) I would expect I would be welcome at home.	○	○	○	○	○	○

4. You call your boyfriend/girlfriend after a bitter argument and tell him/her you want to see him/her.

	Very unconcerned 1	2	3	4	5	Very concerned 6
A) How concerned or anxious would you be over whether or not your boyfriend/girlfriend would want to see you?	○	○	○	○	○	○
	Very unlikely 1	2	3	4	5	Very likely 6
B) I would expect that he/she would want to see me.	○	○	○	○	○	○

5. You ask your parents to come to an occasion important to you.

	Very unconcerned 1	2	3	4	5	Very concerned 6
A) How concerned or anxious would you be over whether or not your parents would want to come?	○	○	○	○	○	○
	Very unlikely 1	2	3	4	5	Very likely 6
B) I would expect that my parents would want to come.	○	○	○	○	○	○
6. You ask a friend to do you a big favor.						
	Very unconcerned 1	2	3	4	5	Very concerned 6
A) How concerned or anxious would you be over whether or not your friend would do this favor?	○	○	○	○	○	○
	Very unlikely 1	2	3	4	5	Very likely 6
B) I would expect that he/she would willingly do this favor for me.	○	○	○	○	○	○
7. You ask your boyfriend/girlfriend if he/she really loves you.						
	Very unconcerned 1	2	3	4	5	Very concerned 6
A) How concerned or anxious would you be over whether or not your boyfriend/girlfriend would say yes?	○	○	○	○	○	○
	Very unlikely 1	2	3	4	5	Very likely 6
B) I would expect that he/she would answer yes sincerely.	○	○	○	○	○	○
8. You go to a party and notice someone on the other side of the room and then you ask them to dance.						
	Very unconcerned 1	2	3	4	5	Very concerned 6
A) How concerned or anxious would you be over whether or not the person would want to dance with you?	○	○	○	○	○	○

	Very unlikely 1	2	3	4	5	Very likely 6
B) I would expect that he/she would want to dance with me.	○	○	○	○	○	○

B-PNI: Use the scale to the right to indicate how much the statements below sound like you.	Not at all like me 0	1	2	3	4	Very much like me 5
I can usually talk my way out of anything.	○	○	○	○	○	○
When people don't notice me, I start to feel bad about myself.	○	○	○	○	○	○
I often hide my needs for fear that others will see me as needy and dependent.	○	○	○	○	○	○
I can make anyone believe anything I want them to.	○	○	○	○	○	○
I get annoyed by people who are not interested in what I say or do.	○	○	○	○	○	○
I find it easy to manipulate people.	○	○	○	○	○	○
Sometimes I avoid people because I'm concerned that they'll disappoint me.	○	○	○	○	○	○
I typically get very angry when I'm unable to get what I want from others.	○	○	○	○	○	○
When others don't meet my expectations, I often feel ashamed about what I wanted.	○	○	○	○	○	○
I feel important when others rely on me.	○	○	○	○	○	○
I can read people like a book.	○	○	○	○	○	○
Sacrificing for others makes me the better person.	○	○	○	○	○	○
I often fantasize about accomplishing things that are probably beyond my means.	○	○	○	○	○	○
Sometimes I avoid people because I'm afraid they won't do what I want them to.	○	○	○	○	○	○
It's hard to show others the weaknesses I feel inside.	○	○	○	○	○	○
It's hard to feel good about myself unless I know other people admire me.	○	○	○	○	○	○
I often fantasize about being rewarded for my efforts.	○	○	○	○	○	○

I am preoccupied with thoughts and concerns that most people are not interested in me.	○	○	○	○	○	○
I like to have friends who rely on me because it makes me feel important.	○	○	○	○	○	○
Sometimes I avoid people because I'm concerned they won't acknowledge what I do for them.	○	○	○	○	○	○
It's hard for me to feel good about myself unless I know other people like me.	○	○	○	○	○	○
It irritates me when people don't notice how good a person I am.	○	○	○	○	○	○
I will never be satisfied until I get all that I deserve.	○	○	○	○	○	○
I try to show what a good person I am through my sacrifices.	○	○	○	○	○	○
I often fantasize about performing heroic deeds.	○	○	○	○	○	○
I often fantasize about being recognized for my accomplishments.	○	○	○	○	○	○
I can't stand relying on other people because it makes me feel weak.	○	○	○	○	○	○
When others get a glimpse of my needs, I feel anxious and ashamed.	○	○	○	○	○	○

Continued on next page →

SCC: Below is a list of statements dealing with your GENERAL feelings about yourself. Indicate how much you agree or disagree with each statement.	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly Agree
My beliefs about myself often conflict with one another.	○	○	○	○	○
On one day I might have one opinion of myself, and on another day I might have a different opinion.	○	○	○	○	○
I spend a lot of time wondering about what kind of person I really am.	○	○	○	○	○
Sometimes I feel that I am not really the person that I appear to be.	○	○	○	○	○
When I think about the kind of person I have been in the past, I'm not sure what I was really like.	○	○	○	○	○
I seldom experience conflict between the different aspects of my personality.	○	○	○	○	○
Sometimes I think I know other people better than I know myself.	○	○	○	○	○
My beliefs about myself seem to change very frequently.	○	○	○	○	○
If I were asked to describe my personality, my description might end up being different from one day to another day.	○	○	○	○	○
Even if I wanted to, I don't think I would tell someone what I'm really like.	○	○	○	○	○
In general, I have a clear sense of who I am and what I am.	○	○	○	○	○
It is often hard for me to make up my mind about things because I don't really know what I want.	○	○	○	○	○

RFQ: The following questions ask about the family household that you grew up in. Some of the questions seem similar, so please read each question carefully and answer using the scale provided. **In the household that you grew up in, how often did a parent or other adult in the household:**	Not at all				Very Often
Make you feel that you were loved, supported, and cared for?	○	○	○	○	○

Swear at you, insult you, put you down, or act in a way that made you feel threatened?	○	○	○	○	○
Make you follow the rules?	○	○	○	○	○
Express physical affection for you, such as hugging, or other physical gestures of warmth and affection?	○	○	○	○	○
Do things for you that you could have done for yourself?	○	○	○	○	○
Push, grab, shove, or slap you?	○	○	○	○	○
Give you whatever you wanted?	○	○	○	○	○
Behaved violently toward a family member or visitor in your home?	○	○	○	○	○
Allow you to take the lead or dominate in the household?	○	○	○	○	○
Did you live with anyone who was a problem drinker or alcoholic, or who used street drugs?	○	○	○	○	○
Would you say that the household you grew up in was well-organized and well-managed?	○	○	○	○	○
How often would you say there was quarreling, arguing, or shouting between your parents?	○	○	○	○	○
How often would you say there was quarreling, arguing, or shouting between a parent and you?	○	○	○	○	○
Would you say the household you grew up in was chaotic and disorganized?	○	○	○	○	○
How often would you say you were neglected while you were growing up, that is, left on your own to fend for yourself?	○	○	○	○	○

Modified Seven-Item Williams Scale: Read each statement and decide whether it is true or false as applied to you.	True	False
I have often had to take orders from someone who did not know as much as I did.	○	○
I have often met people who were supposed to be experts who were no better than I.	○	○
I have frequently worked under people who seem to have things arranged so that they get credit for good work, but are able to pass off mistakes onto those under them.	○	○
Some of my family has habits that bother and annoy me very much.	○	○
I would certainly enjoy beating a crook at their own game.	○	○

I have at times had to be rough with people who were rude or annoying.	○	○
I do not try to cover up my poor opinion or pity of a person so that they won't know how I feel.	○	○

Goldberg's Big-Five Factor Markers: Using the scale to the right, how accurate are each of the following statements when you think about yourself.	Very inaccurate 1	2	3	4	Very accurate 5
Am the life of the party.	○	○	○	○	○
Feel little concern for others.	○	○	○	○	○
Get stressed out easily.	○	○	○	○	○
Don't talk a lot.	○	○	○	○	○
Am interested in people.	○	○	○	○	○
Am relaxed most of the time.	○	○	○	○	○
Feel comfortable around people.	○	○	○	○	○
Insult people.	○	○	○	○	○
Worry about things.	○	○	○	○	○
Keep in the background.	○	○	○	○	○
Sympathize with others' feelings.	○	○	○	○	○
Seldom feel blue.	○	○	○	○	○
Start conversations.	○	○	○	○	○
Am not interested in other people's problems.	○	○	○	○	○
Am easily disturbed.	○	○	○	○	○
Have little to say.	○	○	○	○	○
Have a soft heart.	○	○	○	○	○
Get upset easily.	○	○	○	○	○
Talk to a lot of different people at parties.	○	○	○	○	○
Am not really interested in others.	○	○	○	○	○

Change my mood a lot.	○	○	○	○	○
Don’t like to draw attention to myself.	○	○	○	○	○
Take time out for others.	○	○	○	○	○
Have frequent mood swings.	○	○	○	○	○
Don’t mind being the center of attention.	○	○	○	○	○
Feel others’ emotions.	○	○	○	○	○
Get irritated easily.	○	○	○	○	○
Am quiet around strangers.	○	○	○	○	○
Make people feel at ease.	○	○	○	○	○
Often feel blue.	○	○	○	○	○

Appendix C: Measures of Affective Reactivity

PANAS: Using the scale below, indicate from 1 to 5 how intensely you are feeling the listed emotions <u>right now</u>				
Very Slightly or Not At All	**A Little**	**Moderately**	**Quite a Bit**	**Extremely**
1	2	3	4	5

1.	Interested	_____	11.	Irritable	_____
2.	Distressed	_____	12.	Alert	_____
3.	Excited	_____	13.	Ashamed	_____
4.	Upset	_____	14.	Inspired	_____
5.	Strong	_____	15.	Nervous	_____
6.	Guilty	_____	16.	Determined	_____
7.	Scared	_____	17.	Attentive	_____
8.	Hostile	_____	18.	Jittery	_____
9.	Enthusiastic	_____	19.	Active	_____
10.	Proud	_____	20.	Afraid	_____

SHS: Using the scale below, indicate from 1 to 5 how strongly you agree that you are feeling the listed emotions <u>right now</u>				
Strongly Disagree	**Disagree**	**Neither Agree Nor Disagree**	**Agree**	**Strongly Agree**
1	2	3	4	5

1.	I feel furious.	_____	19.	I feel like I'm about to explode.	_____
2.	I feel willful.	_____	20.	I feel friendly.	_____
3.	I feel aggravated.	_____	21.	I feel understanding.	_____
4.	I feel tender.	_____	22.	I feel amiable.	_____
5.	I feel stormy.	_____	23.	I feel mad.	_____
6.	I feel polite.	_____	24.	I feel mean.	_____
7.	I feel discontented.	_____	25.	I feel bitter.	_____
8.	I feel like banging on a table.	_____	26.	I feel burned up.	_____
9.	I feel irritated.	_____	27.	I feel like yelling at somebody.	_____
10.	I feel frustrated.	_____	28.	I feel cooperative.	_____
11.	I feel kindly.	_____	29.	I feel like swearing.	_____
12.	I feel unsociable.	_____	30.	I feel cruel.	_____
13.	I feel outraged.	_____	31.	I feel good-natured.	_____
14.	I feel agreeable.	_____	32.	I feel disagreeable.	_____
15.	I feel angry.	_____	33.	I feel enraged.	_____
16.	I feel offended.	_____	34.	I feel sympathetic.	_____
17.	I feel disgusted.	_____	35.	I feel vexed.	_____
18.	I feel tame.	_____			

PAS: Using the scale below, indicate from 1 to 5 how intensely you are feeling the listed emotions <u>right now</u>				
Very Slightly or Not At All	**A Little**	**Moderately**	**Quite a Bit**	**Extremely**
1	2	3	4	5

1.	Active	_____	13.	Aroused	_____
2.	Drowsy	_____	14.	Energetic	_____
3.	Exhausted	_____	15.	Forceful	_____
4.	Lively	_____	16.	Quiet	_____
5.	Sleepy	_____	17.	Sluggish	_____
6.	Vigorous	_____	18.	Weary	_____
7.	Alert	_____	19.	Depressed	_____
8.	Dull	_____	20.	Excited	_____
9.	Fatigued	_____	21.	Inactive	_____
10.	Powerful	_____	22.	Sharp	_____
11.	Slow	_____	23.	Tired	_____
12.	Weak	_____	24.	Worn-out	_____

Appendix D: Measures of needs threat, manipulation checks and enhancement, and aggressive cognition

FBNQ: For each question, please select the response that best represents the feelings you were experiencing DURING THE GAME.					
	Not at all 1	2	3	4	Extremely 5
I felt "disconnected"	○	○	○	○	○
I felt rejected	○	○	○	○	○
I felt like an outsider	○	○	○	○	○
I felt I belonged to the group	○	○	○	○	○
I felt other players interacted with me a lot	○	○	○	○	○
I felt good about myself	○	○	○	○	○
My self-esteem was high	○	○	○	○	○
I felt liked	○	○	○	○	○
I felt insecure	○	○	○	○	○
I felt satisfied	○	○	○	○	○
I felt powerful	○	○	○	○	○
I felt I had control over the course of the game	○	○	○	○	○
I felt I had the ability to significantly alter events	○	○	○	○	○
I felt I was unable to influence the action of others	○	○	○	○	○
I felt the other players decided everything	○	○	○	○	○
I felt invisible	○	○	○	○	○
I felt meaningless	○	○	○	○	○
I felt non-existent	○	○	○	○	○
I felt important	○	○	○	○	○
I felt useful	○	○	○	○	○
I was ignored	○	○	○	○	○
I was excluded	○	○	○	○	○

Assuming that the ball should be thrown to each person equally (33% of the time), what percentage of the throws did you receive?	_____%

SPQ: Use the scale below to rate PLAYER 1 (PLAYER 2) for each of the following adjectives.						
	Not at all 1	2	3	4	5	Extremely 6
friendly	○	○	○	○	○	○
helpful	○	○	○	○	○	○
boring	○	○	○	○	○	○
dishonest	○	○	○	○	○	○
caring	○	○	○	○	○	○
selfish	○	○	○	○	○	○
creative	○	○	○	○	○	○
insensitive	○	○	○	○	○	○
sincere	○	○	○	○	○	○

Word Completion Task: Here is a list of words with letters missing. Your task is to fill in the blanks to make complete words. For example: "_rain" can be completed with the letter "T" to spell the word "Train" or the letter "G" to spell the word "Grain". There are no right or wrong answers. If you cannot think of letters to complete a word, skip it and move on to the next.

1. b__h ___ ___ ___
2. in___ ___re
3. ex__e___ ___
4. mu___ ___er
5. pr___ ___e
6. spea__
7. fli___ ___er
8. expl___ ___e
9. w___ ___m
10. ki___ ___
11. t__p__
12. h__r__
13. a__t__r
14. cho__e
15. s__mp___ ___
16. att__c__
17. c__mp___ ___t
18. des___ ___ ___ ___
19. sh__l__
20. sho__t
21. r__p___ ___t
22. str___ ___ e
23. l___ ___e
24. b__rn
25. st__r__o
26. p___ ___son
27. p__st__r
28. m___ ___gle
29. bl__nd
30. sn__re
31. b__e
32. h__t
33. g___ ___pe
34. sm__ck
35. sm___ ___e
36. kn___ ___ ___
37. t__ne
38. s___ ___b
39. sh__r__
40. dr___ ___n
41. p___ ___ne
42. ang___ ___
43. fl___ ___t
44. fi___ ___t
45. p__ck
46. ha__e
47. a__t
48. c__t
49. w__n
50. a__e
51. __ry
52. wa__
53. f__m__
54. sl__p
55. b___ ___k
56. r__pe
57. fo__e__t
58. off___ ___ ___
59. l___ ___on
60. cr___ ___l
61. c__e__te
62. st__r__y
63. m__tc__
64. f__r___ ___
65. t___ ___te
66. n___ ___t__
67. w___ ___d__w
68. w___ ___ked
69. vis___ ___ n
70. en__age
71. scr___ ___n
72. h__tr__d
73. t__l__ph___ ___ ___
74. dis___ ___s__ed
75. c__nt___ ___l
76. prov___ ___e
77. p__nb__ll
78. out___ ___ ___
79. c__ll
80. r__de
81. m__n__ge
82. ins___ ___ ___
83. s__d__
84. b___ ___t
85. br___ ___ze
86. rev___ ___t
87. coo__
88. s___ ___y
89. d___ ___r
90. sm__ck
91. fr___ ___t
92. __unch
93. sh__re
94. a__use
95. cl___ ___r
96. h__nt
97. w__t__r
98. s__ash

Appendix E: Experiment Checklist and Protocol Script

EXPERIMENT CHECKLIST

This document will help you gather and organize all of the documents materials needed to run Social Interactions and Health

_____ Obtain key for room 024. It is kept in the silver basket on top of the desk in room 032. Make sure to bring back to room 032 right after unlocking.

_____ Determine Cyberball condition using the randomization schedule and cross off the list on the bulletin board in room 032).

_____ On Master Sheet, fill in date, participant ID#, and RA initials.

_____ **Circle the experimental condition: control (inclusion) or experimental (exclusion)**.

_____ Open Qualtrics surveys on laptop.

_____ Open Cyberball program on laptop; place laptop on back table and plug in.

_____ Make sure one-way mirror shutter is closed.

_____ Set up the Polar Heart Rate Monitor with the participant's height, weight, age and initials (This information can be found on the Screening Form).

_____ If phone is plugged in in room 024, turn phone off (use horizontal volume arrow – push the left arrow until the ringer is silenced).

Documents needed in the order they are used:

_____ Mastersheet
_____ Microscript
_____ Eligibility Screening Form for Day of Study
_____ 2 Informed Consent Forms
_____ "How to Wear HRM" Guide for Participant
_____ 2 Participant Compensation Forms
_____ Envelope containing $10
_____ Contact Info

Materials needed:

_____ Laptop
_____ Heart Rate Monitoring System
  _____ Strap
  _____ Sensor
  _____ Watch
  _____ Buh-Bump gel
_____ 2 sets of disposable gloves
_____ 2 purple labeled Salivettes (On each label, circle "Baseline" or "2nd" and write in the date and Participant ID#)
_____ Plastic bag for Salivettes (located on 3rd shelf of 1st bookcase in room 032)

Time participant arrived: _____

_____ Welcome and RA Introduction

_____ Eligibility Screening Form for Day of Study completed **(If eligible, move on to next item; if not eligible, reschedule participant)**

_____ Informed consent

_____ Explained

_____ Both Informed Consent Forms signed

_____ One copy given to participant

_____ Heart rate monitor (HRM) visibly recording heart rate Start time: _____

_____ Demographic/baseline questionnaires completed

_____ 5 min baseline HR complete Time began: _____ Time ended: _____

_____ Baseline cortisol sample collected, placed in plastic bag Time collected: _____

_____ Cyberball complete Cyberball began: _____ Cyberball ended: _____

_____ Check HRM to ensure it is still recording heart rate

_____ Post-Cyberball questionnaires completed

_____ 2nd cortisol sample collected, placed in plastic bag (25 minutes after completion of Cyberball)

Time collected: _____

_____ Heart rate monitor off participant (retrieve data, clean, store after participant is gone)

Time of HRM removal: _____

_____ Debriefing statement read to participant

_____ Compensation

_____ Both Compensation Forms signed

_____ One copy given to participant

_____ Give participant envelope containing $10 Time participant left: _____

MICROSCRIPT AND PROCEDURE

Prior to study:

Collect the study materials listed on the pre-experiment checklist (see section 4.01 in Project Book).

Hook up the laptop to the monitor in the back of the room and make sure it is connected to the internet.

Access predetermined (via randomization sheet in room 032) Cyberball condition by accessing one of the two following sites in Firefox:

Inclusion condition: personal.psu.edu/hjc131
Exclusion condition: personal.psu.edu/src233

Access the Qualtrics surveys, have each survey open in its own separate Firefox window apart from Cyberball.

Baseline survey: https://pennstate.qualtrics.com/jfe/form/SV_ePOmBegU3Xu8Ret
Post-Cyberball survey: https://pennstate.qualtrics.com/jfe/form/SV_0CBSSrISCQ2X8kB

Finally, make browser full screen (press F11). You should have three browser windows open in the following order: (1) Baseline questionnaire, (2) Cyberball game, (3) Post-Cyberball questionnaire.

Script Key:

1. Regular Text: Notes/general instructions
2. Underlined Regular: Prompts
3. **Bold: Actions**
4. **Underlined Bold: Section headings and physical objects**
5. *Italicized: Spoken to participant*

VERIFYING THE PARTICIPANT

Note: If at any point you have to end the study early, skip to the last section labeled "FINAL PROCEDURES."

The secondary RA will be waiting with you in room 024 before the participant arrives. The participant should be waiting outside of room 024. Holding a clipboard, the secondary RA will greet the participant and ask for their name, then check the clipboard and explain to the participant that they have been assigned to complete the study in this room (i.e., BBH 024). Finally, the secondary RA will excuse him/herself to "wait for the last participant in the hall."

RESEARCH ASSISTANT

Hello. **(offer handshake)** *My name is _____. I'm the research assistant who will be working with you today. Please have a seat at the table.* **(Have the participant sit in the chair on the right side of the table as you enter the room).** *How are you doing today?*

Good*: Great! We appreciate you taking the time to come in for the study today.*

Bad*: I'm sorry to hear that. We appreciate you taking the time to come in for the study today.*

If participant asks how you are*: I'm doing well, thanks.*

RESEARCH ASSISTANT

We're still waiting on one of the other participants, but they should be along shortly, so we can go ahead and get started. First, I need to go through some general screening questions to make sure you are still eligible to participate.

Use the "Eligibility Screening Form for Day of Study" to screen the participant.

ELIGIBLE: *Great, It looks like you are eligible to participate today.* **[Continue on to next page]**

INELIGIBLE: *Unfortunately you will not be able to participate at this time.*

Explain why the participant is not able to participate. For example, "You drank coffee just before you came. In order to participate, you cannot have any caffeine for two hours prior to the study."

RESEARCH ASSISTANT

If you would like, we can schedule another time for you to come in. Would you like to reschedule your visit?

YES: Set up a new time, reiterate day-of exclusion criteria, and let them know we will send out another email reminder 24 hours before their next visit.

NO: Thank them for their time and see them out.

INFORMED CONSENT

Give both blank copies of the "Informed Consent Form" to the participant and say the following:

RESEARCH ASSISTANT

Now I am going to go over the Informed Consent forms with you. I have to read the main points verbatim in order to give you a general overview of the study. Then, I'll ask that you sign and date both forms – one for our records, and one for you to take home with you. Please stop me at any point if you have any questions and I will be happy to explain more thoroughly.

Purpose of the study: *This research is being done to examine how people respond to basic social interactions. Prior research has found that people have different physical and psychological reactions while interacting with others, and that this may be due to differences in personality. Our research intends to further validate and expand upon these findings in hopes of better understanding how personality might influence physical and psychological reactivity in response to social interaction.*

Procedures to be followed: *In this study, heart rate data and saliva samples will be collected. You will answer several questionnaires and play a basic, old-fashioned computer game online with 2 other participants. Lastly, you will be provided debriefing and compensation information.*

Risks and possible discomforts: *Some people may find the computer game to be mildly irritating. However, this discomfort is not beyond that which is experienced in everyday life.*

Benefits: *Benefits include learning how you react to others during online, computerized gameplay.*

Voluntary participation: *Your involvement in this research is completely voluntary and you can stop at any time. Refusal to take part in this study or withdrawing from it will involve no penalty or loss of benefits you would receive otherwise.*

Other options available: *You have the option of not participating in this research.*

Privacy and confidentiality: *There is a risk of loss of confidentiality if your information or your identity is obtained by someone other than the investigators. Reasonable efforts, such as removing identifying information from your data, and storing signed documents in locked filing cabinets in our lab, will be made to keep the personal information in your research record private. However, absolute confidentiality cannot be guaranteed.*

Compensation: *You will be compensated at $10/hour. Compensation will be settled at the end of the experiment.*

Right to ask questions: *You are allowed to present questions, concerns, or comments about this study to Sulamunn Coleman, the principal investigator, his faculty adviser, Dr. Smyth, or the Penn State Office of Research Protections. You will receive their contact information at the end of the study.*

RESEARCH ASSISTANT

If you don't have any questions, and would still like to participate, please sign and date the last pages. **[Answer any questions without giving away details about the hypotheses].** *Before we get started, please make sure your cellphone is turned off completely because cell phone signals can interfere with the Heart Rate monitor. I'll put it on the back table for you and you can grab it before you leave.* **[Take phone and put it on the back table]** *Are you wearing a FitBit?* **[If YES, take FitBit to room 32 and return after the study]** *Finally, if you need to use the bathroom, please do so now because once the study begins you will not be able to take a break.*

HEART RATE MONITOR SET-UP

Refer to section 2.3 of the Polar RS800 Monitoring System User Guide Version 1.7

RESEARCH ASSISTANT

Now we will set you up with the heart rate monitor. This will measure your heart rate continuously throughout the study. Here is a visual aid for you to look at for reference. **[Hand participant Appendix B: Heart Rate Monitor Guide]** *There are three parts of the monitoring system: The watch, the sensor, and the strap. I will demonstrate on myself how to properly put on and adjust the strap and then have you practice over your clothes. You will need to place the strap where your breastbone ends and make sure it is a snug but comfortable fit. So, it shouldn't be cutting off circulation, but it needs to be tight enough so that it doesn't move around when you shift in your seat. The sensor clips on to the front of the strap like this.* **[Clip sensor to the strap with the logo facing upwards]**. *Point the electrodes towards your body with the logo facing upward on the sensor so that you can hook the clasp on your left side.*

Demonstrate putting the strap on yourself; point to logo on sensor; demonstrate buckle adjustment; have participant practice over their clothing, re-explain as necessary.

RESEARCH ASSISTANT

Okay great, you can take that off now. In order to boost the signal between your skin and the electrodes on the strap **[Point to electrodes on strap]**, *I need to moisten them using either a cream or water. Do you have any type of skin allergies?*

> If NO: *Okay, I am now going to put this electrode gel onto the strap. This is a water-based substance so it will dry without sticky residue and won't stain your clothing.*
>
> If YES: *Okay, I am now going to moisten the electrodes with water so I'll be back in just a minute.* **[Go to water fountain or bathroom and moisten electrodes with water; then return]**

RESEARCH ASSISTANT

Great, now I am going to leave the room to allow you to put the heart rate monitor on underneath your shirt. The strap needs to be in contact with your skin and will not work over your shirt. I will be outside in the hallway, so just open the door when you are ready or if you have any questions. **[Stand in hallway and wait for participant to open door; re-demonstrate steps as necessary]**

Okay now I'm going to hold the watch up towards the sensor in order to establish a connection. **[Hold watch up towards the sensor; hit red button once, wait for HR to show up and then hit red button again to start; troubleshoot as necessary; start time on watch]** *So, now we are going to make sure that the heart rate collection is working properly. I am going to start the watch and collect data for 1 minute. Please sit quietly during this baseline reading.* **[Collect 1 minute of baseline heart rate data to make sure the HRM is working properly; follow the HRM Data Collection Check procedure for ensuring the collection worked properly]**

> WORKING: *Okay, great. The watch is all set up and we can continue on with the study.* **[Start HRM to begin collecting data again. When asked to merge data, select "No," then continue on the next page]**
>
> NOT WORKING: *Okay, it seems as though the watch isn't working properly. Please stay seated as I go to room 032 to fix the problem.* **[Troubleshoot or set up a new watch and repeat process until functioning properly]**

BASELINE SURVEY

RESEARCH ASSISTANT

The next segment of the study includes having you complete some questionnaires. Please have a seat at the laptop on the back counter.

Have the participant move to the seat in the back of the room facing the monitor. Bring Polar watch with you; place on back table in close proximity to the participant, but facing you so you can make sure it's working as you sit at the table. If the watch stops reading, refer to troubleshooting procedures.

Click the tab to open the Baseline survey.

RESEARCH ASSISTANT

This questionnaire is several pages long. There is a "continue" button on the bottom of each page which will advance you, and at the end of the survey there will be a "thank you" screen. Try not to spend too much time on any single item. Just fill out the items according to how you see yourself now. Do you have any questions? **[Address any concerns]**

After you complete the questionnaires, I'll have you sit quietly and relax for 5 minutes before I take your first saliva sample. If you have any questions as you're filling out the questionnaires, please ask me. Otherwise, just let me know when you have reached the "thank you" screen at the end of the questionnaires.

Address any of the participant's concerns as they arise. If you find that the participant is taking longer than 20 minutes to complete the questionnaires, ask if everything is alright, and address any concerns. Otherwise, allow the participant to complete all sections.

Continue on the following page when the participant has finished. DO NOT CLOSE THE BASELINE SURVEY TAB. Participant should indicate when they are finished, but keep an eye on the questionnaire to make sure you know when the participant has completed it.

RESEARCH ASSISTANT

Now we're going to rest for 5 minutes before taking the first saliva sample. Please sit quietly and try to relax.

BASELINE CORTISOL

Put on a pair of plastic gloves.

RESEARCH ASSISTANT

We will now take your first saliva sample. This is a saliva collection tube. I will now demonstrate how to properly remove the cap. You'll want to hold the tube upright and grasp the middle section. To open it, slowly twist and pull off the cap while grasping the tube. **(Keep the tube upright, hold the middle section of the tube, twist, and pull the cap off slowly/ put the cap back on and hand it to the participant).**

Once the cap is removed, you can carefully remove the white gauze. You will put the gauze between your teeth and cheek and hold it there for about 2 minutes. Then, you will spit the piece into the collection tube without touching it with your hands. Please do not bite or chew on it. I will let you know when one minute is over.

Record time participant began saliva sample. Wait 2 minutes to allow proper absorption of the saliva.

RESEARCH ASSISTANT

Okay, great. It has been one minute. Please spit the gauze back in the tube without touching it with your hands.

Collect salivette; write time participant gave saliva sample on the collection tube label.

Thank you. We will store your sample and analyze it later on.

Place labeled saliva sample in a plastic bag marked with the participant's ID number.

Remove and discard your gloves.

CYBERBALL

RESEARCH ASSISTANT

Okay. We should be just about ready to begin the computer game.I'm going to go check with the other research assistants to make sure we are ready to start. I'll be back momentarily.

Leave room 24, closing the door as you exit, and walk down to room 32. There will be another RA waiting in 32. Alert the RA that you are just about ready to begin playing Cyberball. This will prompt the RA to begin the timer for when to inform you that his/her "participant" is also ready to begin (i.e., 4 minutes later). Walk back to room 24, knock on the door and re-enter.

RESEARCH ASSISTANT

Hey, so one of the other participants has a bit longer to wait before taking their first saliva sample, so while we're waiting I'm going to explain the game to you. There will be some instructions on the screen before you start playing. Read through them completely, and when you're done click "start playing" to log into the game. Once in the game you will see players on your left and right. In order to maintain confidentiality, only their age and sex will be visible to you, and your age and sex will be visible to them. This is a basic, old fashioned computer game that's used to test the effects of mental visualization while interacting with others in a digital environment. To pass the ball to another player, you simply have to use the mouse to click on the player you wish to pass the ball to. The game can last anywhere from 5-10 minutes depending on how long each participant holds the ball. To keep the game moving, please don't hold onto the ball for more than a couple of seconds. When the game has finished a screen will appear that says "Thank You" and tells you to wait for further instructions. Just let me know when that screen appears. Do you have any questions? **[Address any concerns]** *Alright; we just have to wait for the other RA to let us know when they're ready to start.*

In 1-2 minutes the second RA will knock on the door to room 24. Excuse yourself by saying "That's the other research assistant." Answer the door (you only need to open it a crack). The second RA will say "We are ready to begin" clearly so the participant can hear it. Shut the door, close the baseline survey tab on the web browser, and bring up the instructions screen for Cyberball.

RESEARCH ASSISTANT

Alright, go ahead and read through the instructions then click "Start Playing" to log into the game.

Note the real time (e.g., 5:30pm) on the Mastersheet.

<u>Questions participants may ask during gameplay:</u>

"Is the game is working properly?" / "I don't think the game is working properly."

"Why aren't they throwing it to me?"

"Am I doing this right?" / "Am I supposed to be doing anything?"

"Why isn't my information (age/sex) showing up?"

"Do the other participants know I'm here?" / "Can the other participant's see me?"

POST-CYBERBALL SURVEY

Start the stopwatch when the game has finished.

RESEARCH ASSISTANT

Great, thanks. Now we have to wait 25 minutes before collecting the final saliva sample. In the meantime, I'd like you to complete a few more questionnaires. If you complete them before the time is up, just let me know, then I will ask you to please sit quietly for the remaining time. It's important that you stay quiet for the entire time because we have to do our best to minimize interference with the heart rate monitor. I'll be happy to answer any questions you have afterwards.

Open up post-cyberball questionnaire on the laptop.

RESEARCH ASSISTANT

Okay. Please fill these out, then just sit quietly once you've finished.

You will use the stopwatch to make sure 25 minutes elapse after Cyberball has finished because that is when you will collect the final cortisol sample. You will need to monitor the watch to make sure exactly 25 minutes have elapsed between the completion of Cyberball and the collection of the final saliva sample.

Double check the Polar Heart Rate Monitoring watch to make sure it is still collecting heart rate data correctly. If it is not, you will need to refer back to the Polar RS800 Monitoring System Researcher User Guide and troubleshoot.

When the participant indicates they have completed the questionnaires, close that specific tab on the computer. From then on, keep an eye on the Polar watch to make sure the HRM is collecting data. Troubleshoot if necessary.

After 25 minutes have elapsed:

RESEARCH ASSISTANT

Okay [Name], the 25 minutes are over. Thanks for your patience.

If the participant has not finished the word-completion task, have them scroll to the bottom of the page and click "continue" to finish

FINAL CORTISOL SAMPLE

RESEARCH ASSISTANT

We will now collect the final saliva sample. Just as before, grasp the middle section of the tube and carefully take the cap off. Take the white gauze out and place it in your mouth, between your cheek area and your teeth. Make sure not to chew on the gauze. Just hold it in your mouth while it collects saliva.

Hand salivette to the participant and make sure they place the gauze in their mouth properly. Wait 2 minutes to allow proper absorption of saliva.

RESEARCH ASSISTANT

Okay. Now spit the gauze directly into the tube insert without touching it with your hand and close the cap securely, just like you did before.

Note the time of collection on the Mastersheet. Place the salivette in the plastic bag and set aside. Press the "Stop" button on the side of the Polar watch.

Continue on the following page.

DEBRIEFING AND COMPENSATION

RESEARCH ASSISTANT

Okay, that completes the study. I will now leave the room in order to give you some privacy so you can remove the heart rate monitor. When you're ready just open the door to let me back in. Then we'll go over final concerns.

Leave the room to allow participant to remove the HRM. Re-enter when the participant opens the door. Check to make sure all of the heart rate monitoring equipment is on the table (i.e., watch, strap, and sensor).

RESEARCH ASSISTANT

Please have a seat at the table again.

Immediately note on the Mastersheet what time the HRM was removed.

Hand the participant the research compensation forms.

RESEARCH ASSISTANT

These are the forms which are used to maintain documentation of compensation. Please print your name, sign, and date the following forms and you will then receive the payment for your participation. One of the copies is for our lab, and the other is for you to keep.

Take one of the compensation forms from the participant to keep for our records.

RESEARCH ASSISTANT

I know your time is valuable, and I really appreciate the effort you put in to give us the data we need. You've been very helpful. Before we go over the details of the study in order to fully disclose the nature of the experiment, what do YOU think that was all about?

Record responses on the mastersheet. This information will be used to determine whether the participant has any idea of the study's main hypotheses. Allow participant to ask questions before finally debriefing.

The purpose of this study is to examine the relationship between personality traits and physiological and psychological reactions following social exclusion. The computer game you played during your participation is a simulation designed to elicit a sense of either social inclusion or exclusion based on the condition to which you were randomly assigned. The other players you interacted with were a preprogrammed part of the simulation, not real people. In order to create a realistic sense of inclusion or exclusion, you were lead to believe that you would be interacting with real people during the game. All participants have a 2:1 chance of being randomly assigned to the exclusion condition. As I said at the beginning of today's experiment, we will make every effort to keep the data in your research record confidential. Since this study will continue over the next few months, we would like to enroll you as a co-scientist while we complete our study. This means we will need your cooperation in keeping the nature of the study to yourself so that the data we get from others are as representative as your data. So, as a co-scientist, it is critical that you do not share details of the study with anyone else as that could compromise our results.

Do you have any final questions? **[Address any concerns; hand <u>compensation envelope</u> and <u>contact information sheet</u> to participant]** *Okay. Thank you for participating in the Social Interactions and Health Project!* **[Show the participant the exit]**

Academic Vita
Andrew Geller

Education

The Pennsylvania State University, The Schreyer Honors College, *University Park, PA*
Bachelor's of Science in Biology with a Vertebrate Physiology Option *May 2019*
Schreyer Honors Scholar in Biobehavioral Health

- Undergraduate Honors Thesis: Examining the Associations Between Body Mass Index, Rejection Sensitivity, and Stress-Reactivity Following Social Exclusion
- Relevant Coursework: Mammalian Physiology, Advanced Human Anatomy, Cancer Biology, Evolution, Biochemistry, Organic Chemistry, Statistics, Calculus, Research Strategies for Biobehavioral Health, Health Services and Policy Issues, and Writing in The Social Sciences

The Roebling H. Knoch Memorial Scholarship in Science

- Awarded to 4th-7th semester students within the Eberly College of Science who are have above a 3.40 GPA and who are phenomenal in the Biology Department

Phi Sigma Delta Educational Foundation Scholarship

- Presented to Penn State undergraduate students who have exceptional academic status at Penn State and are actively involved in the University Park community

Research Experience

The Stress, Health and Daily Experiences (SHADE) Lab, *University Park, PA*
Research Assistant (RA) for Dr. Joshua Smyth *2016-Current*

- Completed tasks for Doctorate and Post-Doctorate student's dissertations and research such as: completing literature searches, running pilot trials, evaluating data, and benchmarking information
- Tasked with duties including: reading recent scientific publications regarding Biobehavioral Health, Stress, and The Biopsychosocial Model, gaining proficiency in the lab protocols, and facilitating experiments as a Primary and Secondary Researcher in The Social Interactions and Health Project

Penn State Undergraduate Research Exhibition *April 2018*

- Completed secondary data analyses titled "Cardiovascular Stress-Reactivity to Social Exclusion: Body Mass Index and Self-Concept Clarity as Possible Moderators" based on the "Social Health and Interactions" dissertation

Work Experience

Camp Saginaw, *Oxford, PA*
Senior Boy's Division Leader, Assistant Division Leader, General Counselor *2015-2018*

- Managed a staff of twenty-five counselors as well as 115 Senior Boy Campers (Ages 12-16) for 8 weeks
- Fostered communication with the Health Center, Guidance Counselors, and Daily Programming Directors to coordinate all activities and maintain the well-being of each camper