

CONTINGENT SELF-WORTH MODERATES THE RELATIONSHIP BETWEEN
SELF-ESTEEM AND HEART RATE VARIABILITY.

by

Kristine Knauff

M.A. (Clinical Psychology), Lakehead University, Canada, 2005

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

in Clinical Psychology

Department of Psychology
Lakehead University

© Kristine Knauff, May 2014

All rights reserved. This work may not be
reproduced in whole or in part, by photocopy
or other measures without permission of the author.

Acknowledgements

I would like to sincerely thank everyone who has had a role in the completion of this dissertation. I am particularly grateful for the supervision, dedication, and creativity of Dr. Ron Davis. Your support has been invaluable. Dr. Mirella Stroink, thank you for your insightful comments and suggestions. I would also like to thank Dr. Dwight Mazmanian for his contributions not only to this dissertation, but also to my graduate career. I am also so appreciative of the feedback given by Dr. Pam Wakewich and Dr. Virgil Zeigler-Hill. Special thanks to Danielle Ransom for her assistance in participant recruitment and data collection. I also give thanks to my colleagues in Dr. Davis' lab who provided additional opportunities for discussion. Lastly, I would like to thank my family and friends for their enduring love and support. I especially need to thank my husband for always believing in me and his many sacrifices in helping me to meet my professional goals. Without your encouragement this dissertation would not have been possible.

Abstract

Criticisms in the field of self-esteem research have led to new methods for conceptualizing and measuring the construct. One such method proposed by Crocker and Wolfe (2001) is that of contingent self-worth (CSW). Studies of heart rate variability (HRV) may also provide a novel biological method by which to examine an individual's self-esteem (Martens et al., 2008). The present study sought to determine whether self-esteem and CSW could predict HRV and affective reactivity. Female participants ($N = 96$) completed a series of questionnaires and then participated in a therapy role-play and video review while their HRV was recorded. Following the experimental tasks participants also completed questionnaires pertaining to their affective reaction to the role-play and video review. A series of moderated multiple regressions were conducted to test whether CSW would moderate any relationship between self-esteem and HRV or affective reactivity. Some support was found for this proposal, with appearance CSW moderating the effect of appearance self-esteem upon HRV reactivity during role-play, but only when the topic was appearance related. Participants who placed a higher importance on appearance as a source of their self-worth demonstrated greater HRV reactivity to the appearance role-play when they also had low appearance self-esteem. In regards to affective reactivity, for positive affect (PA) during both role-play and video review it was found that participants with higher appearance CSW were more likely to retrospectively report higher PA if they also had high appearance self-esteem. These findings support the value of examining contingencies of self-worth when investigating the interplay between self-esteem and parasympathetic response to a social challenge.

Table of Contents

Acknowledgements.....	ii
Abstract.....	iii
List of Tables.....	vi
List of Figures.....	viii
List of Appendices.....	ix
Contingent Self-Worth Moderates the Relationship Between Self-Esteem and Heart Rate Variability.....	1
Controversy in Self-Esteem Research.....	5
Contingent Self-Worth.....	10
Contingent self-worth research.....	13
Academic competence CSW research.....	15
Appearance CSW research.....	17
Heart Rate Variability and Self-Esteem.....	25
Heart rate variability.....	25
Heart rate variability and self-esteem research.....	29
The Present Study.....	32
Method.....	37
Participants.....	37
Materials.....	38
Demographic Questionnaire.....	38
Contingencies of Self-Worth Scale.....	38
State Self-Esteem Scale.....	40
Post-Study Questionnaire.....	41
Anxiety ratings.....	41
Video Recordings.....	42
Cardiac Recordings.....	42
Procedure.....	45
Results.....	46
Analytic Strategy.....	46
MMR assumptions and best practices.....	49
Data Preparation.....	51
Participants.....	51
Psychometric Variables.....	52
Reactivity Check.....	53
Talk Time.....	54
Hypothesis 1.....	54
Role-play.....	54
Video review.....	56
Hypothesis 2.....	57
Role-play.....	57
Video review.....	58
Summary.....	58
Hypothesis 3.....	59
Role-play negative affect.....	60

Role-play positive affect.....	60
Video review negative affect.....	61
Video review positive affect.....	62
Anxiety.....	64
Summary.....	65
Exploratory Analyses.....	65
Identifies.....	66
Discussion.....	67
Reactivity Check.....	67
Weighted CSWS.....	69
Role-play Hypotheses.....	70
Video Review Hypotheses.....	75
Positive Affect.....	77
Negative Affect.....	79
Anxiety.....	79
Exploratory Analyses.....	81
Limitations.....	82
Future Directions.....	83
Conclusion.....	86
References.....	87

List of Tables

Table 1	Reliability Coefficients and Descriptive Statistics of the Psychometric Variables	109
Table 2	Descriptive Statistics of the Cardiac Parameters Over the Phases of the Experiment.....	110
Table 3	Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting HFnu During Role-Play with CSWS: APPw and Scenario as Moderators.....	111
Table 4	Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting HFnu During Video Review with CSWS: APPw and Scenario as Moderators.....	112
Table 5	Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting HFnu During Role-Play with CSWS: ACADw and Scenario as Moderators.....	113
Table 6	Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting HFnu During Video Review with CSWS: ACADw and Scenario as Moderators.....	114
Table 7	Factor Loadings for Exploratory Factor Analysis with Varimax Rotation of Positive and Negative Affect During Role-play and Video Review.....	115
Table 8	Descriptive Statistics and Reliability Coefficients of the Affect Variables.....	116
Table 9	Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting Negative Affect During Role-play with Scenario and CSWS: APPw (top panel) and CSWS: ACADw (bottom panel) as Moderators.....	117
Table 10	Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting Positive Affect During Role-play with Scenario and CSWS: APPw (top panel) and CSWS: ACADw (bottom panel) as Moderators.....	118
Table 11	Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting Negative Affect During Video Review with Scenario and CSWS: APPw (top panel) and CSWS: ACADw (bottom panel) as Moderators.....	119

Table 12	Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting Positive Affect During Video Review with Scenario and CSWS: APPw (top panel) and CSWS: ACADw (bottom panel) as Moderators.....	120
Table 13	Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting Anxiety with Scenario and CSWS: APPw (top panel) and CSWS: ACADw (bottom panel) as Moderators.....	121
Table 14	Factor Loadings for Factor Analysis with Varimax Rotation PSQ Items.....	122
Table 15	Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting Identifies with Scenario and CSWS: APPw (top panel) and CSWS: ACADw (bottom panel) as Moderators.....	123

List of Figures

Figure 1	Timeline of laboratory experimental procedures.....	124
Figure 2	Moderated moderation model of the effects of self-esteem upon HFnu as moderated by scenario and CSWS.....	125
Figure 3	HFnu plotted as a function of phase.....	126
Figure 4	Hfnu during role-play plotted as a function of CSWS: APPw and SSES: Appearance during the appearance (top panel) and academic (bottom panel) scenarios.....	127
Figure 5	Hfnu during role-play plotted as a function of CSWS: APPw and SSES: Social during the appearance (top panel) and academic (bottom panel) scenarios.....	128
Figure 6	Hfnu during role-play plotted as a function of CSWS: ACADw and SSES: Appearance during the appearance (top panel) and academic (bottom panel) scenarios.....	129
Figure 7	Scatterplot of negative affect during role-play plotted as a function of SSES: Performance.....	130
Figure 8	Positive affect during role-play plotted as a function of CSWS: APPw and SSES: Appearance.....	131
Figure 9	Scatterplot of negative affect during video review plotted as a function of SSES: Appearance.....	132
Figure 10	Positive affect during video review plotted as a function of CSWS: APPw and SSES: Appearance.....	133
Figure 11	Anxiety plotted as a function of SSES: Social and scenario.....	134
Figure 12	Scatterplot of identifies plotted as a function of SSES: Appearance.....	135

List of Appendices

Appendix A	
Participant Recruitment E-mail.....	136
Appendix B	
Participant Recruitment Flyer.....	137
Appendix C	
Participant Information and Consent Forms.....	138
Appendix D	
Demographic Questionnaire.....	141
Appendix E	
Contingencies of Self-Worth Scale.....	142
Appendix F	
State Self-Esteem Scale.....	144
Appendix G	
Post-Study Questionnaire.....	145
Appendix H	
Appearance Scenario Script.....	146
Appendix I	
Academic Scenario Script.....	147
Appendix J	
Debriefing Form.....	148

Contingent Self-Worth Moderates the Relationship Between Self-Esteem and Heart Rate Variability

Self-esteem has been the subject of psychological research for over half a century. It is a topic that is studied not only in psychology, but in fields such as medicine, nursing, social work, and education among others. There have been countless news reports, talk show discussions, magazine articles, and self-help books devoted to self-esteem. Indeed, self-esteem is a topic that has been thoroughly disseminated to the general population to the point where most university undergraduates have some idea of what it means to have high self-esteem (Mruk, 2006). Yet, in spite of all this interest, the question remains as to whether researchers really understand the meaning of self-esteem.

Self-esteem is not a topic that is easily understood (Marsh & O'Mara, 2008). There are many different ways that researchers have conceptualized the construct. One of the more traditionally used broad conceptualizations is that of Shavelson, Hubner, and Stanton (1976). These authors defined self-esteem as an individual's perception of himself or herself which is shaped through interactions with significant others, environmental reinforcements, and attributions of his or her own behaviours. A person will therefore self-evaluate his or her own worth as a person either positively ("I am a great person"), representing high self-esteem, or negatively ("I am totally worthless"), indicating low self-esteem. Perceptions of future experiences and resultant behaviours will then be seen through the lens of an individual's own perceptions of his or her worthiness (e.g., "There is no point in trying to make friends because no one could like me"). This conceptualization of self-esteem has been highly influential in research. Morris Rosenberg is one of the originators associated with the viewpoint of self-esteem as a reflection of own feelings of worthiness. Rosenberg went on to create the Rosenberg

Self-Esteem Scale, one of the most frequently used measures in self-esteem research (Baranik et al., 2008; Roth, Decker, Herzberg, & Brahler, 2008).

Although self-worth is a main component of self-esteem for some researchers, other authors have also posited that self-esteem actually involves concepts of feeling competent and capable of handling life stressors (Cast & Burke, 2002). In this conceptualization, individuals would have low self-esteem if they believe that they are incapable of meeting the demands in their lives. Individuals with high self-esteem would believe in their own competence. From this perspective, self-esteem and self-confidence are quite similar concepts. Both concepts involve the belief, or disbelief, in one's own ability to handle challenges and succeed.

Although some researchers take a unidimensional approach to examining self-esteem and only examine worthiness (Baumeister, Smart, & Boden, 1996) or competence (Leary, Tambor, Terdal, & Downs, 1995), others endorse a more complex two-dimensional approach that encompasses both feelings of worthiness and beliefs about competence (Tafarodi & Milne, 2002; Tafarodi & Swann, 1995, 2001). According to this conceptualization, individuals with high self-esteem would feel they are "worthy" and that their abilities will allow them to have control over their lives. One group of studies found differential effects on memory when levels of worthiness versus competence conceptualizations of self-esteem were examined (Tafarodi, Marshall, & Milne, 2003; Tafarodi, Tam, & Milne, 2001). There was a negative association between feelings of worthiness and memory for words related to lack of social worth. Feelings of competence, however, were unrelated to memory for this same group of words. The reverse findings were found for word lists related to competence: there was a negative association between feelings of competence, but not worthiness, and memory for words related to failure. These findings

suggest that individuals low in each type of self-esteem were more likely to remember these words because they are more self-relevant.

Research has also been conducted with both types of self-esteem and personality characteristics. One study found that higher competence based self-esteem was more likely to be associated with greater emotional stability (Mar, DeYoung, Higgins, & Peterson, 2006). A study of the Big Five personality traits and types of self-esteem found that individuals high in worthiness based self-esteem were more likely to be conscientious and agreeable and less neurotic than those high in competence based self-esteem (Ramsdal, 2008). Individuals high in competence based self-esteem, however, were more likely to be extraverted and open to experience. Based on these studies, it would appear that researchers can expect differential findings depending on how they conceptualize self-esteem.

Further complicating the exploration of self-esteem is whether researchers are examining the concept as either a trait or a state. When an author refers to trait self-esteem, this usually is the conceptualization of an individual's level of self-esteem as a stable characteristic, akin to personality traits (Mruk, 2006). From this perspective, through genetics, environmental factors, or both, individuals will consistently experience themselves in a more positive or negative light. While research has shown some support for the overall stability of self-esteem through the life span, children and adolescents display a more unstable sense of self-esteem (Robins, Trzesniewski, Tracy, Gosling, & Potter, 2002; Trzesniewski, Donnellan, & Robins, 2003). One study found that females, in particular, experience a significant decline in trait self-esteem between the ages of 14 to 21, while male trait self-esteem remains stable during that same time period (Baldwin & Hoffmann, 2002).

State self-esteem, on the other hand, refers to how an individual thinks and feels about himself or herself in the present. Authors examining state self-esteem are typically more interested in how experiences can have an effect on the way an individual feels about himself or herself in that moment. Although a person may have an overall high level of self-esteem, state self-esteem researchers would assert that under particularly threatening conditions this person's self-esteem can plummet. Research also supports these findings in a wide variety of areas. Negative peer interactions have been shown to lower the state self-esteem of children over the course of a school day (Lehman & Repetti, 2007; Reynolds & Repetti, 2008). A meta-analysis of 128 studies of exercise and self-esteem found that individuals experience overall small increases in state self-esteem ($d = 0.23$) when they engage in physical activity (Spence, McGannon, & Poon, 2005). Taken as a whole these studies demonstrate that self-esteem can be unstable. Under the right circumstances researchers can induce significant changes in an individual's self-esteem.

There is a great deal of research implicating self-esteem as either a cause or consequence of a variety of emotions, physical symptoms, attitudes, and behaviours. For instance, low self-esteem is thought to be a significant risk factor in the development of depression (Orth, Robins, Trzesniewski, Maes, & Schmidt, 2009; Sowislo & Orth, 2012), while having high self-esteem may provide a buffer against the development of depression following significant negative life events (Abela, 2002). Researchers have also found that when an individual's self-esteem increases, feelings of anxiety and depression decrease (Wallis, 2002). Furthermore, high self-esteem is positively associated with self-reported levels of happiness (Cheng & Furnham, 2003). Self-esteem has also been studied in relation to medical issues such as heart disease, with those who have severe heart disease reporting lower self-esteem than individuals with mild to

moderate heart disease (Cohen, Mansoor, Langut, & Lorber, 2007). Possessing high self-esteem may also protect youth from engaging in activities detrimental to their health such as nicotine, alcohol, and drug use (Kavas, 2009).

To summarize thus far, self-esteem is undeniably one of the core topics in psychological research. In spite of, or perhaps due to, the difficulty in conceptualizing self-esteem, researchers have studied this topic in innumerable ways. This research has led self-esteem to be associated to one degree or another with most life experiences. Having high self-esteem would seem to be the ideal in order to maintain mental and physical health and be successful throughout life. Having low self-esteem, whether conceptualized as a trait or a state, appears to have many negative associations. While these associations seem to be well-supported by the research, some authors have proposed that self-esteem is a far more complex issue than previous research has suggested.

Controversy in Self-Esteem Research

Self-esteem research has been conducted for decades with high or low self-esteem being associated with a variety of positive and negative variables. However, not all researchers agree with these conclusions. There is currently a growing movement in psychological research suggesting that self-esteem is not as significant to well-being as researchers once believed.

An evaluation of past research into self-esteem was conducted by Baumeister, Campbell, Krueger, and Vohs (2003), who came to some interesting conclusions about the state of self-esteem research. The authors criticized past research, particularly the assertion that level of self-esteem is the cause of a variety of positive or negative effects, including increased or decreased performance, aggression, successful relationships, and happiness. They argued that high self-

esteem and happiness is the only domain in which past research may be correct in implicating causation.

The remainder of the research on self-esteem, according to Baumeister et al. (2003) has mixed findings. For example, regarding self-esteem and academic performance, the authors found that past experimental research where a child's self-esteem was increased through various methods did not actually result in an increase in grades. They argued that if self-esteem is really the cause of good academic performance, then grades or marks on exams should also improve. There also does not appear to be a strong relationship between job performance and self-esteem. The authors found that work success is more likely to increase levels of state self-esteem than self-esteem increasing success.

Low self-esteem has also been implicated as a cause of harmful actions including aggression, delinquency, and other types of antisocial behaviours. After reviewing the literature in these fields, Baumeister et al. (2003) concluded that there is little evidence to support the notion that people with low self-esteem are more likely to engage in socially undesirable behaviours. In fact, some studies found the opposite; having high self-esteem is associated with undesirable behaviours such as engaging in risky experimentation (e.g., smoking, alcohol, or drug use).

Baumeister et al. (2003) also examined the relationship between self-esteem and eating disorders, the latter by definition associated with negative body image (American Psychiatric Association, 2000). The overall picture of the research suggests that individuals with eating disorders, particularly bulimia nervosa, are more likely to also have low self-esteem. What could not be concluded from the studies that Baumeister et al. reviewed is whether low self-esteem is a causal factor in eating disorders, eating disorders cause low self-esteem, or whether it is a

bidirectional relationship. Baumeister et al. (2003) are not alone in their criticisms of past self-esteem research. Scheff and Fearon (2004) compared the vast amounts of past self-esteem research to a “whaling expedition that has caught, at best, minnows” (p. 73). They asserted that the lack of significant findings is not necessarily due to self-esteem being an unreliable concept. Rather, they proposed that it is the methods researchers have used that could account for inconsistency in self-esteem research. The authors argued that much of the research has relied on significance levels from correlational studies using large sample sizes. Although correlational studies can provide information about associations, they do not allow researchers to understand whether self-esteem may be a cause of behaviours, thoughts, and emotions. In addition, they noted that most of these studies relied on self-reported self-esteem from as many as 200 different types of self-esteem scales. Therefore, it is difficult to generalize the results from one study to another. Finally, the authors also criticized self-esteem research for not having a strong theoretical perspective and argued that if self-esteem cannot be defined then the research itself has very little validity. They asserted that many researchers who study this construct do not even include a conceptualization of self-esteem in their studies. Without a common definition or theoretical perspective, it makes it difficult for researchers to come to conclusions about the importance of the self-esteem construct.

Other researchers have also questioned what it means to possess high self-esteem and how it is measured. For example, Kernis (2003) proposed that high self-esteem can actually be divided into two categories: secure and fragile. Having secure self-esteem means having feelings of self-worth that are secure and stable. Individuals with fragile self-esteem may possess positive feelings about themselves, but those feelings are fragile and vulnerable to threat. As a result these individuals have to constantly engage in protective and self-enhancing strategies to

maintain their high self-esteem. Therefore, while two people may have high self-esteem a person with secure self-esteem may react quite differently in situations compared to those with fragile self-esteem. Research has shown that people do differ in their reactions to events depending on whether their self-esteem is secure or fragile (Kernis, 2005; Kernis, Lakey, & Heppner, 2008). Yet, Kernis (2003) noted that standard measures of self-esteem may not differentiate between individuals with secure and fragile self-esteem. He stated that items on the Rosenberg Self-Esteem Scale such as “I feel that I have a number of good qualities”, would likely be endorsed by individuals who had either secure or fragile high self-esteem. This suggests that standard questionnaires alone may not be sufficient to understand the complex nature of self-esteem

The notion that self-report measures are not necessarily valid measures of self-esteem would also seem to be supported by the field of implicit self-esteem. Implicit self-esteem is defined as an unconscious and automatic form of self-evaluation (Schroder-Abe, Rudolph, & Schutz, 2007). An individual has low implicit self-esteem, for example, if he or she has negative self-evaluations that are automatic but not necessarily consciously acknowledged. From this perspective, people present themselves, perhaps even unknowingly, in the way in which they want to be perceived rather than their actual attitudes. Researchers assess implicit self-esteem through methods such as the Implicit Association Test (IAT), which involves rapid categorization of words related to the self with either positive or negative words (Greenwald & Banaji, 1995). Individuals who are quicker to categorize self-words with negative words rather than positive words are thought to have lower implicit self-esteem.

Studies have supported the hypothesis that some individuals do possess differences in their explicit and implicit self-esteem. One particular study described findings from past

research in which individuals have explicitly endorsed high self-esteem, while implicit measures of self-esteem indicated that these individuals possessed negative self-evaluations (Zeigler-Hill, 2006b). Another study found that female university students who expressed high explicit self-esteem but low implicit self-esteem were more likely to endorse higher levels of narcissism (Jordan, Spencer, Zanna, Hoshino-Browne, & Correll, 2003). These findings suggest that self-reported levels of self-esteem may not provide a complete representation of this concept.

A meta-analysis has found moderate support for the predictive validity of the IAT (Greenwald, Poehlman, Uhlmann, & Banaji, 2009). This analysis found that when research examines more sensitive topics, such as self-esteem, the predictive validity of self-reports may decrease, but the predictive validity of implicit measures does not change. This observation supports the idea that self-reports may not be as accurate as measures that have less face validity, such as the IAT. A number of studies have also examined implicit versus explicit attitudes towards appearance (Grover, Keel, & Mitchell, 2003; Robertson & Vohora, 2008; Wang, Brownell, & Wadden, 2004). These researchers have found that individuals often hold more negative implicit attitudes towards overweight individuals than they explicitly reveal through questionnaires. Therefore, when researchers are examining more sensitive topics, the attitudes that participants explicitly report may not fully represent their true beliefs. If this is the case, then researchers may need to find methods beyond self-report measures in order to examine self-esteem.

In summary, authors have criticised past self-esteem research for multiple reasons: lack of conceptualization, reliance on self-report measures, and implication of causation from correlational studies. These criticisms are part of a growing voice in psychological research suggesting that there are significant problems with the way in which researchers have been

conducting self-esteem research. One of the issues this dissertation addresses is the lack of conceptualization of self-esteem in research. Although there are many ways to conceptualize the construct, the present study relied upon a relatively new model that could help to understand some of the discrepancies in self-esteem research.

Contingent Self-Worth

One of the more recent conceptualizations of self-esteem, contingent self-worth (CSW), was initially developed by Crocker and Wolfe (2001). These authors proposed that the variable results present in the self-esteem literature may be due to the consideration of self-esteem from only a perspective of whether it is typically “high” or “low” in individuals. Research, for the most part, has simply grouped individuals into high and low self-esteem categories with the assumption that this is a relatively stable characteristic. The authors suggest that two other factors also need to be taken into consideration; the contingencies upon which a person’s self-esteem hinges and the resultant stability of an individual’s self-esteem. According to Crocker and Wolfe (2001), a contingency is:

a domain or category of outcomes on which a person has staked his or her self-esteem, so that a person’s view of his or her value or worth depends on perceived successes or failures or adherence to self-standards in that domain. (p. 594)

What Crocker and Wolfe are suggesting is that “global” self-esteem is in actuality dependent on specific domains. Although the authors acknowledge that some people may have noncontingent self-esteem, in general they proposed that individuals vary on which domains provide the core of their feelings of self-esteem. The authors proposed a variety of domains such as competency, social approval, virtuousness, or even appearance as making up the core of someone’s overall feelings of self-esteem. They also asserted that people possess a variety of contingencies to their

self-esteem. However, these contingencies will vary in how important they are to someone's sense of self-esteem. For instance, to someone with a very strong religious background self-perceived virtuousness may be more integral to self-esteem than perceived physical attractiveness. Alternatively, the self-esteem for the CEO of a major corporation may be more contingent on perceived competence or successful competition than on being virtuous. The issue of global self-esteem therefore appears to be complicated by the fact that not all individuals are motivated by the same type of contingencies.

Further complicating the issue of individual self-esteem is Crocker and Wolfe's (2001) second proposal that the stability of an individual's self-esteem also should be taken into account. They contend that while some people are relatively stable in their level of high or low self-esteem, other people have greater fluctuations. The authors state that global self-esteem will then become contingent upon an individual's perceptions of his or her successes or failures in regard to the specific domains that are more important to his or her own self-worth. For example, if a person's physical appearance is the most important domain to his or her self-worth, then a compliment about appearance from another person is likely to result in a temporary boost to self-esteem whereas a critique may result in a devastating blow. Another example is that a failed exam would be more harmful to the self-esteem of someone with a core contingency of academic competence than to someone who possesses a lower need to achieve. At the same time the environment a person is surrounded by may help to keep self-esteem stable even if it is highly contingent. For instance, a person with self-esteem contingent on social approval who is surrounded by sycophants may maintain their self-esteem provided that this social network does not change.

What Crocker and Wolfe (2001) have proposed is that people who have more unstable self-esteem are more focused on finding evidence of their worth, or lack thereof, in the domains that have importance to them. This evidence can come from comments or actions from other people, successes or failures in academics or careers, or from exceeding or not meeting self-prescribed standards. The problem is that the feedback from these sources leads to only fleeting confirmations of self-esteem, which results in the person needing continual feedback in order to maintain a sense of self-esteem. Needing to pursue this self-esteem can lead to negative consequences in autonomy, relationships, and the ability to self-regulate emotions, which in turn can have detrimental long-term effects to both physical and mental health (Crocker & Park, 2004). For example, a person who has a high degree of social-approval CSW may need a great deal of reassurance from his or her romantic partner. This may lead to reassurance at first, but research has shown it can also lead to deterioration of the relationship when reassurance is continually sought (Lemay & Clark, 2008). Research has shown that individuals with higher levels of certain domains of CSW tend to interact with others in different ways (Zeigler-Hill, 2006a). The author found that people who base their self-worth on competition tend to report a hostile interpersonal style while individuals high in God's love or family CSW self-reported a more nurturing style.

A growing amount of evidence suggests that the conceptualization of CSW is an important area in which the research into self-esteem should continue (Crocker & Knight, 2005; Crocker, Luhtanen, & Sommers, 2004). These researchers argue that by understanding both the domains upon which people base their feelings of self-esteem and the stability of these feelings, researchers would gain a more accurate understanding of the relationship between self-esteem and numerous other psychological phenomena.

Contingent self-worth research. Since the theory emerged, CSW has been receiving attention from researchers in a variety of topics. There is a growing research base suggesting that CSW is a topic worthy of further study in the field of self-esteem. An obvious topic for CSW research is the examination of its relationship to global self-esteem. One study of Chinese university students examined whether the relationship between type and magnitude of contingency predicts global self-esteem (Hu, Yang, Wang, & Liu, 2008). The results of this study provided mixed support for the original theory of CSW, with only the domains of appearance and family having a relationship with global self-esteem. Those students high in appearance CSW, for example, were more likely to have unstable global self-esteem than students who were more contingent in domains related to ability. The authors argued that ability-related CSW is more “controllable” than appearance or family. They further asserted that if individuals base their self-esteem in a domain that they have little control over, they may be more likely to experience fluctuations in their self-esteem when that domain is praised or criticized.

Another area that has received some attention is the relationship between CSW and mood, particularly depression. A longitudinal study of college freshmen examined whether CSW was linked to vulnerability to depressive symptoms (Crocker, 2002; Sargent, Crocker, & Luhtanen, 2006). After following university students over the course of a semester, the authors found that those who endorsed higher degrees of external types of CSW (e.g., appearance, social approval, academics) were more likely to experience depressive symptoms, even when controlling for other factors such as sex or initial levels of depression. According to the authors, external types of CSW are those that rely on validation from outside sources such as comments from peers or academic grades. Internal types of CSW are those that are self-validated, such as

following one's own moral code (virtue CSW) or believing one is loved by God (God's love CSW). This finding did not hold for students who endorsed these more internal types of CSW.

Williams, Schimel, Hayes, and Martens (2010) recently conducted a multiphase study of external contingencies and produced similar results. These authors found that individuals with higher levels of external contingencies who had previously received false negative feedback about their social sensitivity consistently distanced their own personality traits from a socially insensitive individual. They were also less likely to endorse feelings of security and high global self-esteem. The defensiveness of these high external CSW individuals in the face of negative social comparisons was hypothesized to be a way for these participants to control their fragile sense of self-esteem. It would appear that basing self-esteem on external domains may lead to a more unstable sense of self-esteem, which in turn may also be associated with greater disruptions in mood.

A recent study of homosexual males examined the daily costs associated with having high CSW in external domains (Pachankis & Hatzenbuehler, 2013). These authors found that participants who had high academic CSW were more likely to be socially isolated. Furthermore, participants with high appearance CSW engaged in restricted eating. Finally, those participants with high competition CSW were more likely to be dishonest, argue with others, and experience emotional distress over the course of 9 days. The results of this study suggest that having high CSW in external domains can be associated with negative effects beyond low self-esteem and negative affect.

The research in external versus internal CSW suggests that individuals who base their self-worth in more external domains are more likely to experience a host of negative consequences, including changes in self-esteem and affect. This is similar to Kernis' (2003)

proposal of fragile self-esteem. While people with fragile self-esteem or those high in external contingencies can have high self-esteem, their self-esteem is not stable. If this is the case then it might be expected that individuals high in external domains of contingencies such as academics or appearance may be more vulnerable to experimental manipulations of self-esteem.

Academic competence CSW research. Crocker, one of the original authors of the CSW model, was interested in researching the importance of academic competence CSW when studying university students. One such study involved examining the CSW of both male and female engineering and psychology majors (Crocker, Karpinski, Quinn, & Chase, 2003). The authors were interested in whether greater instability of CSW is a risk factor for depressive symptoms. They also questioned whether female engineering majors have greater academic competence CSW because of their work in a typically male-dominated field. The results indicated that females displayed overall higher academic competence CSW than males, but there were no differences in level of CSW in engineering versus psychology majors. Further analyses revealed interaction effects for gender and academic competence CSW. Specifically, people higher in academic competence CSW had lower self-esteem, but this was even more pronounced for females. The study also found that female engineering majors higher in academic competence CSW were more likely to experience a significant drop in overall self-esteem when they received a poor grade. In regard to depressive symptoms, the authors found that possessing greater academic competence CSW predicted increases in depressive symptomatology, but only for students who were more depressed at the outset. This study indicates that the self-esteem of females, at least in the domain of academic competence, is more susceptible to external validation or invalidation than males.

Another recent study has focused on the academic competence CSW of African American college students (Griffin, Chavous, Coburn, Branch, & Sellers, 2012). These authors found that academic competence CSW could be divided into two categories: self-worth enhancing and self-worth dependent. Self-worth enhancing academic contingency means that while students may experience increases in self-esteem from doing well academically, they do not necessarily rely on academics to define their self-worth. On the other hand self-worth dependent academic contingencies mean that an individual's overall sense of self-esteem is dependent on academic success. Griffin et al. (2012) found that high self-worth dependent, but not self-worth enhancing academic contingency was associated with low self-esteem, greater depression symptomatology, and greater perceived stress. This finding suggests that individuals who rely on their academic performance to define their self-worth may be more vulnerable to low self-esteem and negative affect.

Academic competence CSW was further examined in a study on the relationship between this domain and actual academic performance (Lawrence & Crocker, 2009). Both male and female participants were told to either focus on performing well versus simply learning mathematical questions. The authors found that those with a high academic competence CSW were more likely to do poorly in performance tasks versus learning tasks. This finding could have occurred because students who place more importance on their academic success or failure are likely to have increased anxiety when performing academic related tasks. For these students with high academic competence CSW, doing well on an exam is about more than just getting a good grade; their self-esteem depends on their performance. One consistent finding in anxiety research is that the greater the anxiety a person experiences, the worse he or she will perform on

tasks (Burton, 1988; Humara, 1999). Therefore, individuals who are high in academic competence CSW may be more likely to fail and experience resultant low self-esteem.

Research has also been conducted with university students applying to graduate school: a population likely to have higher academic competence CSW. One study examined the role academic competence CSW played in self-esteem ratings following admission to or rejection from graduate schools (Crocker, Sommers, & Luhtanen, 2002). This study found that while admission and rejection letters had an effect on students overall, the resultant increase or decrease in self-esteem was significantly stronger for those who had higher levels of academic competence CSW, especially when they were rejected from graduate schools. Additionally, the authors found that daily reported levels of self-esteem had a greater association with overall affect for those who were high in academic competence CSW. Having high academic competence CSW therefore seems to be associated with greater instability in affect and self-esteem for individuals in an academic environment.

Appearance CSW research. Another area of CSW research that has been investigated is the relationship between appearance CSW and variables such as overall reported self-esteem, body image concerns, affect, and relationships. One recent study of Chinese university students found that appearance CSW moderated the relationship between appearance self-esteem and perceptions of self-competence (Geng & Jiang, 2013). Individuals with high appearance self-esteem and high appearance CSW had greater feelings of self-competence compared to participants with low appearance self-esteem but high appearance CSW. The authors suggested that this finding may be due to participants' beliefs that appearance can be controlled through cosmetics, exercise, or even cosmetic surgery.

Other researchers have examined potential mediators in the relationship between appearance CSW and appearance self-esteem in females (Noser & Zeigler-Hill, 2013). These authors sought to determine whether the relationship between appearance CSW and appearance self-esteem could be mediated by factors related to body consciousness. While females with high appearance CSW reported lower appearance self-esteem, this effect was mediated by body surveillance and body shame. The authors stated that females who base their self-worth on appearance were more likely to engage in greater body surveillance and have greater body shame, which was associated with lower levels of appearance self-esteem. Although this was a correlational study and therefore not able to show causation, the results suggest that possessing high appearance CSW may result in an individual who is highly focused on how she looks. This finding is consistent with Crocker and Wolfe's (2001) proposal that individuals with high contingent self-esteem in more unstable domains (e.g., appearance) fixate on finding evidence of their worth in that domain.

A series of studies was conducted to examine whether appearance CSW and self-esteem predict desire for social connection following threats to appearance (Park & Maner, 2009). In each of these studies participants engaged in tasks that involved threats to appearance (e.g., negative appearance feedback, writing an essay focused on their own body dissatisfaction). Across six studies the authors found that participants with high appearance CSW and high self-esteem responded to appearance threats by desiring closer contact with other people. However, participants with low self-esteem but high appearance CSW responded to threats with a desire to avoid social contact. The authors concluded that "responses to self-threat depend on an interaction between one's level of self-esteem and the extent to which one's self-worth is invested in the threatened domain" (Park & Maner, 2009, p. 213).

A recent correlational study of female college students examined the relationship between different types of CSW, ethnicity, and appearance satisfaction (Overstreet & Quinn, 2012). These authors found that although types of contingencies operated similarly across ethnic groups, different contingencies were associated with varying levels of appearance satisfaction. Females with higher levels of appearance and social approval CSW were more likely to engage in greater body surveillance and endorse lower levels of body satisfaction. However, participants who were more invested in other contingencies, such as academic competence, experienced greater appearance satisfaction.

Another study investigated the relationship between CSW and social networking behaviours (Stefanone, Lackaff, & Rosen, 2011). When the authors examined specific types of social networking they found that high appearance CSW was positively associated with the amount of photos a participant shared online. The authors speculated that photo sharing may be a way for high appearance CSW individuals to get the feedback they need to maintain their feelings of self-worth.

Some research has focused on the relationship between appearance CSW and disordered eating. A recent study examined the role that appearance CSW and body image discrepancies play in relation to self-esteem and disordered eating (Zeigler-Hill & Noser, 2013). After surveying 877 college females, the authors found that low global self-esteem was associated with greater levels of disordered eating. This relationship was then mediated by the degree of discrepancy between the participants' actual and ideal body image. However, this finding was further moderated by appearance CSW. Possessing higher levels of appearance CSW predicted greater discrepancies between actual and ideal body image. The findings demonstrated that females who had high appearance CSW but low global self-esteem had greater discrepancies

between their actual and ideal bodies, which were associated with higher levels of disordered eating.

Some researchers have examined whether appearance CSW would moderate the relationship between anxiety and disordered eating (Bardone-Cone, Brownstone, Higgins, Fitzsimmons-Craft, & Harney, 2013). The authors found that women with high levels of anxiety who also had high appearance CSW were more likely to engage in disordered eating behaviours. In examining specific types of disordered eating behaviours, the authors found that females with high anxiety and high appearance CSW who regularly engaged in appearance conversations with friends more frequently engaged in binge eating.

A further study sought to examine the potential relationship between appearance CSW, perceptions about what the opposite sex finds attractive, and reported body dissatisfaction and disordered eating behaviour (Bergstrom, Neighbors, & Lewis, 2004). The authors had both male and female university students rate male and female figures from their own perception of attractiveness as well as how they felt the opposite sex would rate the figures. Results of the study indicated that females who tend to overestimate male preference for thinness are more likely to also possess negative attitudes about eating if they endorse greater levels of appearance CSW. However, high appearance CSW was not associated with greater levels of disordered eating behaviours for female participants. For males, there was not a significant association between appearance CSW and their perceived attractiveness ratings. However, males who reported higher appearance CSW did display more negative eating attitudes and behaviours. This study suggests that males and females who have high appearance CSW are also likely to endorse attitudes related to disordered eating.

Other authors have researched associations between CSW, relationship concerns, and body image (Sanchez, Good, Kwang, & Saltzman, 2008). Results indicated that for females, appearance CSW was a stronger predictor of body shame than for males in the study. However, for both males and females, relationship CSW was a significant predictor of body shame. This finding suggests that if an individual's self-esteem is highly contingent on whether he or she is in a relationship, then that person is more likely to experience shame about his or her appearance.

Society and the media have often been targeted as playing roles in the development of negative body image in both males and females (Hargreaves & Tiggemann, 2009; Want, 2009). Therefore, it is of no surprise that one researcher conducted a study to determine what role CSW may have in these associations (Vartanian, 2009). This was a two-part study examining the roles of self-concept clarity, internalization of societal standards, body image, and eating disturbances in both males and females. Consistent with previous research, the authors found that greater internalization of societal standards was associated with higher levels of body image and eating issues. It was also found that for females lower clarity of self-concept was also associated with greater internalization of societal standards. The second part of the study looked at appearance CSW and found that for the females, it actually mediated the relationship between clarity of self-concept and internalization of societal standards. This study suggests that for females, if an individual has difficulty in forming her own identity, she may be more likely to have appearance CSW and need to rely more heavily on external cues upon which to gauge her self-esteem.

A final study looked at the potential effects of self-objectification (i.e., a person's perceptions of how other people view his or her own body) in females with high and low appearance CSW and varying degrees of trait self-esteem (Breines, Crocker, & Garcia, 2008). The authors found that self-objectification had varying effects on the female participants

depending on degree of CSW and trait self-esteem. During self-objectification, females with higher appearance CSW and low trait self-esteem endorsed greater increases in perceived unattractiveness compared to participants with high trait self-esteem and similar levels of appearance CSW. Interestingly, the authors concluded that self-objectification can be either threatening or validating to the self depending on a female's level of trait self-esteem and appearance CSW. Therefore, when females are confronted with a potential threat to their appearance those who have both high self-esteem and high appearance CSW may not demonstrate as strong a reaction to that threat as individuals with low self-esteem and high appearance CSW.

To summarize thus far, the research on appearance CSW suggests that individuals who base their self-worth on appearance are more likely to also experience issues such as body dissatisfaction, negative affect, and low trait and state self-esteem. High appearance CSW also seems to be particularly common in females. Therefore, while the study of CSW is relatively new these findings suggest that researchers may need to consider an individual's CSW when studying complex issues such as self-esteem. Researchers may not only need to know whether an individual's self-esteem is high or low, but also the importance of domains of contingencies.

The model of CSW complements the criticisms of self-esteem research presented above. Baumeister et al. (2003) demonstrated that the results of self-esteem research are muddled. Crocker and Wolfe (2001) are suggesting that self-esteem is more complex than simply being high or low. Two people can have high self-esteem, but for completely different reasons. Furthermore, research has demonstrated that depending on types of contingencies an individual's self-esteem may be relatively stable or prone to fluctuations. Yet, researchers have continued to simply group people in high or low categories without consideration for the contingencies on

which people base their self-esteem. Therefore, it is hardly surprising that self-esteem research has not found more compelling results. The addition of CSW to studies of self-esteem may help to elucidate some of the findings. For example, Baumeister et al. (2003) reviewed a number of studies regarding correlations between self-esteem and academic performance and found only “a positive but weak and ambiguous relationship between self-esteem and school performance” (p. 11). Perhaps these weaker correlations are due to varying levels of academic CSW. There may only be a correlation between self-esteem and academics for the children whose self-worth is more strongly related to academic competence.

Although research into CSW has found compelling results, there are some ways in which it could be expanded upon and improved. First, most authors have chosen to focus on studying one domain of CSW (e.g., academic competence) and its association with various types of psychological phenomena. It would be interesting to discern whether such associations differ depending on the specific types of CSW that are investigated. If Crocker and Wolfe’s (2001) original model of CSW is correct, then individuals with higher CSW in one area versus another should react differently when exposed to an experimental situation that is characteristically associated with one type of CSW versus another. For example, an individual with high appearance CSW should experience decreases in state self-esteem when his or her physical manifestation becomes the subject of social evaluation.

Second, the majority of the studies of CSW utilize correlational rather than experimental research paradigms. Although correlational studies have led to some intriguing findings, they are not as capable of determining whether individuals experience drops in state self-esteem or affect when exposed to situations that challenge their self-esteem in CSW congruent areas. The dearth of experimental studies leaves several questions unanswered, including whether high

versus low appearance CSW individuals differ in their reactions to situations where they become the subject of social evaluation.

A third potential issue with CSW research is the use of the Contingencies of Self-Worth Scale (CSWS; Crocker, Luhtanen, Cooper, & Bouvrette, 2003). Studies of Crocker & Wolfe's (2001) model of CSW rely on the use of the CSWS. Other than the article outlining its development and psychometrics (Crocker et al., 2003), there is a dearth of research focused on the CSWS. Considering that any findings hinge on the use of this measure, it is surprising that there has not been more critical examination of the CSWS. While the psychometric properties of the CSWS have been examined (Crocker et al., 2003; Crocker & Wolfe, 2001), there has not been a great deal of experimentation with the questionnaire. Although some researchers have used factor analysis to create internal and external contingency scales from the CSWS (Sanchez & Crocker, 2005; Sargent et al., 2006), this does not challenge the construction of this scale. For example, the CSWS subscales are calculated as item means. Therefore, an individual's score on each subscale can only range from 1 to 7. Crocker and Wolfe (2001) found that the mean item means for all of the subscales ranged from a low of 4.2 for God's Love to a high of 5.5 for Virtue. With item means this high, researchers using the CSWS as designed may have to deal with restriction of range problems. Experimentation with how the CSWS subscales are created could produce even more compelling findings in the study of CSW.

Furthermore, the sole use of self-report measures to assess self-esteem has been the subject of controversy in self-esteem research. Findings from research in implicit and fragile self-esteem suggest that self-report measures may not present an accurate picture of an individual's self-esteem. Studies of CSW may therefore benefit from experimenting with more

objective methods of examining changes in self-esteem. Proposed biological correlates of self-esteem may be one fruitful next step in conducting research into both CSW and state self-esteem.

Heart Rate Variability and Self-Esteem

Heart rate variability. Researchers have also criticized the methodology of past research for almost exclusive reliance on subjective self-report measures of self-esteem (Scheff & Fearon, 2004). This area may benefit from using more objective measures of self-esteem. Recent research in psychology is beginning to examine biological markers of various phenomena previously studied through self-report measures, including the topic of self-esteem.

Heart rate variability (HRV) is one biological phenomenon that has been adapted from purely medical science to the field of psychological research (Porges, 2007). Authors are beginning to posit that there is a significant connection between HRV and a number of psychological phenomena (Thayer, Hansen, Saus-Rose, & Johnsen, 2009). While studies of changes in heart rate in relation to stressful situations have been common (Kraemer, Moergeli, Roth, Hepp, & Schnyder, 2008), studies of HRV in relation to psychological phenomena are only recently gaining in popularity. Heart rate studies generally track an individual's heart rate in response to stressors, with higher heart rates associated with greater levels of emotional response. HRV, on the other hand, refers to the variation in the beat-to-beat intervals of the heart (Acharya, Joseph, Kannathal, Lim, & Suri, 2006).

The autonomic nervous system (ANS) is an involuntary system responsible for regulating the sympathetic and parasympathetic nervous branches (Feldman, Meyer, & Quenzer, 1997). The sympathetic nervous system (SNS) is activated in situations where individuals perceive a threat to their physical or mental safety in the environment. The SNS is responsible for the activation of the in-born "fight or flight" response in which the body mobilizes its resources

against this outside threat to either attack or flee the situation. These resources include increasing both heart and respiration rates. Once the immediate danger is over, the parasympathetic nervous system (PNS) is quickly activated in order to help bring the internal processes back to homeostatic levels including the slowing of heart and respiration rates. These two branches of the ANS operate on the heart through the sinoatrial node (SA). The SA has been found to act as the heart's natural pacemaker, with the SNS increasing activation of the node and the PNS reducing its activation (Irisawa, Brown, & Giles, 1993). The SNS and PNS therefore work together to help the body maintain homeostasis.

Cardiac vagal tone represents the influence of the PNS on the heart. Researchers examine this influence by studying respiratory sinus arrhythmia (RSA), which indicates the overall variability in heart rate that occurs in rhythm with respiration (Martens, Greenberg, & Allen, 2008). In their article Martens et al. explained:

As we inhale, parasympathetic outflow increases, and so the interval between heartbeats is generally shortened. With exhalation, the parasympathetic system generally resumes its inhibitory influence on the heart and so the interval between beats is lengthened.

Therefore, little variability in heart rate because of respiratory rhythm indexes low PNS influence over the heart or low vagal tone. Greater variability in heart rate in time with breathing indexes more PNS influence or higher vagal tone. (p. 376)

Greater heart rate variability suggests flexibility in the body's responses to stressors, while little variability indicates less ability to adaptively respond to threats.

Those researchers studying HRV are interested in examining this interplay of forces on the heart and their possible associations with a number of phenomena. These studies appear to demonstrate that individuals vary in their level of HRV depending on such factors as age, sex,

and ethnicity. Findings have shown that as individuals age, HRV tends to decrease (Bonnemeier et al., 2003). Although there is some variability in the findings, research also generally suggests that females have higher HRV than males (Acharya, Kannathal, Sing, Ping, & Chua, 2004). Furthermore, African Americans tend to have higher resting HRV levels than Caucasians (Li et al., 2009).

Much of the initial research into HRV has been from the field of medicine, with the findings that low HRV has a number of significant negative health consequences, including coronary heart disease (van Ravenswaaij-Arts, Kollee, Hopman, Stoeling, & van Geijn, 1993). A review of the literature base on HRV and myocardial infarction found that those individuals with lower variability in heart rate following an infarction had significantly higher mortality rates than individuals with higher variability following a cardiac event, suggesting that PNS activity is a protective factor against further trauma to the cardiovascular system (Bilchick & Berger, 2006). Lowered HRV has also been observed in individuals with disorders of the nervous system, diabetes, and renal failure (Acharya et al., 2006). Although HRV can predict many of these conditions, it is not clear whether lowered levels of HRV are a consequence or a cause of poor physical health.

Although HRV has been investigated in relation to physical health, research is also beginning to be conducted in the behavioural sciences. It has been studied in general topics such as personality types (Martin et al., 2010; Williams, Rau, Cribbet, & Gunn, 2009), response to emotional stimuli (Beevers, Ellis, & Reid, 2011; de Jong, van Overveld, & Peters, 2011; Schwerdtfeger & Derakshan, 2010; Shiota, Neufeld, Yeung, Moser, & Perea, 2011), cognitive performance (Elliot, Payen, Brisswalter, Cury, & Thayer, 2011), and interpersonal relationships (Cosley, McCoy, Saslow, & Epel, 2010; Schneiderman, Zilberstein-Kra, Leckman, & Feldman,

2011; Smith et al., 2011; Uno, Uchino, & Smith, 2002). Researchers are also beginning to study HRV in relation to various mental disorders. This is also unsurprising especially considering the role the ANS is theorized to play in depression and anxiety disorders (Lehofer et al., 1997; Mussgay & Rüdell, 2004). In a study of over 2,000 individuals, both current and remitted cases of major depressive disorder were associated with lower levels of HRV than controls, however there was some indication that antidepressant medication may have contributed to this association (Licht et al., 2008). Whether HRV is a consequence or a cause of depression and anxiety is still not fully understood. One study has shown that biofeedback to increase HRV may have some promise as an adjunct treatment for depression (Siepmann, Aykac, Unterdörfer, Petrowski, & Mueck-Weymann, 2008). Other researchers have found that HRV is lower in individuals with PTSD who are exposed to trauma imagery when compared to control groups (Hauschildt, Peters, Moritz, & Jelinek, 2011). Another study of individuals with a fear of flying found that those with low HRV were more likely to report greater levels of anxiety when confronted with flying-related stimuli than those who had a fear of flying but higher levels of HRV (Bornas et al., 2005). Furthermore, HRV reactivity to mental stress tasks has been found to differ in individuals with different types of eating disorders (Messerli-Bürgy, Engesser, Lemmenmeier, Steptoe, & Laederach-Hofmann, 2010). These initial studies of HRV and mental disorders suggest that HRV could have significant implications in the development and treatment of mental disorders.

It seems clear that HRV has some promise in furthering psychological research through a biological understanding of processes that had been primarily investigated through self-report methods. A natural extension of this research would be the investigation of another phenomenon

that has been linked to topics that have included anxiety and depression; namely, the concept of self-esteem.

Heart rate variability and self-esteem research. Self-esteem researchers have begun to explore the association between self-esteem and HRV. One of the first articles to examine this issue, which will serve an important theoretical base for this dissertation, was by Martens et al. (2008). The authors proposed that one purpose of self-esteem is to act as a buffer against impending threats. They found evidence that self-esteem reduces threat response in a number of areas: terror management theory, attachment theory, self-affirmation theory, and the biopsychosocial model. Martens et al. described a parallel between the PNS acting as a buffer against the SNS response to threats and research into trait self-esteem as a protective factor against anxiety. In particular, they noted a study by Rector and Roger (1997) in which participants were asked to perform a public speaking task wherein half of participants had previously received a boost to state self-esteem via positive feedback prior to the speaking task. Those participants who received the self-esteem boost did not have as strong an increase in heart rate during the public speaking task compared to those who did not receive positive feedback. This study demonstrated that having a more positive sense of self-esteem, even if only for a short period of time, may prevent anxiety-provoking activities from being as stressful an experience for individuals. Therefore, having high self-esteem may protect individuals from feeling threatened by stressors, thereby preventing physiological changes (i.e., reductions in HRV) in response to threats.

Also included in Martens' et al. (2008) review was the conceptualization of CSW. The authors noted that "the contingencies that seem to strengthen and secure state self-esteem from drops also predict decreased threat responding" (Martens et al., 2008, p. 373). They stated that

past research indicates that when people are confronted with situations in which a more unstable domain of CSW (e.g., appearance) was made salient, people will engage in activities to defend themselves against the threat, such as making downward social comparisons. This would seem to indicate that individuals with high CSW are more likely to feel threatened by situations in which their self-esteem is challenged and perhaps have stronger SNS responses. The authors also reviewed the literature on the stability of CSW and found that studies support the notion that when state self-esteem is more stable, individuals are less vulnerable to threats to their self-esteem. This line of inquiry suggests that the more contingent an individual's self-esteem is the more likely he or she is to be threatened by situations that are congruent with the specific contingencies important to their sense of self-esteem. If this is true, then individuals high in certain domain-specific CSW should show reduced HRV in situations that challenge the contingencies that are most important to their self-esteem.

Martens et al. (2008) concluded this line of inquiry with recommendations for further research in the field of self-esteem and HRV. In particular, they noted that specific types of self-esteem (e.g., CSW) should be studied in relation to HRV. They stated, "it may be in particularly self-esteem relevant situations - situations in which one's self-concept and self-esteem are accessible or salient - that we find one's self-esteem predicts and affects vagal tone" (p. 382).

Although research into the HRV/self-esteem link is in its infancy, several recent studies have found support for the hypothesis that HRV may act as a correlate of self-esteem. Martens, Greenberg, Allen, Hayes, Schimel, and Johns (2010) measured HRV after participants received either positive or negative personality feedback. The authors found that participants who received positive feedback showed increased HRV compared to those who received negative feedback. This finding was further tested when the authors conducted a second experiment using

only participants whose self-esteem was primarily based on their intelligence. When these individuals were given either positive, negative, or no feedback related to their intelligence, participants who received positive feedback again had significantly higher HRV than those who received negative feedback. In a third study, the authors tracked the state self-esteem of participants over a 2-week period and then measured HRV. The authors found that participants who self-reported higher levels of daily self-esteem had higher HRV. Based on these findings the authors suggested that self-esteem and HRV are closely linked. However, what remains unclear are the circumstances under which this relationship is most likely to be observed.

Another study was conducted with university students who first completed a measure of trait self-esteem, then engaged in various mental stress tasks while their HRV was monitored (O'Donnell, Brydon, Wright, & Steptoe, 2008). The authors found that self-esteem predicted HRV during the stress task wherein participants were asked to make a speech while being videotaped and later rated for their performance. Consistent with the Martens et al. (2008) proposal, individuals with high self-esteem displayed less of a reduction in HRV during the speech task compared to participants with low self-esteem.

A further recent study examined potential sex differences in HRV and self-esteem (Schwerdtfeger & Scheel, 2012). These authors monitored the HRV of both male and female participants over the course of a day. Participants also frequently rated their state self-esteem and affect during their daily activities. There was a significant positive association between HRV and self-esteem, but only for male participants. Females had a nonsignificant negative association between HRV and self-esteem but were more likely than males to have a significant association between negative affect and low self-esteem. The authors hypothesized that males may be more vulnerable to physiological changes in self-esteem while females are more likely to

report subjective changes in affect. However, Schwerdtfeger and Scheel (2012) noted that “to elucidate these interactions, further experimental studies with the assessment of self-worth contingencies (e.g., Crocker and Wolfe, 2001) are certainly warranted” (p. 334).

The results of this line of research suggest that in stressful situations, HRV is likely to vary depending on an individual’s self-esteem. HRV therefore could be a biological correlate of an individual’s self-esteem. Simply put, the proposition is that individuals with low self-esteem have reduced cardiac variability in times of stress. Individuals with high self-esteem are more likely to maintain a greater degree of HRV when challenged by stressful circumstances. It is also intriguing that CSW was mentioned as an area for further exploration in many of the studies examining the HRV/self-esteem link. Contingencies of self-worth could be an essential part of this connection. Understanding the contingencies upon which people base their self-worth may help researchers to understand whether a stressor is likely to threaten a participant’s self-esteem. Furthermore, CSW research has demonstrated that having higher levels of certain contingencies can lead to a more unstable sense of self-esteem. Therefore, the HRV/self-esteem link may be most apparent in individuals with greater levels of CSW.

The Present Study

An array of past research has indicated that there are associations between an individual’s self-esteem and many different psychological phenomena (Lowery et al., 2005; Mruk, 2006). However, experts in the field like Baumeister et al. (2003) have noted that when the past research is examined “the benefits of high self-esteem are far fewer and weaker than proponents of self-esteem had hoped” (p. 38). Scheff and Fearon (2004) have further criticized self-esteem research for the lack of clear conceptualizations of self-esteem and the methods used for assessing this construct. This suggests that new methods for both conceptualizing and measuring an

individual's self-esteem need to be explored. Contingent self-worth, originally posited by Crocker and Wolfe (2001), is a newer method of examining self-esteem. This model has shown some promise in helping to understand why some individuals have more variable self-esteem than others. Studies of HRV, while a relatively recently investigated phenomenon in psychology, may likewise provide a newer method by which to investigate self-esteem. Specifically, the evidence presented by Martens et al. (2008) suggests that HRV may act as a biological correlate to an individual's self-esteem.

The study herein sought to expand upon the previous research on both CSW and HRV. To date, no published studies exist that examine both CSW and HRV in experimental research. Martens et al. (2008) proposed that self-esteem may predict HRV when individuals are feeling threatened. The model of CSW suggests that there are specific contingencies upon which individuals base their feelings of self-worth. Furthermore, the model also posits that possessing a greater investment in certain contingencies (e.g., appearance) is more likely to be associated with an unstable sense of self-esteem (Crocker & Wolfe, 2001). Therefore, when predicting HRV from self-esteem, the addition of CSW to the prediction as a potential moderator may further elucidate the psychological circumstances under which self-esteem is predictive of HRV.

A commonly used research paradigm to study cardiac reactivity (Cosley et al., 2010; Rector & Rodger, 1997) is the Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993). The original protocol for the TSST requires the participant to take on the role of a job applicant. While being observed by three individuals playing the role of a selection committee, the participant must stand and give an impromptu 5-min speech on why he or she should be hired for the job. Interestingly, research has demonstrated that HRV can change significantly when individuals are asked to engage in continuous speech (Beda, Jandre, Phillips,

Giannella-Neto, & Simpson, 2007; Bernardi et al., 2000), standing, and moving (Fortrat, Formet, Frutoso, & Gharib, 1999; Gamelin, Berthoin, & Bosquet, 2006). In short, speech and standing may confound the observed effects of social evaluative stress upon HRV. In an effort to minimize these extraneous influences upon HRV, in this study participants' HRV was continuously monitored as they underwent a variant of the TSST that does not require standing or engaging in continuous speech. Specifically, participants were instructed to engage in a role-play with the experimenter; the former as a therapist and the latter as a psychotherapy client taking on one of two highly scripted personal problems. The role-play was videotaped and participants were told that their skills as a therapist would be rated by research assistants trained in the assessment of therapy skills. This mimicked the TSST in that participants were not prepared ahead of time for the task and that the video recording would be reviewed by experts. While this approach does not have the immediate social evaluative component of the "selection committee", other researchers have found that the physical presence of confederates is not necessary in order to produce a significant stress response (Andrews et al., 2007; Jönsson et al., 2010). Also, unlike the original TSST participants do not discuss their own qualities, but instead take on the role of a therapist. Previous research has found that the social evaluative threat of the TSST is similar whether participants talk about their own qualities or those of a person they know (Wadiwalla et al., 2010). Therefore, while the therapeutic role-play used in the present study does vary from the original TSST protocol, previous research suggests that it should still be a significant social evaluative threat. Furthermore, the role-play adds another potential social threat with the participant therapist having to interact with her client rather than giving a speech.

Previous research has found that when individuals are involved in interviews such as this, they are rated by the experimenter as more anxious when the topic under discussion is self-

relevant, like personal emotional health (Spalding & Hardin, 1999). For the present study, appearance and academic problems were chosen as role-play scenarios as both issues are of some importance to the self-esteem of university students (Crocker, Luhtanen, Cooper, & Bouvrette, 2003). A central goal of the present study was to determine whether scenario-congruent self-esteem negatively predicts HRV reactivity. Specifically, individuals with low appearance (or academic) self-esteem should experience greater cardiac reactivity to the scenario-congruent role-play, as this would likely pose a greater psychological threat. In other words, does the specific scenario serve to moderate the relationship between self-esteem and HRV reactivity experienced during the role-play?

An additional issue for the present study is whether CSW may further moderate the relationship between scenario-congruent self-esteem and HRV. From a theoretical perspective, individuals who do not invest their self-esteem in a specific contingency of self-worth should experience little threat when exposed to interpersonal challenges related to this contingency. As a result, these individuals should demonstrate little HRV reactivity regardless of their level of self-esteem with respect to that particular contingency. However, individuals who do invest their self-esteem in a particular contingency should be more vulnerable to scenario-congruent threats and, consequently, have greater HRV reactivity when they also have scenario-congruent low self-esteem.

Participants in the present study also immediately reviewed their role-play video. Research has demonstrated that exposure to one's own visual image leads to increases in body dissatisfaction and negative affect (Rodriguez-Cano et al., 2009; Tuschen-Caffier, Vogele, Bracht, & Hilbert, 2003; Vocks, Legenbauer, Wächter, Wucherer, & Kosfelder, 2007). Therefore, having participants watch their own video allowed this study to further examine the

potential prediction of HRV reactivity from scenario-congruent self-esteem. Specifically, participants with scenario-congruent low self-esteem and congruent high CSW should experience greater cardiac reactivity during video review.

At the end of the experiment participants retrospectively reported their affect during both the role-play and video review tasks. Furthermore, experimenters viewed the participants' videos and rated participant anxiety. Affect was examined due to previous research suggesting that having low self-esteem is associated with higher degrees of negative and lower positive affect (Baumeister et al., 2003; Orth et al., 2009; Sowislo & Orth, 2012). Previous research has also found that having high CSW in appearance (Breines et al., 2008) or academics (Crocker et al., 2002) is associated with greater negative affect. Therefore, it was hypothesized that those participants who are predicted to be most threatened during the role-play (i.e., high CSW + low self-esteem) should also report negative affective reactions (i.e., low positive affect, high negative affect) following completion of the experimental tasks. These same participants should also be rated by experimenters as having greater levels of anxiety during the role-play.

In summary, the main hypotheses for this study are as follows:

1. Participants with low appearance self-esteem will experience greater HRV reactivity during role-play and video review when appearance concerns are targeted as the topic of discussion. However, this relationship will be further moderated by participants' degree of investment in appearance as a source of their self-worth; that is, their appearance CSW. Specifically, low appearance self-esteem should predict greater HRV reactivity under circumstances of high but not low appearance CSW.
2. Participants with low academic self-esteem will experience greater HRV reactivity during the academic failure role-play and video review. However, this will only

- occur if participants are also highly invested in academics as a source of their self-worth (i.e., academic CSW). Low academic self-esteem should predict greater HRV reactivity when participants have high but not low academic CSW.
3. Participants with scenario-congruent low self-esteem will report higher negative affect and lower positive affect during role-play and video review. These same participants will also be rated by observers as being more anxious during the role-play. However, this relationship will be further moderated by participants' degree of investment in the scenario topic as a source of their self-worth. For example, participants in the appearance scenario who have low appearance self-esteem and high appearance CSW should be most vulnerable to negative affective reactions (i.e., low positive affect and high negative affect) following completion of the experimental tasks.

Method

Participants

One-hundred and four female participants were recruited for this study from the Lakehead University student population through mass e-mail (see Appendix A) and advertisements posted throughout the campus (see Appendix B). Males were excluded due to documented sex differences in both HRV (Acharaya et al., 2004; Overbeek, van Boxtel, Westerink, 2012) and CSW (Buckingham, Weber, & Sypher, 2010; Crocker et al., 2003). Participants in eligible undergraduate psychology courses earned 1.5 bonus marks toward their final grade for their participation in the study. Those participants ineligible for bonus marks were given \$20 for completing the study. Participant information and consent forms (see

Appendix C) were made available to participants who followed a supplied web link to www.surveymonkey.com where they completed a battery of online questionnaires.

Materials

Demographic Questionnaire (see Appendix D). This questionnaire ascertained participants' age, ethnicity, marital status, and academic status.

Contingencies of Self-Worth Scale (CSWS; Crocker, Luhtanen, Cooper, & Bouvrette, 2003; Appendix E). The CSWS served as a moderating variable in the prediction of HRV from self-esteem during role-play and video review. This scale consists of 35 items that measure specific types of CSW proposed by the original authors as follows: Family Support, Competition, Appearance, God's Love, Academic Competence, Virtue, and Approval from Others. For this study, only the Appearance and Academic Competence subscales were used as moderating variables. A sample Appearance CSW question is, "My sense of self-worth suffers whenever I think I don't look good".

In an examination of the psychometric properties of the CSWS with college students, the test-retest reliabilities over three months ranged from a high of .92 (God's Love) to a low of .68 (Virtue) (Crocker et al., 2003). This same study also examined the convergent and discriminant validity of the CSWS and found that a global measure of self-esteem was negatively correlated with external types of CSW (Competition, Appearance, and Approval from Others).

Participants respond to questions on the CSWS on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The CSWS is scored by summing the five items on each subscale and dividing the score by 5 to produce a subscale item mean. For example, an individual would have a score of 7 on the Appearance subscale if he or she rated all of the items as 7. While this individual's score suggests a high degree of investment in appearance, what is

missing from this score is how much of this person's self-worth is invested in appearance versus other contingencies. For example, this individual may also have an item mean of 7 on Virtue, God's Love, Academic Competence, Competition, Approval from Others, and Family Support. Therefore, this person has many areas that are important to his or her sense of self-worth.

Another individual may also have an item mean of 7 on the Appearance subscale, but have item means of 1 on all other subscales. For this individual, appearance is the only important source of his or her self-worth. Crocker and Wolfe (2001) suggested that the "more contingencies of self-esteem a person has, the more psychological resources the person has for self-affirmation, and consequently the more possibilities for maintaining self-esteem in the face of negative esteem-relevant events" (p. 615). If a person has only one domain upon which to base self-worth, then a threat to this domain may be more stressful than if a person has multiple domains of investment. Consequently, for this study, the Appearance and Academic Competence subscale item means were converted into weighted indices representing the investment in a particular contingency relative to the total degree of investment in all CSWS subscales.¹ An example for the formula creating a weighted measure for CSWS: Appearance (CSWS: APP) is as follows:

$$\text{CSWS: APP}_w = \frac{\text{Appearance item mean}}{\sum (\text{all seven CSWS item means})}$$

Using the previous examples, the individual who had a score of 7 on the Appearance subscale but also scores of 7 on the other subscales would have a weighted appearance contingency of $7/49 = .14$. On the other hand, the person who had a score of 7 on the Appearance subscale but scores of 1 on the other subscales would have a weighted contingency score of $7/13 = .54$.

The weighted indices are problematic in the way just defined. The CSWS employs a 7-point Likert scale ranging from 1 to 7. As such, weighted indices can only range .14 - .54. An

¹ The published literature on the CSWS uses unweighted subscale item means. Our weighting of means is a novel approach to using this psychometric instrument.

individual who strongly disagrees with all of the items on a subscale would receive an item mean of 1. This increases the denominator in the above CSWS weighted formula, thereby reducing the range of possible scores. To remedy this problem, the following equation was applied to the original CSWS raw scores:

$$\text{CSWS: APP}_w = \frac{\text{Appearance item mean} - 1}{(\text{CSWS: Global} - 1) * 7} * 100$$

The CSWS: Global was created by summing the item means of all seven subscales and then dividing by 7 to create an overall subscale mean score. The reduction of both the numerator and denominator achieved by subtracting 1, along with the multiplication of the ratio by 100, allows each weighted percentage measure to have a full range from 0 to 100. In the previous example, the individual who had an item mean of 7 on the Appearance subscale but scores of 1 on all other subscales would now have a weighted percentage score of $(6/6)*100 = 100\%$. For this individual, 100% of his or her self-worth is contingent upon appearance. On the other hand, the individual who scores 7 on all subscales would have a weighted percentage score of $(6/42)*100 = 14.29\%$. For this person one seventh of his or her self-worth is contingent upon appearance. For the individual who places zero investment in appearance, the weighted percentage score would be $(0/35)*100 = 0\%$.

State Self-Esteem Scale (SSES; Heatherton & Polivy, 1991; Appendix F). The subscales of the SSES were used as independent variables in the prediction of HRV during role-play and video review. The SSES is a measure of an individual's level of self-esteem in the moment. It consists of 20 items over three subscales; Performance, Social, and Appearance. Items on the SSES are scored on a 5-point Likert-type scale ranging from 1 (*not at all*) to 5 (*extremely*). An example of an item from the Performance subscale is, "I feel as smart as others". For this study, the Performance subscale was used as a measure of academic self-

esteem. The Appearance and Social Evaluation subscales were used as measures of appearance and social self-esteem, respectively.

In a series of studies, Heatherton and Polivy (1991) examined the psychometric properties of the SSES in a college population. The authors found that the SSES had high internal consistency ($\alpha = .92$). Furthermore, all of the SSES subscales demonstrated strong positive correlations with global self-esteem ($r = .57 - .68$).

Post-Study Questionnaire (PSQ; Appendix G). This questionnaire was created in order to assess participants' retrospective affective experiences of the role-play and video review. The affective items were rated on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) and included items such as "shameful" and "pleasant". These items were subjected to factor analysis in order to create variables related to Positive and Negative Affect. These factors were then used as outcome variables in order to determine whether affect during role-play and video review could be predicted by self-esteem.

This questionnaire also included four items related to understanding and identifying with the client protagonist such as "I personally related to my client's problem". These items were used in exploratory analyses to examine whether self-esteem could also predict participants' identification with the client's issues.

Anxiety ratings. Experimenters rated the anxiety of the participants during their role-play as the therapist. One item, "She was anxious" was rated by experimenters on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Two experimenters conducted the ratings independently from one another after watching the participants' role-play videos. The experimenters were also unaware of the participants' level of CSW, self-esteem, or

HRV. The mean of experimenters' ratings on this item was calculated for the study². This variable was then used in the analyses to determine whether the regression model would also predict the experimenters' ratings of participant anxiety.

Video Recordings

Video recordings were analyzed in order to determine the percentage of time participants talked during the role-play. Audio for therapist and client were recorded on separate tracks. Therefore, the audio recordings for the participant had silences when the experimenter was speaking. Video files were opened in Vegas Movie Studio Platinum (Sony Creative Software Inc., Middleton, WI) and the participant audio track was selected. This track was then imported into AVS Audio Editor software (Online Media Technologies Ltd., United Kingdom). This software provides a tool to delete silences in below -10 dB for a minimum duration of 1000 ms. Once the silences were deleted only continuous speech remained. The duration of this speech (in s) was divided by 300, and multiplied by 100 to give a percentage of time the participant spoke over the entire 5-min role-play.

Cardiac Recordings

Participants were fitted with a Polar RS800 chest strap and heart rate wrist monitor (www.Polarusa.com). The Polar RS800 continuously recorded the RR intervals throughout the experiment with a sampling frequency of 1000 Hz. The recordings were then transferred to the Polar ProTrainer 5 software (Polar Electro Oy, Kempele, Finland). To correct for artefacts the RR interval data was then subjected to the default filter of a minimum beat protection zone of 6 beats min⁻¹ (Nunan et al., 2009). Following artefact removal the software substituted any errors with interpolated intervals calculated from differences between the previous and the following RR intervals (Nunan et al., 2009).

² See Results section for inter-rater reliability coefficient.

The psychometric properties of the Polar RS800 for measuring HRV have been analyzed and compared with the more traditional 12-lead ECG technology for measuring HRV (Nunan et al., 2009, 2008). These studies found correlations between both methods ranging from 0.85 to 0.99 for all measurements. It was noted that the Polar S810 system added negligible noise to the recordings and has the advantage of being a simpler and less expensive method of conducting HRV analyses in healthy populations.

The corrected RR interval data was then imported into Kubios HRV software (Biosignal Analysis and Medical Imaging Group, Kuopio, Finland). The Kubios program also includes an artefact correction function, which was used at the medium setting. The RR intervals were then used to create a power spectrum density estimate which is derived through a Fast-Fourier transformation (Tarvainen & Niskanen, 2008). This allows the function to be transformed from a time domain to a frequency domain. A recent study investigated the measurement fidelity of three HRV software programs, including Kubios (Jarrin, McGrath, Giovanniello, Poirier, & Lambert, 2012). The authors found that all three programs had excellent correspondence ($ICC_{avg} = 0.91$) for measures of HRV in the frequency domain.

Kubios provided both low (LF ms^2 ; 0.04 – 0.15 Hz) and high frequency (HF ms^2 ; 0.15 – 0.4 Hz) components as measurements of cardiac response. Although the raw power values of HF ms^2 and LF ms^2 can be used to examine HRV, this study utilized a conversion of high frequency normalized units (HFnu). The calculation of HFnu is as follows:

$$HFnu = \frac{HF \text{ } ms^2}{HF \text{ } ms^2 + LF \text{ } ms^2} * 100$$

Multiplying the ratio of HF ms^2 to HF ms^2 + LF ms^2 by 100 allows this number to represent the percentage of total power output accounted for by the HF ms^2 activity in a participant. For

example, the HFnu of a participant would be 100 % if no LF ms^2 activity was present during the recording.

HFnu is often referred to as a measure of sympathovagal balance. The HF ms^2 component has been linked to vagal activity while LF ms^2 is considered a marker for both sympathetic and parasympathetic activity (Burr, 2007; Montano et al., 2009; Thayer, Ahs, Fredrikson, Sollers, & Wager, 2012). In a review of previous studies authors found a reciprocal relationship between HF ms^2 and LF ms^2 , noting “increase in sympathetic activity seems to be associated with a simultaneous enhancement of its LF rhythm and, conversely with a decrease of its HF component” (Montano, Cogliati, da Silva, Gneccchi-Ruscione, & Malliani, 2001, p. 33). Therefore, HFnu represents an index of the modulation of the parasympathetic nervous system. High HFnu can be interpreted as greater HRV activity while low HFnu suggests decreased HRV.

The present study used HFnu as a measure of HRV for several reasons. First, experts in the field of the measurement and interpretation of HRV recommend the use of measures such as HFnu when experimenters are examining short duration HRV recordings (Task Force, 1996). Second, the conversion of HFnu into a percentage is much easier to understand and interpret compared to the raw power values of HF ms^2 (Burr, 2007). Third, although HF ms^2 can be used on its own for analysis, normalization solves the very common issue that HF ms^2 tends to be highly skewed to the right in most populations (Burr, 2007). The present study was no exception, with HF ms^2 being highly skewed in each of the four phases of the experiment. However, conversion to HFnu produced distributions closer to normal in all phases, with only the second phase still significantly skewed. Finally, HFnu is thought to be more generalizable across studies as the normalization process helps to mitigate differences that can be due to practical issues in HRV research, such as recording length (Burr, 2007).

Procedure

Participants were directed to complete the online psychometric battery of questionnaires that included demographics, CSWS, and SSES. Subsequently, participants used an online scheduler (<http://www.sona-systems.com/>) to book a 1-hr appointment to come to the laboratory located within the Department of Psychology. Average lag between questionnaire completion and participation in the laboratory experiment was 7 days. A timeline of experimental procedures is outlined in Figure 1. Upon arrival at the laboratory, participants were greeted by one of two female experimenters and fitted with the Polar RS800 chest strap and heart rate wrist monitor. Participants were then seated in a chair where they remained for the rest of the experiment. In order to minimize recording artefacts caused by movements, participants were instructed to keep as still as possible throughout the experiment and to avoid slouching or crossing their arms over their chests.

Participants first viewed a 5-min portion of the *Planet Earth* (Fothergill, 2006) video series. This provided a baseline level (Phase 1) of HRV for the participants. The segments of *Planet Earth* used for this study were selected for their neutral content (e.g., waterfall). Participants were next told they were going to role-play being a therapist (Phase 2), interviewing a client (the experimenter) with a scripted problem. Using the experimenter as the client mimics the social evaluative component of the TSST (Kirschbaum et al., 1993) in which a participant gives an interview in front of a panel of “experts”.

Participants were randomly assigned by the experimenter to either an appearance or academic problem scenario (see Appendix H for participant instructions and Appendix I for role-play scripts). The scenarios were highly scripted in order to make the content of each interview as similar as possible. Participants were told that the role-play was videotaped in order to be

later rated for performance by research assistants trained in the assessment of therapy skills. This served to emulate the TSST in that participants are not prepared ahead of time for the task and that the video recording will be reviewed by experts. Participants were then fitted with a microphone and a high-definition video camera was set up to record the participant's full body in a seated position. The experimenter was seated off camera approximately 1.5 m away from the participant. Participants then engaged in role-play interview for 5 min with the experimenter as the protagonist complaining of appearance concerns or academic failure.

Next, the experimenter connected the video camera to a 72-in high definition television in order for the participant to watch her role-play for 5 min (Phase 3) followed by completion of the PSQ. The final phase 4 of the experiment involved participants once again viewing a continuation of the *Planet Earth* video for 5 min. Participants were then given a debriefing form to complete (see Appendix J) and thanked for their participation.

Results

Analytic Strategy

The primary analytic technique used for this study was moderated multiple regression (MMR) which allows researchers to examine whether a moderating effect is present in the population based on sample data (Aguinis, 2004). Two moderating variables were investigated; CSWS and scenario. Consequently, the regression equation tests a model predicting the outcome variable Y from the predictor X and the moderators M and W . The initial equation illustrating this model is as follows:

$$Y = a + b_1X + b_2M + b_3W + e$$

where a is the least squares estimate of the intercept. The residual error term is e (Aguinis, 2004). The b values are the least-squares estimates of the population regression coefficients that

test potential conditional effects of X, M and W in predicting Y. According to Hayes (2013), b_1 “estimates the conditional effect of X on Y when both M and W are zero” (p. 303). In addition, b_2 estimates the conditional effect of M on Y when X is zero and W is held constant (Hayes, 2013). For b_3 , it is the conditional effect of W on Y with X being zero while holding M constant (Hayes, 2013).

In order to test for each of the 3 two-way interaction effects, product terms (e.g., $X \times M$) must be created between the predictor variable and each of the moderators and added to the regression model. The equation illustrating this model is as follows:

$$Y = a + b_1X + b_2M + b_3W + b_4X \times M + b_5X \times W + b_6M \times W + e$$

where b_4 through b_6 represent the least-squares estimate of the population regression coefficients for the product terms representing each of the two-way interactions (Aguinis, 2004).

In the final equation for the MMR, a product term is created between the predictor and both moderators ($X \times M \times W$) in order to test for a higher order three-way interaction. This equation tests whether the interaction effect of the two predictors (e.g., X and M) on Y is moderated by the third predictor (W) (Aguinis, 2004). The equation illustrating this model is as follows:

$$Y = a + b_1X + b_2M + b_3W + b_4X \times M + b_5X \times W + b_6M \times W + b_7 X \times M \times W + e$$

where b_7 represents the least-squares estimate of the population regression coefficient for the final product term representing the three-way interaction.

The present study utilized a MMR model in the prediction of HFnu (Y) from self-esteem (X), role-play scenario (M), and CSWS (W). The predictor variables (X) were three SSES subscales, with particular focus on SSES: Appearance and SSES: Performance. Whether the topic of the role-play was focused on appearance or academics served as the scenario moderator

(M). Participants' level of CSWS in either the Appearance or Academic subscales acted as the second moderator (W). Separate analyses were conducted on HFnu (Y) during role-play and video review, with baseline HFnu serving as the covariate in each instance. Using baseline HFnu as a covariate in MMR controls its influence in the relationship between the independent variables and the outcome variable.

According to Fleeson (2007), this analysis (i.e., using HFnu as a covariate) is recommended over the use of change scores or residualized change scores. He argued that change scores are not recommended because they are usually correlated with the outcome variable at baseline. Fleeson noted this correlation is problematic because the change scores reflect both change over time and the outcome variable at baseline. Therefore, it is difficult to determine whether any associations between the independent variables and change scores are due to actual change in the outcome variable or a relationship with the outcome variable at baseline. Fleeson also noted that because the change scores will contain variance from the baseline outcome variable it is also difficult to determine the direction of causality for any relationship between the independent variables and change score. Residualized change scores, while independent of the baseline outcome variable, are problematic because baseline outcome is still potentially associated with the independent variables (Fleeson, 2007). Therefore, Fleeson recommends using the baseline outcome variable (i.e., HFnu) as a covariate because it removes the influence of the baseline outcome variable from both the independent variables and the outcome variable.

All of the MMRs conducted in this study utilized the PROCESS macro for SPSS (Hayes, 2012). PROCESS uses an ordinary least squares path analytic framework to estimate conditional effects of variable X on Y, and moderator effects for M and W. It produces the unstandardized

regression coefficients for conditional effects as well as for two- and three-way interaction effects. The specific moderated moderation model tested in the present study is depicted in Figure 2.

MMR assumptions and best practices. When conducting MMRs there are certain assumptions about the population data that must be explored in the given sample. If these assumptions are violated researchers risk making inaccurate conclusions based on their analyses. A description of these assumptions and their application to this study are listed below. As these assumptions cannot be tested using the PROCESS macro, all but the first assumption were examined through regular SPSS analyses.

1. The homogeneity of error variance assumption specifies that the distribution of residuals is the same across moderator subgroups. This means that the predicted scores for the Y variable should be distributed across the regression line similarly for each of the moderator populations (Aguinis, 2004). Aguinis, Petersen, and Pierce (1999) developed the program ALTMMR as a tool for researchers to check whether this assumption is violated. The key statistic that can be generated from this program is Bartlett's M . Bartlett's M assesses whether the null hypothesis of homogeneity of error variance should be rejected. Additionally, the program provides DeShon and Alexander's heuristic which states that the F value in MMR may be negatively affected when the error variance in one subgroup is 1.5 times larger than another subgroup (Aguinis, 2004). Several analyses contained within this present study violated the DeShon and Alexander heuristic. As recommended by Aguinis (2004), all results in violation of this heuristic included James' J statistic and Alexander's A statistic to verify the moderated relationship. The J and A statistics are alternatives to the MMR F test that can be used to examine differences in subgroup regression slopes when there is heterogeneity of error variance

Aguinis 2004). If the J and A statistics are in agreement with the F statistic results, the MMRs in question can be considered valid in spite of violations of this assumption.

2. It is also important for residuals to exhibit homoscedasticity, which means that the variance is constant across values of each predictor (Aguinis, 2004). This assumption can be checked through examination of scatterplots with the regression standardized predicted values on the X axis and the regression standardized residuals on the Y axis. If this assumption is met the data points should be randomly and evenly displayed throughout the scatterplot (Field, 2009). Visual inspection of the scatterplots for the present study did not indicate a violation of this assumption.

3. The residuals in a MMR model must also be uncorrelated (Aguinis, 2004). The Durbin-Watson test, which checks for serial correlations among errors, can be used to examine this assumption (Field, 2009). The test statistic can vary between 0 and 4, with values below 1 and above 3 indicating a potential violation of this assumption. The Durbin-Watson values for the MMRs in the present study all fell within the accepted range.

4. MMR models also assume less than complete multicollinearity (Aguinis, 2004). Multicollinearity is a perfect relationship between predictors, which is problematic in MMR because it makes it difficult to assess the importance of each predictor (Field, 2009). One method of testing this assumption is through the tolerance statistic, which can be included with SPSS regression output. If this statistic is less than 0.1 for any predictor there may be serious problems with multicollinearity (Field, 2009). Examination of the tolerance statistics for the MMRs in the present study did not suggest any issues with multicollinearity.

5. The residuals in MMR should also be normally distributed (Aguinis, 2004). The normal distribution of these residuals can be examined through checks of histograms and P-P

plots provided with the SPSS output. Visual inspection of the plots in the present study did not indicate violation of this assumption.

6. Although the assumptions do not directly state that residuals should be checked for outliers, this step may be helpful to ensure the accuracy of the MMRs. The present study utilized the casewise diagnostics output from SPSS to examine conventionally defined outliers as $z > 3.29$ (Tabachnick & Fidell, 2007). One individual was identified as an outlier on three of the MMR analyses. However, when this individual was removed from the analyses there were no appreciable changes to the model prediction; therefore, that outlier was retained in all analyses.

7. Lastly, all predictors were first mean centered prior to the creation of product terms in order to aid in the interpretability of the MMR results (Hayes, 2012).

Data Preparation

Data was entered into SPSS v. 19. Examination of the data revealed 22 missing values from the online questionnaires, accounting for less than 1 % of the total data. On the SSES, six participants were missing one item, while two participants had two missing values apiece. Data was also missing on the CSWS on one item for seven participants, two items for one participant, and three items for one participant. Two participants were missing one item apiece on the PSQ. In all cases missing data points were replaced with prorated scores within individuals on the scales in question.

Data was also examined for univariate outliers, defined as $z > 3.29$ (Tabachnick & Fidell, 2007). The analysis revealed a total of six outliers from the online questionnaires, with two outliers on the CSWS: Academic, two outliers on CSWS: ACADw, one outlier on CSWS: Appearance, and one on the SSES: Performance. There was also an additional eight outliers on

the cardiac measures, with four HF ms² outliers and four LF ms² outliers. All univariate outliers were replaced with next highest score not meeting outlier criteria (Field, 2009).

Participants

One-hundred and four female participants completed the online questionnaires and laboratory session. Due to technical difficulties with the video or cardiac recordings, five and three participants were deleted, respectively, leaving a total of 96 participants for analyses. The mean age of participants was 21.72 years (SD = 5.70). The majority of participants identified their ethnicity as Caucasian (84.3 %), followed by First Nations (7.3 %), South Asian (2.1 %), African-Canadian (2.1 %), East Asian (1.0 %), Hispanic (1.0 %), and Other (1.0 %). With regards to marital status, the majority of participants were single (86.5 %), followed by common-law relationships (8.3 %), divorced or separated (4.2 %), or widowed (1.0 %). Most participants reported being enrolled in full-time studies (94.8 %), with a further (4.2 %) being part-time students, and (1.0 %) not a current student.

Psychometric Variables

Descriptive information and indices of internal consistency pertaining to the psychometric variables are presented in Table 1. Two of the variables, SSES: Social and CSWS: ACADw, were significantly skewed, with $z_{skewness} = (\text{skewness} - 0) / SE_{skewness}$ exceeding the convention of 1.96 consistent with $p < .05$ (Field, 2009). Following reflection of the negatively skewed SSES: Social, these two skewed variables were subjected to a variety of transformations as described by Field (2009). The natural log transformation produced $z_{skewness} < 1.96$ for CSWS: ACADw. The SSES: Social was slightly improved by the natural log transformation ($z_{skewness} = 3.10$). No other transformations produced $z_{skewness} < 1.96$ for SSES: Social. Therefore, the log transformed variables were used for the remainder of the analyses.

The Kolmogorov-Smirnov test (K-S test) was used to further check the normality of the distribution of the psychometric variables at each of the two levels of scenario. The K-S test checks for normality by comparing the scores from the sample to a normally distributed set of scores with the same mean and standard deviation (Field, 2009). This test was not significant for the psychometric variables used in the experiment. Therefore, these results suggest that, when analyzed at each level of scenario, the distributions for all psychometric variables were normal.

Descriptive information for the cardiac measures is presented in Table 2. The variable of primary interest, HFnu, was positively skewed ($p < .05$) during the role-play phase of the experiment. Consistent with the skewed psychometric variables above, HFnu during role-play was subjected to the natural log transformation, however this produced a significant negative skew ($z_{\text{skewness}} = -2.73$). Other attempts to resolve the skew (e.g., square root transformation) likewise failed. Consequently, raw HFnu was analysed.

Reactivity Check

It was predicted that HFnu would be reactive to the phases of the experimental manipulation; in particular, a decrease from baseline was expected during the role-play and video review tasks. To determine such, HFnu served as the dependent variable in a 2-between (scenario [appearance, academic]) \times 4-within (phase [baseline, role-play, video review, recovery]) mixed model ANOVA. Examination of Box's Test indicated the analysis did not violate the assumption of homogeneity of covariances matrices ($p = .094$). Mauchly's test indicated that the assumption of sphericity was not violated ($p = .531$). Levene's test was also not significant for any of the analyses, suggesting the homogeneity of variance assumption was not in violation. The main effect of scenario was not significant $F(1, 94) = 2.79, p = .098, \text{partial } \eta^2 = .03$. However, there was a significant effect for phase, $F(3, 282) = 28.18, p < .001, \text{partial } \eta^2 = .23$

(see Figure 3). The Scenario \times Phase interaction was not significant $F(3, 282) = 2.13, p = .097$, partial $\eta^2 = .02$. Simple nonorthogonal contrasts were conducted to examine differences between baseline HFnu and each the remaining three phases of the experiment (role-play, video review, and recovery). The results of the simple contrasts identified a significant decrease in HFnu from baseline to role-play ($p < .001$) and from baseline to recovery ($p = .040$).

Talk Time

The percentage of time participants talked during the 5-min role-play was $M = 32.29\%$ ($SD = 11.09$) which equates to approximately 97 s of talk time. This variable was regressed upon HFnu during role-play with baseline HFnu covaried and scenario serving as the moderator. Neither conditional effect of talk time and scenario, nor their interaction, were significant in the MMR (all $ps > .10$). These results confirm that amount of talk time did not influence HFnu during role-play.

Hypothesis 1

Recall the prediction that participants who are simultaneously low in SSES: Appearance and high in CSWS: APPw will experience greater HFnu reactivity during role-play and video review when appearance concerns are targeted as the topic of discussion. This was explored through a series of MMR analyses.

Role-play. Table 3 displays the first series of multiple regressions conducted using CSWS: APPw as a moderator in the prediction of HFnu during role-play³. Two covariates were initially used in the MMR; HFnu at baseline and the percentage talk time during the role-play. The latter was not a significant covariate in any of the analyses reported herein and it was therefore removed from the final MMR model. The model was conducted separately on each of

³ Identical analyses using unweighted CSWS: Appearance failed to produce any significant main or interaction effects with this variable, the detailed statistical results of which are not reported herein.

three SSES subscales in order to ascertain the specificity of the hypothesis that scenario-congruent self-esteem should uniquely predict subsequent HFnu reactivity during role-play. Scenario was coded such that 0 represented the academic scenario and 1 corresponded to the appearance scenario. As revealed in Table 3, contrary to this specificity hypothesis, two—not one—of the three SSES predictors emerged in statistically significant three-way interactions with the two moderators of scenario and CSWS: APPw in predicting HFnu. Regarding the MMR with SSES: Appearance as the predictor, there were no significant conditional or two-way interactions. However, consistent with hypothesis 1, there was a significant three-way interaction of SSES: Appearance \times CSWS: APPw \times Scenario, $t = 3.09$, $p = .003$, $\Delta R^2 = .068$, as depicted in Figure 4. Although Bartlett's M indicated homogeneous error variance (4.34, $p = .228$), the DeShon and Alexander heuristic was violated for this analysis. However, James' J statistic (13.65, $U_{crit} = 8.52$, $p < .05$) and Alexander's A statistic ($A = 11.92$, $p = .008$) both confirmed the presence of differential slopes, suggesting that although the homogeneity of error heuristic was violated, the MMR was accurate. Tests of the conditional two-way effect of the SSES: Appearance \times CSWS: APPw interaction at each level of scenario revealed that the two-way interaction was significant in the appearance scenario, $\beta = 0.36$ ($SE = 0.12$), $t = 2.98$, $p = .004$, but not the academic scenario, $\beta = -0.08$ ($SE = 0.08$), $t = -1.08$, $p = .282$. Analysis of simple effects revealed a significant slope for individuals in the appearance scenario who had higher levels of CSWS: APPw, $\beta = 1.85$ ($SE = 0.66$), $t = 2.82$, $p = .006$. Among such individuals, high SSES: Appearance was associated with high HFnu, a relationship not shared by their low CSWS: APPw counterparts. Importantly, and as predicted, this significant two-way interaction did not hold within the self-esteem-incongruent academic scenario.

Contrary to hypothesis 1, SSES: Social also produced a significant three-way interaction in the prediction of HFnu that was virtually identical to the results above for SSES: Appearance, $t = 2.18, p = .032, \Delta R^2 = .035$. Tests of conditional effects revealed that the SSES: Social \times CSWS: APPw interaction was significant for the appearance scenario, $\beta = 1.95 (SE = 0.83), t = 2.35, p = .021$, but not the academic scenario $\beta = -0.55 (SE = 0.79), t = -0.70, p = .486$. Tests of the homogeneity of variance assumption were contradictory, with Bartlett's M indicating homogenous variance ($2.07, p = .559$), while the DeShon and Alexander heuristic was violated. However, James' J statistic ($8.91, U_{crit} = 8.51, p < .05$) and Alexander's A statistic ($A = 7.95, p = .047$), verified differential slopes in the moderation. As shown in Figure 5, the only significant simple slope was for participants in the appearance scenario who also had high CSWS: APPw, $\beta = 11.40 (SE = 4.78), t = 2.39, p = .019$.

The final predictor in this series of MMRs, SSES: Performance did not produce any significant conditional effects or interactions. While the overall model was significant ($p < .001$), this was largely due to the significance of the HFnu baseline covariate ($p < .001$). Although the DeShon and Alexander heuristic was in violation, Bartlett's M indicated homogeneous error variance ($3.70, p = .296$). James' J statistic ($7.02, U_{crit} = 8.50, p > .05$) and Alexander's A statistic ($A = 6.43, p = .092$) further confirmed the lack of significant moderation. The lack of significance in the SSES: Performance \times CSWS: APPw \times Scenario three-way interaction does support the specificity of hypothesis 1 wherein only scenario-congruent self-esteem with CSW should predict HRV reactivity to the role-play.

Video review. Table 4 displays the MMRs conducted using CSWS: APPw as a moderator, this time in the prediction of HFnu during video review. A consistent finding was the statistically significant conditional effect for the scenario moderator variable in each analysis:

SSES: Appearance, $t = -2.03$, $p = .045$; SSES: Social, $t = -2.07$, $p = .042$; SSES: Performance, $t = -2.45$, $p = .016$. The significant scenario conditional effect may be interpreted thusly: Regardless of type or level of self-esteem or degree of investment in appearance as a source of self-worth, participants who engaged in the appearance role-play scenario had lower HFnu while they watched their video compared to those in the academic scenario. The obtained James' J and Alexander's A statistics for testing moderation effects further confirmed the MMR results demonstrating the absence of statistical significance in any of the two- and three-way interaction terms contained within each of the three separate MMRs. Such is contrary to hypothesis 1.

Hypothesis 2

It was hypothesized that participants in the academic role-play and video review would experience greater HFnu reactivity if they had low SSES: Performance and high levels of CSWS: ACADw. As above, this prediction was investigated through a series of MMRs.

Role-play. Table 5 displays the series of regressions predicting HFnu during role-play. Once again, the three SSES subscales were used to examine the specificity of the hypothesis that scenario-congruent self-esteem (i.e., SSES: Performance) would predict HFnu reactivity during the academic role-play. However, contrary to hypothesis 2, there were no significant conditional effects or interactions using SSES: Performance as a predictor of HFnu during role-play.

As shown in Table 5, the only MMR analysis that produced significant findings utilized SSES: Appearance as a predictor of HFnu during role-play. Although there was a significant conditional effect for CSWS: ACADw moderator, $t = -2.29$, $p = .025$, this was qualified by a significant three-way interaction for SSES: Appearance \times CSWS: ACADw \times Scenario, $t = 2.46$, $p = .016$, $\Delta R^2 = .045$. Analysis of the conditional effects at each level of scenario revealed that the interaction was significant in the appearance scenario, $\beta = 5.96$ ($SE = 2.53$), $t = 2.36$, $p = .021$, but not the academic scenario, $\beta = -1.59$ ($SE = 1.74$), $t = -0.91$, $p = .363$. As depicted in

Figure 6, the only significant simple slope was for individuals with high CSWS: ACADw in the appearance scenario, $\beta = 1.30$ ($SE = 0.59$), $t = 2.22$, $p = .029$. Therefore, individuals who had high investment in academics as a source of their self-worth and high appearance self-esteem demonstrated greater HFnu in the appearance scenario compared to individuals with low SSES: Appearance. These findings do not support hypothesis 2.

Video review. Table 6 displays the MMRs conducted using CSWS: ACADw as a moderator in the prediction of HFnu during video review. Once again, the only significant finding across all three analyses was a conditional effect for scenario: SSES: Appearance, $t = -2.53$, $p = .013$; SSES: Social, $t = -2.36$, $p = .021$; SSES: Performance $t = -2.36$, $p = .021$. James' *J* and Alexander's *A* further confirmed the lack of moderation in each of the three MMRs. Contrary to hypothesis 2, the pattern of the scenario conditional effect was the same across all types of SSES. Participants in the appearance scenario exhibited lower HFnu during video review compared to participants in the academic scenario. Furthermore, this result was consistent with the findings above using CSWS: APPw, suggesting that domain of investment did not make a difference in HFnu reactivity when participants were reviewing their role-play videos.

Summary. Thus far, the results have shown some support for the hypothesis 1. Participants who placed a higher importance on appearance as a source of their self-worth demonstrated greater HRV reactivity to the appearance role-play when they also had low appearance self-esteem. However, this relationship was not found for hypothesis 2; there was no predicted interaction between performance self-esteem, academic contingent self-worth, and scenario when predicting HRV during role-play. There were also no interactions in the prediction of HRV during video review. Instead, across all MMR models, participants who were

in the appearance scenario had lower HRV during video review compared to participants in the academic scenario.

Hypothesis 3

It was predicted that participants with scenario-congruent low SSES and scenario-congruent high CSWS would be rated as more anxious and retrospectively report greater negative affect and lower positive affect during role-play and video review. Before this hypothesis could be explored through MMR, it was first necessary to create the two affect variables derived from the PSQ, a questionnaire of participants' reported feelings during their role-play and video review (see Appendix G). Two separate factor analyses were conducted on the nine items of this questionnaire; one for affect during role-play and the other for affect during video review. A principal component analysis (PCA) with orthogonal rotation (varimax) was used. The Kaiser-Meyer-Olkin statistic for role-play ($KMO = .76$) and video review ($KMO = .85$) items exceeded the suggested .5 level (Field, 2009), indicating the sampling adequacy was satisfactory. Bartlett's test of sphericity for role-play, $\chi^2(36) = 284.44, p < .001$ and video review, $\chi^2(36) = 450.83, p < .001$ verified that correlations were sufficiently large for the analyses. Two factors emerged in each factor analysis that exceeded Kaiser's criterion of eigenvalues greater than 1 (Field, 2009). Together, these two factors explained 57 % and 66 % of the variance for role-play and video review, respectively. As can be seen in Table 7, Factor 1 represents a Negative Affect (NA) factor while Factor 2 represents a Positive Affect (PA) factor. Both factors had good internal consistency for role-play, with Cronbach's $\alpha = .82$ and $.87$ for NA and PA, respectively. The internal consistency was also good for the video review factors, Cronbach's $\alpha = .82$ for NA and $\alpha = .87$ for PA. Based on the findings of the factor analysis, NA and PA item means were created by summing the raw scores of the items loading on the factor

and dividing by the number of items. These item means were then used as the dependent variable in a series of MMRs.

Recall, a third affective variable is experimenter-rated anxiety of the participant during role-play, the inter-rater reliability of which is $r = .45$. The two independent ratings were averaged across raters to produce a single score wherein higher values represent greater perceived anxiety in the participant. Table 8 displays the descriptive information for this anxiety variable along with self-reported NA and PA during role-play and video review.

Role-play negative affect. Table 9 displays the results of the MMRs with each type of CSWS and SSES predicting self-reported NA during role-play. The only significant results were conditional effects for SSES: Performance in both the CSWS: APPw, $t = -2.85, p = .006$ and CSWS: ACADw, $t = -2.89, p = .005$ MMR models. A scatterplot of the relationship between NA and SSES: Performance can be seen in Figure 7. Contrary to hypothesis 3, these results suggest that regardless of scenario or the domain of CSWS, participants who had high SSES: Performance retrospectively reported lower levels of NA during their role-play.

Role-play positive affect. The next variable explored using the MMR model was participants' PA during role-play. As can be seen in Table 10, only the MMR using appearance self-esteem as a predictor and CSWS: APPw as a moderator produced any significant findings. While there were no significant conditional effects, there was a significant SSES: Appearance \times CSWS: APPw interaction, $t = 2.03, p = .045, \Delta R^2 = .044$. Due to the absence of a three-way interaction with scenario, the latter variable was removed from the model and the regression rerun in order to further explore the simple slopes of the SSES: Appearance \times CSWS: APPw interaction. As displayed in Figure 8 the slope was significant for participants with high levels of CSWS: APPw, $\beta = 0.02 (SE = 0.01), t = 2.35, p = .021$ but not those of low CSWS: APPw, β

= -0.01 ($SE = 0.01$), $t = -0.75$, $p = .458$. Therefore, participants with greater investment in appearance as a source of self-worth were more likely to retrospectively report higher PA during role-play if they also had high appearance self-esteem.

Video review negative affect. As with NA during role-play, it was hypothesized that participants with scenario-congruent low SSES but high CSWS would experience greater negative affect compared to other participants when reviewing their video. The results of the six MMRs conducted for video review NA can be seen in Table 11. The first of these analyses examined SSES: Appearance with CSWS: APPw as a moderator. The only finding of significance for this model was a conditional effect for SSES: Appearance, $t = -4.70$, $p < .001$. As depicted in the scatterplot of Figure 9, higher SSES: Appearance is associated with lower retrospectively reported NA during video review. Contrary to hypothesis 3, this effect was not moderated by scenario or CSWS.

The next MMR used SSES: Social as the predictor of NA during video review with CSWS: APPw as a moderator. Although there was a significant conditional effect for SSES: Social, $t = -4.55$, $p < .001$, this was qualified by a significant two-way interaction for CSWS: APPw \times Scenario, $t = -2.53$, $p = .013$, $\Delta R^2 = .063$. In testing the assumptions for this model, the DeShon and Alexander heuristic was in violation, but Bartlett's M indicated homogeneous error variance (1.30, $p = .729$). However, James' J statistic (1.87, $U_{crit} = 8.54$, $p > .05$) and Alexander's A statistic ($A = 1.77$, $p = .621$) did not indicate any moderation. According to Aguinis (2004), when these results do not converge with the findings from the MMR F test, definitive conclusions cannot be made without further replication of the study. Therefore, as this result may be in violation of the homogeneity of variance assumption, no further analyses of this MMR will be discussed herein.

The third MMR analysis was conducted using CSWS: APPw as a moderator and SSES: Performance as the predictor. The only significant finding was a conditional effect for SSES: Performance, $t = -2.80$, $p = .006$. Similarly to the analysis using SSES: Appearance, as SSES: Performance increased, reported NA during video review decreased.

Another series of MMRs examining NA during video review was conducted, this time using CSWS: ACADw as a moderator. In each of these regressions there were conditional effects for the predictor variables SSES: Appearance, $t = -5.16$, $p < .001$, SSES: Social, $t = -4.35$, $p < .001$, and SSES: Performance, $t = -2.55$, $p = .013$. There was also a significant two-way SSES: Performance \times CSWS: ACADw interaction, $t = 2.13$, $p = .036$, $\Delta R^2 = .046$. However, the DeShon and Alexander heuristic was in violation for this analysis, while the J (3.98 , $U_{\text{crit}} = 8.51$, $p > .05$) and A ($A = 3.74$, $p = .291$) statistics did not indicate any moderation. Therefore, the two-way interaction found by the MMR F test was likely invalid. The significant conditional effects indicate that high SSES, regardless of the domain, predicts low NA among participants during video review.

Video review positive affect. PA during video review was also examined through a series of MMRs, the results of which are displayed in Table 12. The first group of MMRs predicting PA during video review used CSWS: APPw as a moderator. SSES: Appearance produced a significant conditional effect, $t = 4.10$, $p < .001$, which was qualified by a two-way interaction for SSES: Appearance \times CSWS: APPw, $t = 2.08$, $p = .040$, $\Delta R^2 = .035$. As can be seen in Figure 10 the slope was significant for participants with high levels of CSWS: APPw, $\beta = 0.16$ ($SE = 0.03$), $t = 5.15$, $p < .001$ but not those of low CSWS: APPw $\beta = 0.06$ ($SE = 0.04$), $t = 1.43$, $p = .156$. The results of this analysis provided partial support for hypothesis 3. Participants with greater investment in appearance as a source of self-worth retrospectively reported the

lowest levels of PA during video review if they also had low appearance self-esteem. The participants who had high CSWS: APPw and high SSES: Appearance reported the highest levels of PA. However, contrary to hypothesis 3, this relationship was independent of whether the participant engaged in the appearance or academic scenario.

The next MMR using SSES: Social as the predictor of PA during video review produced one conditional effect for SSES: Social, $t = 4.03$, $p < .001$. The J (0.20 , $U_{crit} = 8.52$, $p > .05$) and A ($A = 0.19$, $p = .979$) statistics confirmed the lack of moderation. This result indicates that participants who had high SSES: Social also reported higher PA during video review compared to participants with low SSES: Social.

In the model using SSES: Performance as the predictor variable there were significant conditional effects for SSES: Performance, $t = 2.18$, $p = .032$, and scenario, $t = 2.00$, $p = .049$. As with the above analyses, participants with high SSES: Performance also had high PA during video review. Furthermore, participants in the academic scenario reported lower PA than participants in the appearance scenario.

The final group of MMRs examining PA during video review were run using CSWS: ACADw as a moderator. In the three models there were significant conditional effects for SSES: Appearance, $t = 4.88$, $p < .001$, SSES: Social, $t = 4.42$, $p < .001$, and SSES: Performance, $t = 2.28$, $p = .025$. In the model using SSES: Performance as a predictor there was also a significant conditional effect for scenario, $t = 2.16$, $p = .033$, indicating that participants in the academic scenario reported lower PA. James' J and Alexander's A confirmed the lack of moderation in each of the three MMRs. The results of these MMRs demonstrate that participants who were high in SSES, regardless of domain, retrospectively reported higher levels of PA while watching their role-play videos. This finding mirrors the results for NA during video review in which

participants reported lower NA while watching their role-play compared to participants with low self-esteem in these domains.

Anxiety. The final affect variable, experimenter ratings of participant anxiety during role-play, was also examined through a series of MMRs. It was hypothesized that participants with scenario-congruent low self-esteem and high CSWS would be rated as more anxious during their role-play compared to other participants. The results of these analyses can be seen in Table 13.

The first series of MMR models to predict anxiety used CSWS: APPw as a moderator. In two models a significant conditional effect emerged for self-esteem: SSES: Appearance, $t = -3.51, p < .001$; and SSES: Performance, $t = -2.53, p = .013$. Participants who had low appearance or performance self-esteem were rated by the experimenters as more anxious during their role-play compared to participants with high self-esteem in these domains.

The MMR for SSES: Social conditional effect verged on significance, $t = -1.96, p = .053$. However, there was a significant two-way interaction for SSES: Social \times Scenario, $t = -2.53, p = .013, \Delta R^2 = .071$. While the DeShon and Alexander heuristic was violated, Bartlett's M indicated homogeneous error variance ($M = 1.4884, p = .685$). James' J ($8.94, U_{crit} = 8.54, p < .05$) and Alexander's A ($A = 8.09, p = .044$) both noted the moderation effect and showing that while this analysis may have violated the homogeneity of variance assumption, the MMR F test was valid. An examination of the simple slopes for the SSES: Social \times Scenario interaction revealed that the simple slope was significant for participants in the appearance scenario, $\beta = -1.12 (SE = 0.33), t = -3.43, p = .001$, but not the academic scenario, $\beta = 0.12 (SE = 0.32), t = 0.38, p = .704$ (see Figure 11). This interaction demonstrates that participants with low social

self-esteem who engaged in the appearance role-play were rated by the experimenters as more anxious than individuals with high SSES: Social.

The final series of MMRs utilized CSWS: ACADw as a moderator in the prediction of anxiety. For all three models there was a significant conditional effect for the SSES predictor: SSES: Appearance, $t = -3.03$, $p = .003$; SSES: Social, $t = -2.06$, $p = .043$; and SSES: Performance, $t = -2.85$, $p = .005$. There were also significant two-way interactions for SSES: Appearance \times Scenario, $t = -2.80$, $p = .006$, $\Delta R^2 = .072$; and SSES: Social \times Scenario, $t = -2.53$, $p = .013$, $\Delta R^2 = .071$. However, both of these analyses violated the DeShon and Alexander heuristic. In each analysis James' J and Alexander's A did not find any evidence of differential slopes. Consequently, these results simply demonstrate that higher SSES in any domain was associated with lower experimenter ratings of anxiety during role-play.

Summary. The results of these MMRs provide partial support for hypothesis 3. For PA during both role-play and video review it was found that participants with higher CSWS: APPw were more likely to retrospectively report higher PA if they also had high SSES: Appearance. However, For NA during role-play there was only a significant conditional effect for SSES: Performance (i.e., higher self-esteem = lower NA). Having high self-esteem in any domain was also associated with lower NA during video review, regardless of scenario or CSWS. For experimenter-rated anxiety, it was found that higher SSES in any domain was associated with lower ratings of anxiety during role-play. Furthermore, participants in the appearance scenario with high social self-esteem were rated as less anxious than their counterparts with low SSES: Social.

Exploratory Analyses

Four remaining items on the PSQ pertaining to identification with the protagonist were subjected to a principal component analysis (PCA) with orthogonal rotation (varimax). Sampling adequacy was satisfactory, with the Kaiser-Meyer-Olkin statistic ($KMO = .61$) exceeding the .5 level (Field, 2009). Bartlett's test of sphericity $\chi^2(6) = 145.42, p < .001$ confirmed that the correlations were sufficiently large for the analysis. Two factors exceeded Kaiser's criterion of eigenvalues greater than 1 (Field, 2009). Together, these two factors explained 83 % of the variance. Factor 1 (Identifies) explained 58 % of the variance, while Factor 2 (Understands) accounted for 25 % of the variance. However, only Identifies will be discussed in this dissertation because the exploratory analyses using the Understands variable did not produce any significant findings. As can be seen in Table 14, the first factor, Identifies, was related to the participants' identification with their client's issue. The internal consistency for Identifies was Cronbach's $\alpha = .87$. In order to conduct the MMRs, the item mean for identifies was created by summing the raw scores of both items loading on the factor and dividing by 2. This variable was significantly negatively skewed ($z_{\text{Skewness}} = -2.39$) and was therefore reflected and subjected to the natural log transformation. Following transformation, identifies ($M = 1.93, SD = 0.54$) was no longer significantly skewed. The transformed item mean score was then used as the dependent variable in a series of MMRs.

Identifies. It is possible that participants with scenario-congruent low SSES and high CSWS were more likely to identify with their client's issue. This possibility was explored through a series of MMRs, the results of which are displayed in Table 15. The results were consistent across all of the analyses regardless of the domain of SSES or CSWS moderator. The only finding was a significant conditional effect for the SSES subscale variable in each of the analyses. There were no significant interactions in any of the models, which was confirmed by

the *J* and *A* statistics. Participants with low self-esteem reported high levels of identification. Neither topic of the role-play nor domain of self-worth moderated this relationship. An example of the relationship between SSES: Appearance and identifies in the model using CSWS: APPw as a moderator is shown in Figure 12.

Discussion

The purpose of the current study was threefold. First, it sought to expand on Martens' et al. (2008) proposal of the link between self-esteem and HRV by determining whether scenario-congruent self-esteem negatively predicts HRV reactivity during an experimental role-play and video review. The second purpose was to determine whether CSW would moderate the proposed relationship between scenario-congruent self-esteem and HRV. Although authors have suggested further examination of the role of CSW in the relationship between self-esteem and HRV (Martens et al., 2008; Schwerdtfeger & Scheel, 2012), to date, no published studies have examined the relationship in experimental research. Finally, the present study also sought to determine whether CSW would moderate the relationship between self-esteem and affect. Before discussion turns to the findings that bear upon these purposes, key methodological aspects of the study are first emphasized; namely, the novel operational definitions employed for experimental challenge and the CSW variable.

Reactivity Check

The present study utilized a therapeutic role-play as a new variant of the TSST. Previous research has suggested that HRV can be confounded through standing (Fortrat et al., 1999; Gamelin, 2006) and continuous speech (Beda et al., 2007; Bernardi et al., 2000). The therapeutic role-play had the advantage of allowing participants to remain seated and did not require continuous speech. However, as this was a new approach it was essential to examine whether

participants would exhibit HRV reactivity to the tasks. The results showed a significant reduction in HRV and an increase in heart rate from baseline to role-play. This suggests that the therapeutic role-play was a significant stressor for participants. This is unsurprising as this task consisted of a number of factors participants might find challenging: being asked to perform a novel task, having their performance videotaped and later rated by experts, and engaging in a social interaction with a stranger. While the role-play task represented a significant stressor for participants, this was not true for the video review task. The video review task did not produce a significant reduction in HRV from baseline. However, considering that the results of the MMRs found that participants in the appearance scenario had lower HRV during video review, it may be that the video review task only acts as a stressor under specific experimental manipulations (i.e., role-play scenario discussing negative body image).

Unlike the original TSST, there was potential for variability in the amount of time each participant spoke during the role-play. Participant talk time had a range from a low of 41 s to a high of 236 s during the 5-min (300-s) role-play. As the amount of time the participant spoke could have been a significant confound, talk time was entered as a covariate for each of the role-play MMRs. However, talk time was not a significant covariate in any of the analyses. This suggests that any differences in HRV during role-play were not due to the amount of time the participant spoke during the role-play. The breaks while the client was speaking appear to have been sufficient in preventing the continuous speech issues that can confound HRV research (Beda et al., 2007; Bernardi et al., 2000). The present study demonstrated that participants experienced reductions in HRV during the role-play and that these reductions were not accounted for by the amount of time that the participant spoke. Therefore, therapist role-plays may be ideal for researchers who wish to study HRV reactivity under conditions of a social

challenge. This method may be particularly suited for researchers who want to examine HRV reactivity in relation to social constructs or interactions. For example, researchers have found links between compassion, social support, and HRV (Cosley et al, 2010). It would be interesting to see if individuals with higher degrees of compassion for others have different HRV reactivity during the therapist role-play compared to their less compassionate counterparts.

Weighted CSWS

All results using the CSWS were derived from a novel method of calculating the individual subscales. As described in the Method section, subscales on the CSWS are typically calculated by summing five items on each subscale and dividing the score by 5 to produce a subscale item mean. However, for the present study each subscale was converted to represent the weighted percentage of the participant's self-worth that is derived from each individual domain of contingency. This conversion was done for two reasons. First, as can be seen in Table 1, most participants had high item means for both CSWS: Appearance and CSWS: Academic. This result was consistent with previous administrations of the CSWS in a college sample (Crocker & Wolfe, 2001). If all participants have high investment in appearance, for example, then there may not be enough distinction between participants to make CSWS: Appearance an effective moderator; in other words, a restriction of range problem. Converting the item means to weighted percentages allowed a greater range of values.

The high item means for CSWS: Appearance and CSWS: Academic also raised the question of whether there would be differences in the moderation effect for participants with multiple areas of investment versus those who based their self-worth on few domains of contingency. A participant with an item mean of 7 for CSWS: Appearance, but also item means of 7 for all subscales may not be as vulnerable to appearance threats compared to a participant

with an item mean of 7 for appearance CSW but low item means for all other domains of contingency. The weighted percentage allowed a more complete picture of the participants' domains of contingency: not just the importance, but the comparative importance of a domain of contingency to self-worth.

For the present study, when item means (i.e., CSWS: Appearance and CSWS: Academic) were used in the MMRs there were no significant conditional effects or interactions. However, when the weighted CSWS measures were used there were a number of significant findings. These results make sense as the main role-play task in the present study was designed to threaten participants high in appearance or academic CSW. Participants who not just place a greater importance, but also a greater *reliance*, on one of these domains of CSW could be more threatened by the congruent scenario. The weighted percentage CSWS subscales were a key variable in several of the MMR analyses. This conversion may be useful for researchers examining the predictive value of CSWS subscales.

Role-play Hypotheses

It was hypothesized that participants who were in the appearance scenario and had low appearance self-esteem and high appearance CSW would experience greater HRV reactivity during role-play and video review. As predicted, those participants who placed a higher importance on appearance as a source of their self-worth demonstrated lower HRV during the appearance role-play when they also had low appearance self-esteem. This finding lends support for Martens' et al. (2008) proposal that HRV may represent a biological correlate for self-esteem under threatening conditions. In this case, having low appearance self-esteem was associated with lower HRV during a stressful role-play task. Individuals with low appearance self-esteem

may be more vulnerable to threats to self-esteem and therefore exhibit lower HRV as a physiological response to these psychological threats.

The proposal of a HRV/self-esteem link is appealing. As Martens et al. (2008) discussed, one function of self-esteem is to act as a buffer against impending threats. Heart rate variability is a measure of parasympathetic activity. Therefore, both self-esteem and HRV can be associated with threat response. The present study has shown that under certain conditions, self-esteem can predict HRV during a threatening task; a psychological construct predicted a physiological response to threat. This finding may have important implications for the study of self-esteem. Researchers have found that HRV is associated with health issues such as high blood pressure, diabetes, and myocardial infarction (Acharaya et al., 2006). If self-esteem predicts HRV it may also be an important contributor to these health concerns. An association between self-esteem and HRV also could help researchers to develop methods of increasing self-esteem. For example, HRV biofeedback has shown some promise in the treatment of depression and PTSD (Wheat & Larkin, 2010). This leads to the question of whether HRV biofeedback could be used to increase self-esteem. Furthermore, if biofeedback does increase self-esteem would this also mean that HRV would be less likely to decrease when self-esteem is threatened? The potentially reciprocal relationship between self-esteem and HRV could be an interesting area for further exploration.

The HRV/self-esteem link may also have implications for the measurement of self-esteem. Previously, self-esteem research has been criticized for relying too heavily on self-report measures, which can be subject to bias or impression management issues (Scheff & Fearon, 2004). With the results of the present study demonstrating correlation between self-esteem and HRV, it does raise the possibility of researchers using HRV as a measure of state

self-esteem. Researchers are often interested in examining changes in self-esteem during some form of experimental manipulation. However, having a participant complete a self-esteem questionnaire multiple times during an experiment can be problematic (e.g., Hawthorne effect). By utilizing HRV, researchers may be able to understand how an experiment is affecting self-esteem without having to use a questionnaire multiple times. Furthermore, with the current technology, obtaining HRV recordings is a fairly unobtrusive process. In the present study, participants simply wore a chest strap under their clothes. Therefore, using HRV as a self-esteem correlate could present a relatively simple, but advantageous method for examining changes in self-esteem.

However, Martens et al. (2008) also noted that the relationship between self-esteem and HRV would likely depend on context. Although participants had lower HRV during the role-play, it was only during the appearance scenario where participants showed differences in HRV depending on their level of appearance self-esteem. Therefore, hearing an individual talk about problems in an unrelated topic is not likely to be as great a threat to individuals with low appearance self-esteem. It should be emphasized that the content of the two scenarios was highly scripted. The only difference between the appearance versus academic scenarios was in replacing words such as “ugly” for “stupid”. These small changes made a significant difference in the HRV reactivity of participants with low appearance self-esteem. This suggests that researchers who want to examine the relationship between self-esteem and HRV would have to be careful in selecting the task serving as a threat to self-esteem. The task selected may need to be specific to the type of self-esteem under examination.

It is important to note that for the analysis using appearance self-esteem and appearance CSW there were no conditional effects or lower-order interactions. HRV reactivity during the

appearance scenario role-play could *only* be predicted from low appearance self-esteem when participants were also high in appearance CSW. The degree that participants invested their self-worth in appearance was pivotal to how threatening it was to hear another female discuss how much she dislikes her appearance. In spite of having low appearance self-esteem, participants who were low in appearance CSW did not exhibit lower HRV in the appearance scenario role-play. Even if participants did not feel good about their appearance (i.e., low appearance self-esteem), it was not threatening to hear the client discuss her appearance issues because these participants did not rely on appearance as a major source of their self-worth. This finding lends support for the notion that self-esteem is a complex issue. Baumeister et al. (2003) suggested that the benefits of having high self-esteem were overrated. If the present study had simply been a test of whether self-esteem can predict HRV reactivity the lack of results could have further supported the claims of Baumeister et al. (2003). However, in the present study having high self-esteem did appear to protect individuals who had high appearance CSW from exhibiting greater HRV reactivity. The key to the significant results was the interaction between self-esteem and CSW. Therefore, examining this issue from a more complex perspective may lead to a greater understanding of the benefits of high self-esteem.

Crocker and Wolfe (2001) proposed that people who invest their self-worth in more unstable, external contingencies (e.g., appearance) can become focused on finding evidence of their worth, or lack thereof, in the domains that have importance to them. If HRV can be considered a biological correlate of self-esteem, the results from the present study provide support for the previous research regarding the instability of self-esteem in individuals with greater investment in external sources of CSW (Crocker et al., 2003; Crocker et al., 2002; Hu et al., 2008). It may be that participants who already had low appearance self-esteem, but high

investment in appearance CSW, took the client's appearance issues as evidence of her own unattractiveness. This resulted in the lowest levels of HRV for anyone in the appearance scenario. Whereas participants who were equally invested in appearance CSW but had high appearance self-esteem may have taken these same criticisms as evidence of how much better they feel about their own appearance. These participants had the highest HRV levels of anyone in the appearance scenario. Therefore, basing self-worth on appearance can lead to more unstable self-esteem as evidenced by the differences in HRV of these two groups.

Contrary to predictions, in the analyses using appearance CSW as a moderator there was a significant three-way interaction using social self-esteem as the predictor variable. In fact, the interaction was virtually identical to the interaction using appearance self-esteem as a predictor. This raises the question of why the appearance scenario would be a threat to participants with low social self-esteem, but high appearance CSW. Examination of the SSES: Social subscale revealed that several of the items could be related to how participants feel about their appearance (e.g., "I feel displeased with myself" and "I feel self-conscious"). There was also a strong positive correlation between SSES: Social and SSES: Appearance ($r = .62, p < .001$), which would also support the similarities between social and appearance self-esteem. Furthermore, during the role-play the client discussed her appearance from a social context: comparisons of her appearance to her peers and how self-conscious she feels about her appearance during social activities. It could be that these discussions also increased the threat of appearance concerns for participants with low social self-esteem.

In the second hypothesis, it was predicted that participants low in performance self-esteem, but with high academic CSW would demonstrate greater HRV reactivity to the academic role-play. This hypothesis was not supported. The only finding of significance was a three-way

interaction between appearance self-esteem, scenario, and academic CSW. The pattern was the same as the previous interactions, with participants with low appearance self-esteem, but high academic CSW having lower HRV during role-play. This finding could be due to a significant correlation between CSWS: ACADw and CSWS: APPw ($r = .46, p < .001$). Considering that this study utilized females who were primarily young, university students, it is unsurprising that both appearance and academics would be important to their self-worth. If participants tended to be highly invested in both appearance and academics, then it would lead to similar interactions regardless of whether CSWS: ACADw or CSWS: APPw was used as a moderator.

It is interesting that performance self-esteem did not produce any interactions with academic CSW. Although the SSES: Performance subscale does include questions related to academics, the majority of the items are not nonspecific, such as, “I feel confident about my abilities”. This measure may not have been as specific to academic self-esteem as was needed to produce interactions with CSWS: ACADw. For future studies a measure of specific academic self-esteem should be used in order to determine whether it can predict HRV reactivity during the academic scenario.

In summary, there was mixed support for the hypotheses involving HRV reactivity to the role-play task. However, as predicted, participants in the appearance scenario with low appearance self-esteem but high appearance CSW had greater HRV reactivity. This finding highlights the importance of understanding the domains in which people invest their self-esteem. An individual’s reaction to a threat to a particular domain may not just depend on whether they feel good about themselves in that area, but also how much they *need* to feel good about themselves in that threatened domain.

Video Review Hypotheses

Embedded in hypothesis one and two were predictions of greater HRV reactivity during video review for participants with low scenario-congruent self-esteem and high scenario-congruent CSW. This prediction was not confirmed. A consistent finding across all analyses was that participants in the appearance scenario, regardless of self-esteem or CSW, had lower HRV during video review compared to participants in the academic scenario. While these findings do not support the hypotheses, the appearance scenario video review was likely threatening for several reasons. First, participants were exposed to their own image on a large high-definition television screen for 5 min. Previous research has established that body image exposure techniques (e.g., mirror exposure) can be associated in women with increased negative emotions, reduced self-esteem, and greater body dissatisfaction (Hilbert, Tuschen-Caffier, & Vögele, 2002; Rodriguez-Cano et al., 2009; Tuschen-Caffier, Vögele, Bracht, & Hilbert, 2003; Vocks, Legenbauer, Wächter, Wucherer, & Kosfelder, 2007). The research suggests that most females find body image exposure to be a threatening experience.

However, as all participants reviewed the video of their role-play, body image exposure alone cannot account for the HRV differences between the scenario groups. The difference between the two groups was likely due to the content of the role-play scenario. Participants had to look at their own images while hearing pejorative terms about appearance such as “fat” or “ugly”. The academic scenario group also had to look at their own images during video review, but without the negative statements about appearance. As a result, compared to the academic scenario participants, the video review likely comprised a “double dose” of threat for participants in the appearance scenario.

Furthermore, this situation has similarities to “fat talk”. Fat talk has been defined as social interactions focused on negative discussions about appearance and body weight and shape

(Warren, Holland, Billings, & Parker, 2012), common among female college students (Ousley, Cordero, & White, 2008). Researchers have found associations between fat talk and variables such as body dissatisfaction (Stice, Maxfield, & Wells, 2003; Tucker, Martz, Curtin, & Bazzini, 2007; Warren et al., 2012) and negative emotions (Gapinski, Brownell, & LaFrance, 2003; Salk & Engeln-Maddox, 2012). It has been further observed that, during social interactions, females who hear a peer denigrate her own appearance are expected to respond with negativity about her own appearance (Britton, Martz, Bazzini, Curtin, & LeaShomb, 2006; Tucker et al., 2007).

During the role-play, participants had to take on a positive role as therapist. They could not respond in a reciprocally negative fashion. However, during the video review participants did not have to respond in a positive manner. Although the social interaction was over, all participants, regardless of their self-esteem or CSW, still may have been triggered to think about their own appearance issues by listening to the client on the video. This effect may have even been heightened by the fact that they were also looking at images of themselves. Therefore, the appearance scenario video review may have led to lower HRV because participants felt compelled to degrade themselves in response to the client.

Positive Affect

It was hypothesized that participants with scenario-congruent low self-esteem would self-report lower levels of PA during role-play and video review if they also had scenario-congruent high CSW. The results provided some support for this hypothesis. Retrospective PA during role-play was predicted from an interaction between appearance self-esteem and appearance CSW. Participants with high appearance self-esteem and greater investment in appearance as a source of self-worth reported the highest levels of PA during role-play. Conversely, participants with low appearance self-esteem but high appearance CSW reported the lowest levels of role-

play PA. Although previous research has found that high self-esteem is associated with higher PA (Baumeister et al., 2003), there was not a conditional effect for appearance self-esteem. This interaction was only significant when participants also had high appearance CSW. Once again, degree of investment in appearance as a source of self-worth was essential in predicting participant affective reaction to the role-play. However, scenario was irrelevant in the interaction predicting PA during role-play. Considering that the interaction was between appearance self-esteem and appearance CSW, it might have been expected that there would be stronger reactions to the appearance scenario. One possibility for the lack of difference between the appearance and academic scenarios was the videotaping. Participants with low appearance self-esteem, but greater investment in appearance, may have had lower PA, regardless of scenario, because they were uncomfortable with being videotaped. Unfortunately, the PSQ did not include any items that examined participant reactions to being videotaped separate from their reactions to participating in the role-play.

This finding complements the results for predicting HRV during role-play using appearance self-esteem and appearance CSW. Participants with the lowest levels of PA during role-play also had the lowest HRV. This finding further strengthens the proposal that participants with low appearance self-esteem and high appearance CSW found the role-play task the most threatening. These participants exhibited this threat with both lower HRV and PA.

It should also be noted that the interaction between appearance self-esteem and appearance CSW also predicted PA during video review. This consistency suggests that both the role-play and video review tasks were the least threatening for individuals who had higher appearance self-esteem and also placed a higher value on appearance for their sense of self-

worth. These individuals felt more positive while being videotaped while they performed a novel task as well as having to watch the video of their performance.

Negative Affect

It was predicted that participants with scenario-congruent low self-esteem but high CSW would self-report greater levels of negative affect during role-play and video review. The results indicated that regardless of scenario or the domain of CSWS, only participants who had high performance self-esteem retrospectively reported lower levels of NA during their role-play. This is an interesting finding considering that SSES: Performance did not produce any significant conditional or interaction effects for the HRV analyses. However, it does make sense that participants who were more confident in their abilities did not feel as negative about performing a potentially threatening task.

The results also revealed that high self-esteem in any of the three domains was associated with lower retrospectively reported NA during video review. Individuals with low self-esteem felt worse while watching their role-play video. This result is reasonable as watching the video could be a negative experience for any domain of low self-esteem. Low appearance self-esteem participants might have reacted to how they looked during the role-play, low social self-esteem participants could have focused on how they interacted with the client, while low performance self-esteem individuals were feeling bad about how they performed as a therapist. Therefore, participants with low self-esteem in any domain could have found the video review to be a negative experience, and possibly for quite different reasons, in spite of whether they were in a congruent scenario or were highly invested in a particular domain of CSW.

Anxiety

Overall, the findings for experimenter ratings of participant anxiety during role-play indicated that lower self-esteem in any of the three domains was associated with higher anxiety ratings. However, a further interesting finding was that there was an interaction predicting experimenter rated anxiety from both social self-esteem and scenario. Participants in the appearance scenario who had low social self-esteem were rated as significantly more anxious than participants in the same scenario with high social self-esteem. Furthermore, level of social esteem made no difference to the experimenter anxiety ratings for participants in the academic scenario. This finding may be due to participant response to the scenarios. Although a formal content analysis was not conducted, the experimenters observed that participants in the academic scenario generally responded to the client with solutions to her feelings of inadequacy by giving tips for better study habits (e.g., studying in the library). In contrast, participants in the appearance scenario tended to focus on the emotions the client was experiencing. In other words, the appearance scenario may have invited a more personal discussion from the therapist participant than the academic scenario. This could be an issue for participants with low social self-esteem. Giving someone advice on study habits would not seem to require a high a degree of social skill. However, trying to make someone feel better about her appearance could make participants think they might be at risk for saying the “wrong” thing. It is logical that participants in the appearance scenario with low social self-esteem were rated as the most anxious. These participants already felt insecure about how they come across in social settings. Having then been put into a difficult social situation it is reasonable that these participants would display more anxious behaviours.

To summarize, the results from the MMRs predicting participant affect during role-play and video review did not provide full support for hypothesis three. While self-esteem did

generally predict affective response to role-play and video review, there was not a three-way interaction with scenario and CSW for any of the affect variables. However, the significant two-way interaction between appearance self-esteem and appearance CSW in the prediction of PA during both role-play and video review does suggest that CSW may be helpful in predicting affective responses to stressful experimental situations.

Exploratory Analyses

A final analysis examined whether the MMR model could predict participants' self-reported identification with the role-play client. The results revealed that participants with low self-esteem in any domain reported greater identification with the client. This finding was consistent, regardless of scenario or domain of CSW. This suggests that participants with low self-esteem could relate with the client's presented issues even if the topic under discussion may not have been a personally relevant concern. While it may be that participants could identify with the emotions the client was experiencing rather than the content, it should be noted that there were also strong correlations between the domains of self-esteem. That is, if participants had low self-esteem in one domain, they were also likely to have low self-esteem in the other measured domains.

It might be expected that participants who reported identifying with the client would have exhibited greater HRV reactivity. However, there were no significant correlations between identification and HRV during role-play ($r = -.06, p = .553$) or video review ($r = .08, p = .467$). Therefore, while participants with low self-esteem may have reported relating to or having the same problem as their client, their self-reported identification did not predict HRV reactivity. This is interesting because participants who identified with the client might have been most threatened by the role-play and video review. However, this does not appear to be the case. It

could be that for some participants with low self-esteem, hearing the client discuss how much she dislikes herself allowed for downward social comparison, thereby decreasing the threat to the participants' own self-esteem. Researchers have previously found that engaging in comparisons with people who are perceived as being worse off in a trait or ability make people feel better about themselves (Aspinwall & Taylor, 1993; Wheeler & Miyake, 1992; Wills, 1981; Wood, Michela, & Giordano, 2000). Therefore, hearing the client disparage herself may have helped the participants with low self-esteem to feel better about her own qualities.

The relationship between identification with the client and self-esteem is also intriguing when considering the significant three-way interaction for HRV during role-play. While participants with low appearance self-esteem identified with the client, it was only when appearance was integral to their self-worth that there was a significant reduction in HRV during the role-play. Once again, this demonstrates the importance of CSW in the proposed model. Participants with low appearance self-esteem may have identified with the client, but this did not result in HRV reactivity. The high appearance CSW, low appearance self-esteem participants went beyond identifying with the client to being threatened by what the client was saying, as exhibited by the lowered HRV.

Limitations

The present study is not without limitations. The most glaring issue is the use of SSES: Performance as a measure of academic self-esteem. Although this subscale does contain two items that can be related to academics, "I feel as smart as others" and "I feel that I have less scholastic ability right now than others", the remainder of the items are more generally related to performance self-esteem. Therefore, it is difficult to determine whether the lack of significant interactions using SSES: Performance can be ascribed to an invalid hypothesis or an inadequate

measure of academic self-esteem. If this study were to be replicated, questionnaires that were specific to academic self-esteem should be used.

The present study is also limited by the use of university females as participants. Although only females were recruited due to sex differences in both CSW (Buckingham et al., 2010; Crocker et al., 2003) and HRV (Acharaya et al., 2004; Overbeek et al., 2012), this does limit the generalizability of the findings. It would be interesting if this study was replicated using only male participants. Considering the aforementioned sex differences, it is quite possible that the results would be different.

A further issue with the present study was participant recruitment. In spite of the incentives of bonus marks or money, there was a great deal of difficulty in recruiting participants for the present study. At the end of each laboratory session, participants were informally asked what may have been the reason for lack of participation in the present study. Most participants responded that either the prospect of being videotaped or having to role-play being a therapist was intimidating for them or their peer group. This suggests that the sample obtained for this study may have been different from the university population. While it might be assumed that individuals who did participate in the present study had higher self-esteem, the means and standard deviations were comparable to those obtained by Heatherton and Polivy (1991). The psychometrics for the CSWS in the present study were also comparable to other university samples (Crocker et al., 2003; Crocker & Wolf, 2001). Therefore, while the participants may have been different from the university population, the differences did not manifest in the measures used for the present study.

Future Directions

Martens et al. (2008) proposed that CSW may provide an important link in the relationship between self-esteem and HRV. The present study has demonstrated that in certain situations CSW moderates the relationship between self-esteem and HRV reactivity. As the present study was novel in the examination of the relationship between self-esteem and CSW in the prediction of HRV, further replication efforts are warranted.

The results provide some support for the hypotheses using appearance CSW but not for academic CSW. Although the use of a measure of performance self-esteem may have been part of the reason for lack of significant results, an important issue is whether the experimental tasks represented a threat to self-esteem for those high in academic CSW. Would participants with high academic CSW have demonstrated similar HRV reactivity if the experimental design included an academic challenge such as a math test? Given the flaws in this study in regards to studying academic CSW, researchers who correct these issues may find results similar to those of the three-way interaction using appearance CSW during the role-play.

An area that may prove interesting is further exploration of specific types of CSW. Only two of the seven domains of CSW proposed by Crocker and Wolfe (2001) were utilized in the present study. One type of CSW that could be particularly threatened is approval from others. People high in approval from others CSW base their self-worth on what they believe other people think of them. The role-play task could be threatening for individuals with high approval from others CSW if the client discussed her beliefs that people do not like her instead of academic or appearance concerns. Furthermore, the role-play is an unfamiliar task for participants and they are unlikely to feel that they are doing well in their role as a therapist. Knowing that their performance will then be judged by experts would likely be more threatening for participants who base their self-worth on receiving approval from others. Approval from

others CSW would also be interesting to examine because it is highly associated with appearance CSW (Crocker et al., 2004; Crocker & Wolfe, 2001). If these two types of contingencies are associated, it may mean that the participants high in approval from others CSW could react to the role-play in a similar fashion.

Crocker and Wolfe (2001) also noted that approval from others, followed by appearance, may represent the most external types of CSW. It would be interesting to compare results utilizing internal types of CSW (i.e., virtue and God's love) versus external CSW. Researchers have previously found that individuals high in external contingencies were more likely to experience low self-esteem (Crocker et al., 2004; Williams et al., 2010) and depression (Crocker, 2002; Sargent et al., 2006). Therefore, participants higher in internal types of CSW may not be as vulnerable to threats to self-esteem represented by the experimental tasks utilized in the present study.

More research is still needed to understand the HRV/self-esteem link. Research in this area has produced some interesting initial findings (Martens et al., 2010; O'Donnell et al., 2008; Schwerdtfeger & Scheel, 2012). The present study has added to these findings by demonstrating a connection under specific circumstances. There was not a simple relationship between self-esteem and HRV during the therapist role-play. The link was only found when utilizing appearance CSW with the appearance scenario. Further replication of these results is certainly warranted. Moreover, research could focus on expansion of these results with different measures of self-esteem or alternative experimental tasks.

A potentially intriguing area for further research is whether specific populations may have stronger HRV reactivity during the experimental tasks. One group that would be interesting to examine is first year clinical psychology graduate students. Previous research has

shown that individuals applying to graduate school who have higher academic CSW experience greater decreases in self-esteem following rejection from graduate programs (Crocker et al., 2002). While the hypotheses related to academic CSW did not produce any significant results in the present study, a study involving individuals who may be more vulnerable to the threats presented by the therapist role-play could produce interesting findings. Clinical psychology graduate students would likely be more vulnerable to threats to self-esteem as the role-play task directly relates to their academic and professional goals.

Conclusion

The present study sought to determine whether a MMR model using self-esteem, scenario, and CSW would predict HRV and affective reactivity to role-play and video review tasks. While the MMR model was not significant for all analyses, the results do suggest the importance of both self-esteem and CSW in the prediction of HRV and affect. A particularly important finding was the three-way interaction between appearance self-esteem, scenario, and appearance CSW in the prediction of HRV reactivity during role-play. This interaction provides some support for Martens' et al. (2008) proposal that HRV could act as a biological correlate to self-esteem. These results also bolster the proposal that self-esteem is a far more complicated topic than many researchers have considered. Whether a person has high or low self-esteem may not be the only important information a researcher needs about a participant. Perhaps equally essential in predicting a participant's response to experimental tasks is an understanding of the participant's CSW. While the present study is a first to examine the association between self-esteem, CSW, and HRV, the results provide compelling evidence to warrant further investigation of this relationship.

References

- Abela, J. R. Z. (2002). Depressive mood reactions to failure in the achievement domain: A test of the integration of the hopelessness and self-esteem theories of depression. *Cognitive Therapy and Research, 26*, 531-552. doi: 10.1023/A:1016236018858
- Acharya, U. R., Joseph, K. P., Kannathal, N., Lim, C. M., & Suri, J. S. (2006). Heart rate variability: A review. *Medical and Biological Engineering and Computing, 44*, 1031-1051. doi: 10.1007/s11517-006-0119-0
- Acharya, U. R., Kannathal, N., Sing, O. W., Ping, L. Y., & Chua, T. (2004). Heart rate analysis in normal subjects of various age groups. *BioMedical Engineering Online, 3*, 1-8. doi: 10.1186/1475-925X-3-24
- Aguinis, H. (2004). *Regression analysis for categorical moderators*. New York: The Guilford Press.
- Aguinis, H., Petersen, S. A., & Pierce, C. A. (1999). Appraisal of the homogeneity of error variance assumption and alternatives to multiple regression for estimating moderating effects of categorical variables. *Organizational Research Methods, 2*, 315-339. Retrieved from <http://mypage.iu.edu/~haguinis/mmr/download/Aguinis,%20Petersen,%20and%20Pierce%201999%20ORM.pdf>
- Andrews, J., Wadiwalla, M., Juster, R. P., Lord, C., Lupien, S. J., & Pruessner, J. C. (2007). Effects of manipulating the amount of social-evaluative threat on cortisol stress response in young healthy men. *Behavioral Neuroscience, 121*, 871-876. doi: 10.1037/0735-7044.121.5.871
- Aspinwall, L. G. & Taylor, S. E. (1993). Effects of social comparison direction, threat, and self-esteem on affect, self-evaluation, and expected success. *Journal of Personality and*

Social Psychology, 64(5), 708-722. Retrieved from <http://www.apa.org/pubs/journals/psp/index.aspx>

AVS Audio Editor (Version 7.1) [Computer software]. United Kingdom, Online Media Technologies Ltd.

Baldwin, S. A. & Hoffmann, J. P. (2002). The dynamics of self-esteem: A growth curve analysis. *Journal of Youth and Adolescence*, 31, 101-113. doi: 10.1023/A:1014065825598

Baranik, L. E., Meade, A. W., Lakey, C. E., Lance, C. E., Hu, C., Hua, W., & Michalos, A. (2008). Examining the differential item functioning of the Rosenberg Self-Esteem Scale across eight countries. *Journal of Applied Social Psychology*, 38, 1867-1904. doi: 10.1111/j.1559-1816.2008.00372.x

Bardone-Cone, A. M., Brownstone, L. M., Higgins, M. K., Fitzsimmons-Craft, E. E., & Harney, M. B. (2013). Anxiety, appearance contingent self-worth, and appearance conversations with friends in relation to disordered eating: Examining moderator models. *Cognitive Therapy and Research*. Advance online publication. doi: 10.1007/s10608-013-9520-9

Baumeister, R. F., Campbell, J. D., Krueger, J. I., & Vohs, K. D. (2003). Does high self-esteem cause better performance, interpersonal success, happiness, or healthier lifestyles? *Psychological Science in the Public Interest*, 4, 1-44. doi: 10.1111/1529-1006.01431

Baumeister, R. F., Smart, L., & Boden, J. M. (1996). Relation of threatened egotism to violence and aggression: The dark side of high self-esteem. *Psychological Review*, 103, 5-33. doi: 10.1037/0033-295X.103.1.5

Beda, A., Jandre, F. C., Phillips, D. I. W., Giannella-Neto, A., & Simpson, D. M. (2007). Heart-rate and blood-pressure variability during psychophysiological tasks involving speech:

- Influence of respiration. *Psychophysiology*, 44, 767-778. doi: 10.1111/j.1469-8986.2007.00542.x
- Beevers, C. G., Ellis, A. J., & Reid, R. M. (2011). Heart rate variability predicts cognitive reactivity to a sad mood provocation. *Cognitive Therapy Research*, 35, 395-403. doi: 10.1007/s10608-010-9324-0
- Bergstrom, R. L., Neighbors, C., & Lewis, M. A. (2004). Do men find “bony” women attractive?: Consequences of misperceiving opposite sex perceptions of attractive body image. *Body Image*, 1, 183-191. doi: 10.1016/S1740-1445(03)00025-1
- Bernardi, L., Wdowczyk-Szulc, J., Valenti, C., Castoldi, S., Passino, C., Spadacini, G., & Sleight, P. (2000). Effects of controlled breathing, mental activity, and mental stress with or without verbalization on heart rate variability. *Journal of the American College of Cardiology*, 35, 1462-1469. doi:10.1016/S0735-1097(00)00595-7
- Bilchick, K. C. & Berger, R. D. (2006). Heart rate variability. *Journal of Cardiovascular Electrophysiology*, 17, 691-694. doi: 10.1111/j.1540-8167.2006.00501.x
- Bongers, K. C. A., Dijksterhuis, A. & Spears, R. (2009). Self-esteem regulation after success and failure to attain unconsciously activated goals. *Journal of Experimental Social Psychology*, 45, 468-477. doi: 10.1016/j.jesp.2008.12.007
- Bonnemeier, H., Wiegand, U. K. H., Brandes, A., Kluge, N., Katus, H. A., Richardt, H. et al., (2003). Circadian profile of cardiac autonomic nervous modulation in healthy subjects: Differing effects of aging and gender on heart rate variability. *Journal of Cardiovascular Electrophysiology*, 14, 791-799. doi: 10.1046/j.1540-8167.2003.03078.x
- Bornas, A., Llabres, J., Noguera, M., Lopez, A. M., Barcelo, F., Tortella-Feliu, M. et al., (2005). Looking at the heart of low and high heart rate variability fearful flyers: Self-reported

- anxiety when confronting feared stimuli. *Biological Psychology*, *70*, 182-187. doi: 10.1016/j.biopsycho.2005.01.002
- Breines, J. G., Crocker, J., & Garcia, J. A. (2008). Self-objectification and well-being in women's daily lives. *Personality and Social Psychology Bulletin*, *34*, 583-598. doi: 10.1177/0146167207313727
- Britton, L. E., Martz, D. M., Bazzini, D. G., Curtin, L. A., & LeaShomb, A. (2006). Fat talk and self-presentation of body image: Is there a social norm for women to self-degrade? *Body Image*, *3*, 247-254. doi: 10.1016/j.bodyim.2006.05.006
- Buckingham, J. T., Weber, A. M., & Sypher, A. K. (2010). Self-esteem and self-perpetuating effects of threat on contingencies of self-worth. *Self & Identity*, *11*, 360-385. doi: 10.1080/15298868.2011.591537
- Burr, R. L. (2007). Interpretation of normalized spectral heart rate variability indices in sleep research: A critical review. *Sleep*, *30*(7), 913-919. Retrieved from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1978375/pdf/aasm.30.7.913.pdf>
- Cast, A. D. & Burke, P. J. (2002). A theory of self-esteem. *Social Forces*, *80* (3), 1041-1068. doi: 10.1353/sof.2002.0003
- Cheng, H. & Furnham A. (2003). Personality, self-esteem, and demographic predictions of happiness and depression. *Personality and Individual Differences*, *34*, 921-942. doi: 10.1016/S0191-8869(02)00078-8
- Cohen, M., Mansoor, D., Langut, H., & Lorber, A. (2007). Quality of life, depressed mood, and self-esteem in adolescents with heart disease. *Psychosomatic Medicine*, *69*, 313-318. doi: 10.1097/PSY.0b013e318051542c

- Cosley, B. J., McCoy, S. K., Saslow, L. R., & Epel, E. S. (2010). Is compassion for others stress buffering? Consequences of compassion and social support for physiological reactivity to stress. *Journal of Experimental Social Psychology, 46*, 816-823. doi: 10.1016/j.jesp.2010.04.008
- Crocker, J. (2002). Contingencies of self-worth: Implications for self-regulation and psychological vulnerability. *Self and Identity, 1*, 143-149. doi: 10.1080/152988602317319320
- Crocker, J., Karpinski, A., Quinn, D. M., & Chase, S. K. (2003). When grades determine self-worth: Consequences of contingent self-worth for male and female engineering and psychology majors. *Journal of Personality and Social Psychology, 85*, 507-516. doi: 10.1037/0022-3514.85.3.507
- Crocker, J. & Knight, K. M. (2005). Contingencies of self-worth. *Current Directions in Psychological Science, 14*, 200-203. doi: 10.1111/j.0963-7214.2005.00364.x
- Crocker, J., Luhtanen, R. K., & Sommers, S. R. (2004). Contingencies of self-worth: Progress and prospects. *European Review of Social Psychology, 15*, 133-181. doi: 10.1080/10463280440000017
- Crocker, J. & Park, L. E. (2004). The costly pursuit of self-esteem. *Psychological Bulletin, 130*, 392-414. doi: 10.1037/0033-2909.130.3.392
- Crocker, J., Luhtanen, R. K., Cooper, M. L., & Bouvrette, S. (2003). Contingencies of self-worth in college students: Theory and measurement. *Journal of Personality and Social Psychology, 85*, 894-908. doi: 10.1037/0022-3514.85.5.894

- Crocker, J. Sommers, S. R., & Luhtanen, R. K. (2002). Hopes dashed and dreams fulfilled: Contingencies of self-worth and graduate school admissions. *Personality and Social Psychology Bulletin*, 28, 1275-1286. doi: 10.1177/01461672022812012
- Crocker, J. & Wolfe, C. T. (2001). Contingencies of self-worth. *Psychological Review*, 108, 593-623. doi: 10.1037/0033-295X.108.3.593
- de Jong, P. J., van Overveld, M., & Peters, M. L. (2011). Sympathetic and parasympathetic responses to a core disgust video clip as a function of disgust propensity and disgust sensitivity. *Biological Psychology*, 88, 174-179. doi: 10.1016/j.biopsycho.2011.07.009
- Feldman, R. S., Meyer, J. S., & Quenzer, L. F. (1997). *Principles of Neuropsychopharmacology*. Sunderland, MA: Sinauer Associates, Inc.
- Field, A. (2009). *Discovering statistics using SPSS (3rd ed.)*. London: Sage Publications Ltd.
- Fleeson, W. (2007). Studying personality processes: Explaining change in between-persons longitudinal and within-person multilevel models. In R. W. Robins, R. C. Fraley, & R. F. Krueger (Eds.), *Handbook of research in personality psychology* (pp. 523-542). New York, NY: Guilford Press.
- Fortrat, J. O., Formet, C., Frutoso, J., & Gharib, C. (1999). Even slight movements disturb analysis of cardiovascular dynamics. *American Journal of Physiology-Heart and Circulatory Physiology*, 277, 261-267. Retrieved from <http://ajpheart.physiology.org/content/277/1/H261.full.pdf+html>
- Fothergill, A. (Producer). (2006). *Planet Earth* [Motion Picture]. United Kingdom: BBC.
- Gamelin, F. X., Berthoin, S., & Bosquet, L. (2006). Validity of the polar S810 heart rate monitor to measure RR intervals at rest. *Medicine and Science in Sports and Exercise*, 38, 887-893. doi: 10.1249/01.mss.0000218135.79476.9c

- Gapinski, K. D., Brownell, K. D., & LaFrance, M. (2003). Body objectification and “fat talk”: Effects on emotion, motivation, and cognitive performance. *Sex Roles, 48*, 377-388. doi: 10.1023/A:1023516209973
- Geng, L. & Jiang, T. (2013). Contingencies of self-worth moderates the effect of specific self-esteem on self-liking or self-competence. *Social Behavior and Personality, 41*, 95-108. doi: 10.2224/sbp.2013.41.1.95
- Greenwald, A. G. & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review, 102*, 4-27. doi: /10.1037/0033-295X.102.1.4
- Greenwald, A. G., Poehlman, T. A., Uhlmann, E. L., & Banaji, M. R. (2009). Understanding and using the implicit association test: III. Meta-analysis of predictive validity. *Journal of Personality and Social Psychology, 97*, 17-41. doi: 10.1037/a0015575
- Griffin, T. M., Chavous, T., Coburn, C., Branch, L., & Sellers, R. (2012). Dimensions of academic contingencies among African American college students. *Journal of Black Psychology, 38*, 201-227. doi: 10.1177/0095798411414892
- Grossbard, J. R., Lee, C. M., Neighbors, C., & Larimer, M. E. (2009). Body image concerns and contingent self-esteem in male and female college students. *Sex Roles, 60*, 198-207. doi: 10.1007/s11199-008-9535-y
- Grover, V. P., Keel, P. K., & Mitchell, J. P. (2003). Gender differences in implicit weight identity. *International Journal of Eating Disorders, 34*, 125-135. doi: 10.1002/eat.10167
- Hargreaves, D. A. & Tiggemann, M. (2009). Muscular ideal media images and men's body image: Social comparison processing and individual vulnerability. *Psychology of Men & Masculinity, 10*, 109-119. doi: 10.1037/a0014691

- Hauschildt, M., Peters, M. J. V., Moritz, S., & Jelinek, L. (2011). Heart rate variability in response to affective scenes in posttraumatic stress disorder. *Biological Psychology*, *88*, 215-222. doi: 10.1016/j.biopsycho.2011.08.004
- Hayes, A.F. (2012). PROCESS: A versatile computational tool for observed variable mediation, moderation, and conditional process modeling [White paper]. Retrieved from <http://www.afhayes.com/public/process2012.pdf>
- Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York: The Guilford Press.
- Heatherton, T. F. & Polivy J. (1991). Development and validation of a scale for measuring state self-esteem. *Journal of Personality and Social Psychology*, *60*, 895-910. doi: 10.1016/0191-8869(96)83741-X
- Hilbert, A., Tuschen Caffier, B., & Vögele (2002). Effects of prolonged and repeated body image exposure in binge-eating disorder. *Journal of Psychosomatic Research*, *52*, 137-144. doi: 10.1016/S0022-3999(01)00314-2
- Hu, J., Yang, Y., Wang, D., & Liu, Y. (2008). Contingency as a moderator of the effect of domain-self-esteem on global self-esteem. *Social Behavior and Personality*, *36*, 851-864. doi: 10.2224/sbp.2008.36.6.851
- Humara, M. (1999). The relationship between anxiety and performance: A cognitive-behavioural perspective. *Athletic Insight: The Online Journal of Sports Psychology*, *1*(2), 1-14. Retrieved from <http://www.headforawin.co.uk/userfiles/file/imageryapplied.pdf>
- Jarrin, D. D., McGrath, J. J., Giovannello, S, Poirier, P., & Lambert, M. (2012). Measurement fidelity of heart rate variability signal processing: The devil is in the details.

International Journal of Psychophysiology, 86, 88-97. doi: 10.1016/j.ijpsycho.

2012.07.004

Jönsson, P., Wallergård, M., Österberg, K., Hansen, Å., Johansson, G., & Karlson, B. (2010).

Cardiovascular and cortisol reactivity and habituation to a virtual reality version of the Trier Social Stress Test: A pilot study. *Psychoneuroendocrinology*, 35, 1397-1403.

doi: 10.1016/j.psyneuen.2010.04.003

Jordan, C. H., Spencer, S. J., Zanna, M. P., Hoshino-Browne, E., & Correll, J. (2003). Secure

and defensive high self-esteem. *Journal of Personality and Social Psychology*, 85,

969-978. doi: 10.1037/0022-3514.85.5.969

Kernis, M. H. (2003). Toward a conceptualization of optimal self-esteem. *Psychological Inquiry*,

14, 1-26. doi: 10.1207/S15327965PLI1401_01

Kernis, M. H. (2005). Measuring self-esteem in context: The importance of stability of self-

esteem in psychological functioning. *Journal of Personality*, 73, 1-37. doi:

10.1111/j.1467-6494.2005.00359.x

Kernis, M. H., Lakey, C. E., & Heppner, W. L. (2008). Secure versus fragile high self-esteem as

a predictor of verbal defensiveness: Converging findings across three different markers.

Journal of Personality, 76, 477-512. doi: 10.1111/j.1467-6494.2008.00493.x

Kirschbaum, C. Pirke, K. M., & Hellhammer, D. H. (1993). The Trier Social Stress Test: A tool

for investigating psychobiological stress responses in a laboratory setting.

Neuropsychobiology, 28, 76-81. Retrieved from [http://p113367.typo3server.](http://p113367.typo3server.info/uploads/media/lit9304.pdf)

[info/uploads/media/lit9304.pdf](http://p113367.typo3server.info/uploads/media/lit9304.pdf)

- Kraemer, B., Moergeli, H., Roth, H., Hepp, U., & Schnyder, U. (2008). Contribution of initial heart rate to the prediction of posttraumatic stress symptom level in accident victims. *Journal of Psychiatric Research, 42*, 158-162. doi: 10.1016/j.jpsychires.2006.11.005
- Kubios HRV (Version 2.0) [Computer software]. Kuopio, Finland, Biosignal Analysis and Medical Imaging Group.
- Lawrence, J. S. & Crocker, J. (2009). Academic contingencies of self-worth impair positively- and negatively-stereotyped students' performance in performance-goal settings. *Journal of Research in Personality, 43*, 868-874. doi: 10.1016/j.jrp.2009.05.002
- Leary, M. R., Tambor, E. S., Terdal, S. K., & Downs, D. L. (1995). Self-esteem as an interpersonal monitor: The sociometer hypothesis. *Journal of Personality and Social Psychology, 68*, 518-530. doi: 10.1037/0022-3514.68.3.518
- Lehman, B. J. & Repetti, R. L. (2007). Bad days don't end when the school bell rings: The lingering effects of negative school events on children's mood, self-esteem, and perceptions of parent-child interactions. *Social Development, 16*, 596-618.
doi: 10.1111/j.1467-9507.2007.00398.x
- Lehofer, M., Moser, M., Hoehn-Saric, R., Mcleod, D., Liebmann, P., Drnovsek, B et al., (1997). Major depression and cardiac autonomic control. *Biological Psychiatry, 42*, 914-919.
doi: 10.1016/S0006-3223(96)00494-5
- Lemay, E. P. & Clark, M. S. (2008). "You're just saying that." Contingencies of self-worth, suspicion, and authenticity in the interpersonal affirmation process. *Journal of Experimental Social Psychology, 44*, 1376-1382. doi: 10.1016/j.jesp.2008.05.001

- Li, Z., Snieder, H., Su, S., Ding, X., Thayer, J. F., Treiber, F. A., et al. (2009). A longitudinal study in youth of heart rate variability at rest and in response to stress. *International Journal of Psychophysiology*, *73*, 212-217. doi: 10.1016/j.ijpsycho.2009.03.002
- Licht, C. M. M., de Geus, E. J. C., Zitman, F. G., Hoodendijk, W. J. G., van Dyck, R., & Penninx, B. W. J. H. (2008). Association between major depressive disorder and heart rate variability in the Netherlands Study of Depression and Anxiety (NESDA). *Archives of General Psychiatry*, *65*, 1358-1367. doi: 10.1001/archpsyc.65.12.1358.
- Lowery, S. E., Kurpius, S. E. R., Befort, C., Blanks, E. H., Sollenberger, S., Nicpon, M. F., & Huser, L. (2005). Body image, self-esteem, and health-related behaviours among male and female first-year college students. *Journal of College Student Development*, *46*, 612-623. doi: 10.1353/csd.2005.0062
- Mar, R. A., DeYoung, C. G., Higgins, D. M., & Peterson, J. B. (2006). Self-liking and self-competence separate self-evaluation from deception: Associations with personality, ability, and achievement. *Journal of Personality*, *74*, 1047-1078. doi: 10.1111/j.1467-6494.2006.00402.x
- Marsh, H. W. & O'Mara, A. O. (2008). Reciprocal effects between academic self-concept, self-esteem, achievement, and attainment over seven adolescent years: Unidimensional and multidimensional perspectives of self-concept. *Personality and Social Psychology Bulletin*, *34*, 542-552. doi: 10.1177/0146167207312313
- Martens, A., Greenberg, J., & Allen, J. J. B. (2008). Self-esteem and autonomic physiology: Parallels between self-esteem and cardiac vagal tone as buffers of threat. *Personality and Social Psychology Review*, *12*, 370-389. doi: 10.1177/1088868308323224

- Martens, A., Greenberg, J., Allen, J. J. B., Hayes, J., Schimel, J., & Johns, M. (2010). Self-esteem and autonomic physiology: Self-esteem levels predict cardiac vagal tone. *Journal of Research in Personality, 44*, 573-584. doi: 10.1016/j.jrp.2010.07.001
- Martin, L. A., Doster, J. A., Critelli, J. W., Lambert, P. L., Purdum, M., Powers, C., & Prazak, M. (2010). Ethnicity and Type D personality as predictors of heart rate variability. *International Journal of Psychophysiology, 76*, 118-121. doi: 10.1016/j.ijpsycho.2010.03.001
- Messerli-Bürgy, N., Engesser, C., Lemmenmeier, E., Steptoe, A., & Laederach-Hofmann, K. (2010). Cardiovascular stress reactivity and recovery in bulimia nervosa and binge eating disorder. *International Journal of Psychophysiology, 78*, 163-168. doi: 10.1016/j.ijpsycho.2010.07.005
- Montano, N., Cogliati, C., da Silva, V. J. D., Gnechi-Ruscione, T., & Malliani, A. (2001). Sympathetic rhythms and cardiovascular oscillations. *Autonomic Neuroscience: Basic and Clinical, 90*, 29-34. doi: 10.1016/S1566-0702(01)00264-8
- Montano, N., Porta, A., Cogliati, C., Constantino, G., Tobaldini, E., Casali, K. R., & Iellamo, F. (2009). Heart rate variability explored in the frequency domain: A tool to investigate the link between heart and behavior. *Neuroscience and Biobehavioral Review, 33*, 71-80. doi: 10.1016/j.neubiorev.2008.07.006
- Mruk, C. J. (2006). The crucial issue of defining self-esteem. In C. J. Mruk (Ed.), *Self-esteem research, theory, and practice: Toward a positive psychology of self-esteem* (pp.1-30). New York: Springer Publishing Company, Inc.
- Mussgay, L. & Rüdell, H. (2004). Autonomic dysfunctions in patients with anxiety throughout therapy. *Journal of Psychophysiology, 18*, 27-37. doi: 10.1027/0269-8803.18.1.27

- Noser, A. & Zeigler-Hill, V. (2013) Investing in the ideal: Does objectified body consciousness mediate the association between appearance contingent self-worth and appearance self-esteem in women? *Body Image*. Advance online publication. doi: 10.1016/j.bodyim.2013.11.006
- Nunan, D., Donovan, G., Jakovljevic, D. G., Hodges, L. D., Sandercock, G. R. H., & Brodie, D. A. (2009). Validity and reliability of short-term heart rate variability from the Polar S810. *Medicine & Science in Sports & Exercise*, *41*, 243-250. doi: 10.1249/MSS.0b013e318184a4b1
- Nunan, D., Jakovljevic, D. G., Donovan, G., Hodges, L. D., Sandercock, G. R. H., & Brodie, D. A. (2008). Levels of agreement for RR intervals and short-term heart rate variability obtained from the Polar S810 and an alternative system. *European Journal of Applied Physiology*, *103*, 529-537. doi: 10.1007/s00421-008-0742-6
- O'Donnell, K., Brydon, L., Wright, C., & Steptoe, A. (2008). Self-esteem levels and cardiovascular and inflammatory responses to acute stress. *Brain, Behavior, and Immunity*, *22*, 1241-1247. doi: 10.1016/j.bbi.2008.06.012
- Orth, U., Robins, R. W., Trzesniewski, K. H., Maes, J., & Schmidt, M. (2009). Low self-esteem is a risk factor for depressive symptoms from young adulthood to old age. *Journal of Abnormal Psychology*, *118*, 472-478. doi: 10.1037/a0015922
- Ousley, L., Cordero, E. D., & White, S. (2008). Fat talk among college students: How undergraduates communicate regarding food and body weight, shape, and appearance. *Eating Disorders*, *16*, 73-84. doi: 10.1080/10640260701773546
- Overbeek, T.J.M., van Boxtel, A., & Westerink, J.H.D.M. (2012). Respiratory sinus arrhythmia responses to induced emotional states: Effects of RSA indices, emotion induction

- method, age, and sex. *Biological Psychology*, *91*, 128-141. doi: 10.1016/j.biopsycho.2012.05.011
- Overstreet, N. M. & Quinn, D. M. (2012). Contingencies of self-worth and appearance concerns: Do domains of self-worth matter? *Psychology of Women Quarterly*. Advance online publication. doi: 10.1177/0361684311435221.
- Pachankis, J.E. & Hatzenbuehler, M. L. (2013). The social development of contingent self-worth in sexual minority young men: An empirical investigation of the “Best little boy in the world” hypothesis. *Basic and Applied Social Psychology*, *35*, 176-190. doi: 10.1080/01973533.2013.764304
- Park, L. E. & Maner, J. K. (2009). Does self-threat promote social connection? The role of self-esteem and contingencies of self-worth. *Journal of Personality and Social Psychology*, *96*, 203-217. doi: 10.1037/a0013933
- Polar ProTrainer 5 [Computer software]. Kempele, Finland, Polar Electro Oy.
- Porges, S. W. (2007). A phylogenetic journey through the vague and ambiguous Xth cranial nerve: A commentary on contemporary heart rate variability research. *Biological Psychology*, *74*, 301-307. doi: 10.1016/j.biopsycho.2006.08.007
- Ramsdal, G. H. (2008). Differential relations between two dimensions of self-esteem and the Big Five? *Scandinavian Journal of Psychology*, *49*, 333-338. doi: 10.1111/j.1467-6494.2006.00402.x
- Rector, N. A. & Roger, D. (1997). The stress buffering effects of self-esteem. *Personality and Individual Differences*, *23*, 799-808. doi: 10.1016/S0191-8869(97)00095-0

- Reynolds, B. M. & Repetti, R. L. (2008). Contextual variations in negative mood and state self-esteem: What role do peers play? *The Journal of Early Adolescence*, *28*, 405-427. doi: 10.1177/0272431608316598
- Robertson, N. & Vohora, R. (2008). Fitness vs. fatness: Implicit bias towards obesity among fitness professionals and regular exercisers. *Psychology of Sport and Exercise*, *9*, 547-557. doi: 10.1016/j.psychsport.2007.06.002
- Robins, R. W., Trzesniewski, K. H., Tracy, J. L., Gosling, S. D., & Potter, J. (2002). Global self-esteem across the life span. *Psychology and Aging*, *17*, 423-434. doi: 10.1037/0882-7974.17.3.423
- Rodriguez-Cano, T., Beato-Fernandez, L., Garcia-Vilches, I., Garcia-Vicente, A., Poblete-Garcia, V., & Soriano-Casterjon, A. (2009). Regional cerebral blood flow patterns of change following the own body image exposure in eating disorders: A longitudinal study. *European Psychiatry*, *24*, 275-281. doi: 10.1016/j.psychresns.2008.01.001
- Rosenberg, M. (1965). *Society and adolescent self-image*. Princeton NJ: Princeton Press.
- Roth, M., Decker, O., Herzberg, P. Y., & Brahler, E. (2008). Dimensionality and norms of the Rosenberg Self-Esteem Scale in a German general population sample. *European Journal of Psychological Assessment*, *24*, 190-197. doi: 10.1027/1015-5759.24.3.190
- Salk, R. H. & Engeln-Maddox, R. (2012). Fat talk among college women is both contagious and harmful. *Sex Roles*, *66*, 636-645. doi: 10.1007/s11199-011-0050-1
- Sanchez, D. T. & Crocker, J. (2005). How investment in gender ideals affects well-being: The role of external contingencies of self-worth. *Psychology of Women Quarterly*, *29*, 63-77. doi: 10.1111/j.1471-6402.2005.00169.x

- Sanchez, D. T., Good, J. J., Kwang, T. K. & Saltzman, E. (2008). When finding a mate feels urgent: Why relationship contingency predicts men's and women's body shame. *Social Psychology, 39*, 90-102. doi: 10.1027/1864-9335.39.2.90
- Sargent, J. T., Crocker, J., & Luhtanen, R. K. (2006). Contingencies of self-worth and depressive symptoms in college students. *Journal of Social and Clinical Psychology, 25*, 628-646. doi: 10.1521/jscp.2006.25.6.628
- Scheff, T. J. & Fearon, D. S. (2004). Cognition and emotion? The dead end in self-esteem research. *Journal for the Theory of Social Behaviour, 34*, 73-90. doi: 10.1111/j.1468-5914.2004.00235.x
- Schneiderman, I., Zilberstein-Kra, Y., Leckman, J. F., & Feldman, R. (2011). Love alters autonomic reactivity to emotions. *Emotion, 11*, 1314-1321. doi: 10.1037/a0024090
- Schwerdtfeger, A. R. & Derakshan, N. (2010). The time line of threat processing and vagal withdrawal in response to a self-threatening stressor in cognitive avoidant copers: Evidence for vigilance-avoidance theory. *Psychophysiology, 47*, 786-795. doi: 10.1111/j.1469-8986.2010.00965.x
- Schwerdtfeger, A. R. & Scheel, S. (2012). Self-esteem fluctuations and cardiac vagal control in everyday life. *International Journal of Psychophysiology, 83*, 328-335. doi: 10.1016/j.ijpsycho.2011.11.016
- Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-concept: Validation of construct interpretations. *Review of Educational Research, 46*, 407-441. Retrieved from <http://www.jstor.org/stable/1170010>
- Shiota, M. N., Neufeld, S. L., Yeung, W. H., Moser, S. E., & Perea, E. F. (2011). Feeling good: Autonomic nervous responding in five positive emotions. *Emotion, 11*, 1368-1378.

doi: 10.1037/a0024278

- Siepmann, M., Aykac, V., Unterdörfer, J., Petrowski, K., & Mueck-Weymann, M. (2008). A pilot study on the effects of heart rate variability biofeedback in patients with depression and healthy subjects. *Applied Psychophysiology and Biofeedback, 33*, 195-201. doi: 10.1007/s10484-008-9064-z
- Smith, T. W., Cribbet, M. R., Nealey-Moore, J. B., Uchino, B. N., Williams, P. G., MacKenzie, J., & Thayer, J. F. (2011). Matters of the variable heart: Respiratory sinus arrhythmia response to marital interaction and associations with marital quality. *Journal of Personality and Social Psychology, 100*, 103-119. doi: 10.1037/a0021136
- Sowislo, J. F. & Orth, U. (2012). Does low self-esteem predict depression and anxiety? A meta-analysis of longitudinal studies. *Psychological Bulletin*. Advance online publication. doi: 10.1037/a0028931
- Spalding, L. R. & Hardin, C. D. (1999). Unconscious unease and self-handicapping: Behavioural consequences of individual differences in implicit and explicit self-esteem. *Psychological Science, 10*, 535-539. doi: 10.1111/1467-9280.00202
- Spence, J. C., McGannon, K. R., & Poon, P. (2005). The effect of exercise on global self-esteem: A quantitative review. *Journal of Sport and Exercise Psychology, 27*, 311-334.
Retrieved from <http://journals.humankinetics.com>
- Stefanone, M. A., Lackaff, D., & Rosen, D. (2011). Contingencies of self-worth and social-networking-site behavior. *Cyberpsychology, Behavior, and Social Networking, 14*, 41-49. doi: 10.1089/cyber.2010.0049

- Stice, E., Maxfield, J., & Wells, T. (2003). Adverse effects of social pressure to be thin on young women: An experimental investigation of the effects of “fat talk”. *International Journal of Eating Disorders, 34*, 108-117. doi: 10.1002/eat.10171
- Tabachnik, B. G. & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Pearson.
- Tafarodi, R. W., Marshall, T. C., & Milne, A. B. (2003). Self-esteem and memory. *Journal of Personality and Social Psychology, 84*, 29-44. doi: 10.1037/0022-3514.84.1.29
- Tafarodi, R. W. & Milne, A. B. (2002). Decomposing global self-esteem. *Journal of Personality, 70*, 443-484. doi: 10.1111/1467-6494.05017
- Tafarodi, R. W. & Swann, W. B. (1995). Self-liking and self-competence as dimensions of global self-esteem: Initial validation of a measure. *Journal of Personality Assessment, 65*, 322-342. doi: 10.1207/s15327752jpa6502_8
- Tafarodi, R. W. & Swann, W. B. (2001). Two-dimensional self-esteem: Theory and measurement. *Personality and Individual Differences, 31*, 653-673. doi:10.1016/S0191-8869(00)00169-0
- Tafarodi, R. W., Tam, J., & Milne, A. B. (2001). Selective memory and the persistence of paradoxical self-esteem. *Personality and Social Psychology Bulletin, 27*, 1179-1189. doi: 10.1177/0146167201279010
- Tarvainen, M. P. & Niskanen, J. P. (2008). Kubios HRV analysis: User’s guide. Biosignal Analysis and Medical Imaging Group (BSAMIG), University of Kuopio, Finland.
- Task Force of the European Society of Cardiology the North American Society of Pacing

- Electrophysiology (1996). Heart rate variability: Standards of measurement, physiological interpretation, and clinical use. *Circulation*, *93*, 1043-1065. doi: 10.1161/01.CIR.93.5.1043
- Thayer, J. F., Ahs, F., Fredrikson, M., Sollers, J. J., & Wager, T. D. (2012). A meta-analysis of heart rate variability and neuroimaging studies: Implications for heart rate variability as a marker of stress and health. *Neuroscience and Biobehavioral Reviews*, *36*, 747-756. doi: 10.1016/j.neubiorev.2011.11.009
- Thayer, J. F., Hansen, A. L., Saus-Rose, E., & Johnsen, B. H. (2009). Heart rate variability, prefrontal neural function, and cognitive performance: The neurovisceral integration perspective on self-regulation, adaptation, and health. *Annals of Behavioral Medicine*, *37*, 141-153. doi: 10.1007/s12160-009-9101-z
- Trzesniewski, K. H., Donnellan, M. B., & Robins, R. W. (2003). Stability of self-esteem across the life span. *Journal of Personality and Social Psychology*, *84*, 205-220. doi:10.1037/0022-3514.84.1.205
- Tucker, K. L., Martz, D. M., Curtin, L. A., & Bazzini, D. G. (2007). Examining “fat talk” experimentally in a female dyad: How are women influenced by another woman’s body presentation style? *Body Image*, *4*, 157-164. doi: 10.1016/j.bodyim.2006.12.005
- Tuschen-Caffier, Vögele, C., Bracht, S., & Hilbert, A. (2003). Psychological responses to body shape exposure in patients with bulimia nervosa. *Behavior Research and Therapy*, *41*, 573-586. doi: 10.1016/S0005-7967(02)00030-X
- Uno, D., Uchino, B. N., & Smith, T. W. (2002). Relationship quality moderates the effect of social support given by close friends on cardiovascular reactivity in women.

International Journal of Behavioral Medicine, 9, 243-262. doi: 10.1207/

S15327558IJBM0903_06

van Ravenswaaij-Arts, C. M. A., Kollee, L. A. A., Hopman, J. C. W., Stoeling, G. B. A., & van

Geijn, H. P. (1993). Heart rate variability. *Annals of Internal Medicine*, 118, 436-447.

Vartanian, L. R. (2009). When the body defines the self: Self-concept clarity, internalization, and

body image. *Journal of Social and Clinical Psychology*, 28, 94-126. doi: 10.1521/jscp.

2009.28.1.94

Vegas Movie Studio Platinum (Version 11) [Computer software]. Middleton, WI, Sony Creative

Software, Inc.

Vocks, S., Legenbauer, T., Wächter, A., Wucherer, M., & Kosfelder, J. (2007). What happens

in the course of body exposure?: Emotional, cognitive, and physiological reactions to

mirror confrontation in eating disorders. *Journal of Psychosomatic Research*, 62, 231-

239. doi: 10.1016/j.jpsychores.2006.08.007

Wadiwalla, M., Andrews, J., Lai, B., Buss, C., Lupien, S. J., & Pruessner, J. C. (2010). Effects

of manipulating the amount of social-evaluative threat on the cortisol stress response in

young healthy women. *Stress*, 13, 214-220. doi:10.3109/10253890903277561

Wallis, D. A. N. (2002). Depression, anxiety, and self-esteem: A clinical field study. *Behavior*

Change, 19, 112-120. doi: 10.1375/bech.19.2.112

Wang, S. S., Brownell, K. D., & Wadden, T. A. (2004). The influence of the stigma of obesity on

overweight individuals. *International Journal of Obesity*, 28, 1333-1337. doi: 10.1038/

sj.ijo.0802730

- Want, S. C. (2009). Meta-analytic moderators of experimental exposure to media portrayals of women on female appearance satisfaction: Social comparisons as automatic processes. *Body Image, 6*, 257-269. doi: 10.1016/j.bodyim.2009.07.008
- Warren, C. S., Holland, S., Billings, H., & Parker, A. (2012). The relationship between fat talk, body dissatisfaction, and drive for thinness: Perceived stress as a moderator. *Body Image, 9*, 358-364. doi: 10.1016/j.bodyim.2012.03.008
- Wheat, A. L. & Larkin, K. T. (2010). Biofeedback of heart rate variability and related physiology: A critical review. *Applied Psychophysiology and Biofeedback, 35*, 229-242. doi: 10.1007/s10484-010-9133-y
- Wheeler, L. & Miyake, K. (1992). Social comparison in everyday life. *Journal of Personality and Social Psychology, 62*, 760-773. Retrieved from <http://www.apa.org/pubs/journals/psp/index.aspx>
- Williams, P. G., Rau, H. K., Cribbet, M. R., & Gunn, H. E. (2009). Openness to experience and stress regulation. *Journal of Research in Personality, 43*, 777-784. doi: 10.1016/j.jrp.2009.06.003
- Williams, T., Schimel, J., Hayes, J., & Martens, A. (2010). The moderating role of extrinsic contingency focus on reactions to threat. *European Journal of Social Psychology, 40*, 300-320. doi: 10.1002/ejsp.624
- Wills, T. A. (1981). Downward comparison principles in social psychology. *Psychological Bulletin, 90*, 245-271. Retrieved from <http://www.apa.org/pubs/journals/bul/index.aspx>
- Wood, J. V., Michela, J. L., & Giordano, C. (2000). Downward comparison in everyday life: Reconciling self-enhancement models with the mood-cognition priming model. *Journal of Personality and Social Psychology, 79*, 563-579. doi: 10.1037/0022-3514.79.4.563

- Zeigler-Hill, V. (2006a) Contingent self-esteem and the interpersonal circumplex: The interpersonal pursuit of self-esteem. *Personality and Individual Differences*, 40, 713-723. doi: 10.1016/j.paid.2005.08.009
- Zeigler-Hill, V. (2006b). Discrepancies between implicit and explicit self-esteem: Implications for narcissism and self-esteem instability. *Journal of Personality*, 74, 119-144. doi: 10.1111/j.1467-6494.2005.00371.x
- Zeigler-Hill, V. & Noser, A. (2013). Will I ever think I'm thin enough? A moderated mediation study of women's contingent self-esteem, body image discrepancies, and disordered eating. *Psychology of Women Quarterly*. Advance online publication. doi: 10.1177/0361684313515841

Table 1

Reliability Coefficients and Descriptive Statistics of the Psychometric Variables

Variables	<i>M</i>	<i>SD</i>	No. of items	Actual Range	<i>Z</i> _{Skewness}	α
SSES: Appearance	19.30	4.50	6	7.00-29.00	-1.39	.83
SSES: Performance	26.65	4.25	7	17.00-35.00	-0.99	.82
SSES: Social	25.66	5.58	7	9.00-35.00	-3.59	.87
CSWS: Global	4.62	0.65	35	3.00-6.51	0.39	.90
CSWS: Appearance	5.06	0.95	5	2.60-7.00	-1.87	.71
CSWS: Academic	5.48	0.77	5	3.40-7.00	-0.95	.79
CSWS: APPw	16.38	3.84	5	8.11-27.47	0.60	-
CSWS: ACADw	18.02	3.28	5	10.53-27.03	2.78	-

Note. *N* = 96. SSES = State Self-Esteem Scale; CSWS = Contingencies of Self-Worth Scale; APPw = CSWS: Appearance weighted; ACADw = CSWS: Academic weighted; α = Cronbach's alpha internal consistency.

Table 2

Descriptive Statistics of the Cardiac Parameters Over the Phases of the Experiment

	Phase 1: Baseline	Phase 2: Role-play	Phase 3: Video Review	Phase 4: Recovery
HR (bpm)	79.00 (12.28) [0.27]	89.68 (13.59) [1.57]	78.80 (11.67) [0.47]	76.51 (10.92) [0.32]
HF (ms ²)	773.09 (746.13) [5.85]	492.00 (480.75) [7.06]	671.71 (675.60) [6.88]	789.97 (706.69) [5.81]
LF (ms ²)	950.80 (716.33) [5.19]	1139.13 (749.97) [4.21]	909.47 (727.92) [6.18]	1193.95 (902.46) [5.80]
HFnu	41.17 (18.81) [0.48]	27.80 (12.18) [1.99]	39.75 (17.79) [0.87]	38.07 (15.95) [1.87]

Note: $N = 96$. Mean (standard deviation) [z_{skewness}]

Table 3

Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting HFnu During Role-Play with CSWS: APPw and Scenario as Moderators

Variable	State Self-Esteem Scale subscale X		
	Appearance	Social	Performance
HFnu covariate	0.33 (0.06)***	0.34 (0.06)***	0.32 (0.06)***
SSES subscale X	0.26 (0.26)	0.75 (1.84)	0.27 (0.26)
M = CSWS	-0.49 (0.30)	-0.33 (0.30)	-0.32 (0.32)
W = Scenario	-2.04 (2.18)	-2.02 (2.14)	-2.79 (2.18)
X × M	0.13 (0.07)	0.67 (0.57)	0.08 (0.06)
X × W	0.42 (0.52)	6.18 (3.69)	0.22 (0.52)
M × W	0.37 (0.59)	0.58 (0.59)	0.66 (0.62)
X × M × W	0.44 (0.14)**	2.51 (1.15)*	0.21 (0.13)
Overall Model F	6.61***	6.12***	5.74***

Note. $N = 96$. Covariate = HFnu at baseline. CSWS = Contingencies of Self-Worth Scale.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4

Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting HFnu During Video Review with CSWS: APPw and Scenario as Moderators

Variable	State Self-Esteem Scale subscale X		
	Appearance	Social	Performance
HFnu covariate	0.52 (0.08)***	0.52 (0.08)***	0.51 (0.08)***
SSES subscale X	0.08 (0.38)	0.18 (0.29)	0.22 (0.37)
M = CSWS	-0.03 (0.44)	0.27 (0.45)	-0.03 (0.45)
W = Scenario	-6.57 (3.24)*	-6.53 (3.16)*	-7.66 (3.13)*
X × M	-0.00 (0.10)	-0.08 (0.10)	0.03 (0.09)
X × W	0.50 (0.77)	0.01 (0.59)	1.11 (0.74)
M × W	0.68 (0.88)	0.31 (0.89)	0.38 (0.89)
X × M × W	0.22 (0.21)	0.20 (0.20)	0.10 (0.18)
Overall Model F	6.12***	6.11***	6.33***

Note. $N = 96$. Covariate = HFnu at baseline. CSWS = Contingencies of Self-Worth Scale.

* $p < .05$. *** $p < .001$.

Table 5

Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting HFnu During Role-Play with CSWS: ACADw and Scenario as Moderators

Variable	State Self-Esteem Scale subscale X		
	Appearance	Social	Performance
HFnu covariate	0.31 (0.06)***	0.32 (0.06)***	0.31 (0.06)***
SSES subscale X	0.21 (0.25)	1.28 (1.93)	0.37 (0.27)
M = CSWS	-15.83 (6.93)*	-10.99 (6.67)	-11.21 (6.39)
W = Scenario	-2.29 (2.14)	-2.37 (2.23)	-2.19 (2.22)
X × M	2.11 (1.52)	9.93 (11.16)	0.78 (1.36)
X × W	0.05 (0.50)	5.23 (3.86)	0.01 (0.53)
M × W	3.75 (13.61)	3.90 (13.06)	7.70 (12.61)
X × M × W	7.55 (3.07)*	41.99 (22.38)	3.28 (2.74)
Overall Model F	5.79***	5.31***	5.27***

Note. $N = 96$. Covariate = HFnu at baseline. CSWS = Contingencies of Self-Worth Scale.

* $p < .05$. *** $p < .001$.

Table 6

Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting HFnu During Video Review with CSWS: ACADw and Scenario as Moderators

Variable	State Self-Esteem Scale subscale X		
	Appearance	Social	Performance
HFnu covariate	0.49 (0.08)***	0.49 (0.08)***	0.50 (0.08)***
SSES subscale X	0.04 (0.36)	3.77 (2.73)	0.29 (0.37)
M = CSWS	-15.64 (9.99)	-12.46 (9.46)	-11.59 (8.96)
W = Scenario	-7.79 (3.08)*	-7.46 (3.16)*	-7.34 (3.12)*
X × M	1.30 (2.19)	5.93 (15.77)	1.24 (1.90)
X × W	0.47 (0.73)	1.56 (5.48)	1.12 (0.75)
M × W	-7.24 (19.62)	-3.36 (18.53)	-9.56 (17.68)
X × M × W	5.23 (4.43)	-3.47 (31.75)	0.51 (3.84)
Overall Model F	6.23***	6.29***	6.64***

Note. $N = 96$. Covariate = HFnu at baseline. CSWS = Contingencies of Self-Worth Scale.

* $p < .05$. *** $p < .001$.

Table 7

Factor Loadings for Exploratory Factor Analysis with Varimax Rotation of Positive and Negative Affect During Role-play and Video Review

Item	Role-play		Video review	
	NA	PA	NA	PA
1. Difficult	.68	.01	.65	-.41
2. Enjoyable	-.16	.83	-.51	.73
3. Stressful	.76	-.15	.82	-.21
4. Pleasant	-.19	.82	-.32	.80
5. Shameful	.69	-.28	.85	-.09
6. Inspiring	-.03	.80	-.08	.88
7. Depressing	.61	-.28	.70	-.28
8. Positive	-.28	.73	-.29	.74
9. Awkward	.61	-.08	.53	-.35

Note. NA = Negative affect. PA= Positive affect.

Table 8

Descriptive Statistics and Reliability Coefficients of the Affect Variables

Variables	<i>M</i>	<i>SD</i>	No. of items	Range	Z _{Skewness}	α
Role-play: NA	3.45	1.00	5	1.00-5.80	-0.61	.72
Role-play: PA	4.96	1.02	4	2.25-7.00	-2.30	.83
Video review: NA	3.51	1.28	5	1.00-6.00	-0.67	.82
Video review: PA	4.14	1.20	4	1.50-7.00	-0.50	.87
Anxiety	4.48	1.41	1	2.00-7.00	-0.64	-

Note. $N = 96$. α = Cronbach's alpha internal consistency.

Table 9

Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting Negative Affect During Role-play with Scenario and CSWS: APPw (top panel) and CSWS: ACADw (bottom panel) as Moderators

Variable	State Self-Esteem Scale subscale X		
	Appearance	Social	Performance
SSES subscale X	-0.05 (0.03)	-0.28 (0.18)	-0.07 (0.02)**
M = CSWS: APPw	-0.02 (0.03)	-0.01 (0.03)	0.02 (0.03)
W = Scenario	-0.23 (0.21)	-0.15 (0.21)	-0.15 (0.20)
X * M	0.01 (0.01)	0.02 (0.06)	-0.00 (0.00)
X * W	-0.02 (0.05)	-0.12 (0.36)	-0.04 (0.05)
M * W	-0.08 (0.06)	-0.08 (0.06)	-0.08 (0.06)
X * M * W	-0.01 (0.01)	0.01 (0.11)	0.01 (0.01)
Overall Model F	1.37	0.91	1.98
SSES subscale X	-0.05 (0.02)	-0.25 (0.18)	-0.07 (0.02)**
M = CSWS: ACADw	0.04 (0.66)	-0.01 (0.63)	0.25 (0.58)
W = Scenario	-0.08 (0.21)	-0.13 (0.21)	-0.12 (0.21)
X * M	0.16 (0.15)	0.49 (1.07)	0.04 (0.13)
X * W	-0.05 (0.05)	-0.17 (0.37)	-0.05 (0.05)
M * W	0.67 (1.32)	1.14 (1.26)	1.29 (1.17)
X * M * W	0.06 (0.30)	1.02 (2.15)	-0.00 (0.25)
Overall Model F	1.01	0.79	1.82

Note. $N = 96$. SSES = State Self-Esteem Scale; CSWS = Contingencies of Self-Worth Scale.

** $p < .01$.

Table 10

Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting Positive Affect During Role-play with Scenario and CSWS: APPw (top panel) and CSWS: ACADw (bottom panel) as Moderators

Variable	State Self-Esteem Scale subscale X		
	Appearance	Social	Performance
SSES subscale X	0.01 (0.01)	0.10 (0.06)	0.01 (0.01)
M = CSWS: APPw	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
W = Scenario	0.08 (0.07)	0.12 (0.21)	0.12 (0.07)
X * M	0.00 (0.00)*	0.01 (0.02)	0.00 (0.00)
X * W	0.02 (0.02)	0.01 (0.13)	0.01 (0.02)
M * W	0.02 (0.02)	0.03 (0.02)	0.03 (0.02)
X * M * W	0.00 (0.00)	0.04 (0.04)	-0.00 (0.00)
Overall Model F	1.68	1.38	1.32
SSES subscale X	0.01 (0.01)	0.10 (0.07)	0.02 (0.01)
M = CSWS: ACADw	-0.06 (0.24)	-0.19 (0.22)	-0.14 (0.21)
W = Scenario	0.11 (0.07)	0.09 (0.08)	0.11 (0.07)
X * M	0.04 (0.05)	0.00 (0.38)	-0.00 (0.05)
X * W	0.01 (0.02)	0.02 (0.13)	0.01 (0.02)
M * W	-0.29 (0.47)	-0.03 (0.44)	-0.11 (0.42)
X * M * W	0.02 (0.11)	0.78 (0.76)	-0.00 (0.09)
Overall Model F	0.67	0.84	1.01

Note. SSES = State Self-Esteem Scale; CSWS = Contingencies of Self-Worth Scale. $n = 96$.

* $p < .05$.

Table 11

Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting Negative Affect During Video Review with Scenario and CSWS: APPw (top panel) and CSWS: ACADw (bottom panel) as Moderators

Variable	State Self-Esteem Scale subscale X		
	Appearance	Social	Performance
SSES subscale X	-0.14 (0.03)***	-0.91 (0.20)***	-0.08 (0.03)**
M = CSWS: APPw	-0.01 (0.03)	0.01 (0.03)	0.03 (0.04)
W = Scenario	-0.17 (0.25)	-0.15 (0.23)	-0.22 (0.26)
X * M	0.00 (0.01)	-0.02 (0.06)	0.00 (0.01)
X * W	-0.00 (0.06)	0.04 (0.40)	-0.06 (0.06)
M * W	-0.09 (0.07)	-0.16 (0.06)^{§§}	-0.12 (0.07)
X * M * W	-0.01 (0.02)	0.12 (0.12)	0.00 (0.02)
Overall Model F	4.68***	5.37***	2.46*
SSES subscale X	-0.14 (0.03)***	-0.91 (0.21)***	-0.08 (0.03)^{§§}
M = CSWS: ACADw	-1.15 (0.74)	-0.62 (0.71)	-1.04 (0.73)
W = Scenario	-0.11 (0.23)	-0.18 (0.24)	-0.18 (0.26)
X * M	0.23 (0.17)	1.67 (1.21)	0.33 (0.16)*
X * W	-0.02 (0.05)	0.25 (0.42)	-0.10 (0.06)
M * W	-0.63 (1.48)	-0.99 (1.42)	0.54 (1.46)
X * M * W	0.36 (0.33)	2.12 (2.42)	-0.03 (0.31)
Overall Model F	5.00***	4.62***	2.56*

Note. $N = 96$. SSES = State Self-Esteem Scale; CSWS = Contingencies of Self-Worth Scale.
^{*} $p < .05$. ^{§§} $p = .01$. ^{**} $p < .01$. ^{***} $p < .001$.

Table 12

Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting Positive Affect During Video Review with Scenario and CSWS: APPw (top panel) and CSWS: ACADw (bottom panel) as Moderators

Variable	State Self-Esteem Scale subscale X		
	Appearance	Social	Performance
SSES subscale X	0.11 (0.03)***	0.77 (0.19)***	0.06 (0.03)*
M = CSWS: APPw	-0.03 (0.03)	-0.03 (0.03)	-0.05 (0.03)
W = Scenario	0.26 (0.23)	0.39 (0.22)	0.48 (0.24)*
X * M	0.02 (0.01)*	0.08 (0.06)	0.00 (0.01)
X * W	0.09 (0.05)	0.09 (0.38)	0.03 (0.06)
M * W	0.05 (0.06)	0.12 (0.06)	0.12 (0.07)
X * M * W	0.01 (0.01)	-0.03 (0.12)	-0.01 (0.01)
Overall Model F	5.22***	4.75***	2.27*
SSES subscale X	0.13 (0.03)***	0.88 (0.20)***	0.07 (0.03)*
M = CSWS: ACADw	0.24 (0.71)	-0.42 (0.68)	-0.00 (0.71)
W = Scenario	0.39 (0.22)	0.44 (0.23)	0.54 (0.25)*
X * M	-0.09 (0.16)	-0.34 (1.15)	-0.07 (0.15)
X * W	0.05 (0.05)	-0.30 (0.40)	0.03 (0.06)
M * W	1.26 (1.42)	1.94 (1.36)	1.09 (1.41)
X * M * W	-0.23 (0.32)	-0.16 (2.32)	-0.25 (0.30)
Overall Model F	4.32***	4.02***	1.65

Note. $N = 96$. SSES = State Self-Esteem Scale; CSWS = Contingencies of Self-Worth Scale.
* $p < .05$. *** $p < .001$.

Table 13

Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting Anxiety with Scenario and CSWS: APPw (top panel) and CSWS: ACADw (bottom panel) as Moderators

Variable	State Self-Esteem Scale subscale X		
	Appearance	Social	Performance
SSES subscale X	-0.12 (0.03)***	-0.48 (0.25)[‡]	-0.09 (0.03)^{§§}
M = CSWS: APPw	-0.04 (0.04)	-0.04 (0.04)	-0.02 (0.04)
W = Scenario	-0.10 (0.29)	0.00 (0.29)	-0.01 (0.29)
X * M	0.01 (0.01)	- 0.02 (0.08)	0.00 (0.01)
X * W	-0.13 (0.07)	-1.25 (0.49)^{§§}	-0.11 (0.07)
M * W	-0.03 (0.08)	-0.07 (0.08)	-0.02 (0.08)
X * M * W	-0.03 (0.02)	- 0.03 (0.15)	-0.00 (0.02)
Overall Model F	2.96**	1.91	1.65
SSES subscale X	-0.10 (0.03)**	-0.52 (0.25)*	0.10 (0.04)**
M = CSWS: ACADw	0.61 (0.88)	-0.05 (0.86)	0.30 (0.83)
W = Scenario	0.17 (0.28)	0.02 (0.29)	-0.00 (0.29)
X * M	0.30 (0.20)	-0.28 (1.46)	0.06 (0.18)
X * W	-0.18 (0.06)**	-1.18 (0.51)*	-0.10 (0.07)
M * W	- 3.00 (1.76)	-1.08 (1.72)	-1.53 (1.65)
X * M * W	-0.34 (0.40)	-0.16 (2.93)	0.17 (0.35)
Overall Model F	2.71^{§§}	1.72	1.80

Note. $N = 96$. SSES = State Self-Esteem Scale; CSWS = Contingencies of Self-Worth Scale.
[‡] $p < .06$. * $p < .05$. ^{§§} $p = .01$. ** $p < .01$. *** $p < .001$.

Table 14

Factor Loadings for Factor Analysis with Varimax Rotation PSQ Items

Item	Identifies	Understands
1. I understand my client's problem	.37	.76
2. I personally related to my client's problem	.89	.31
3. I too have a similar problem as my client	.95	.06
4. If this role-play scenario were the real thing, I believe that I would be able to help my client with her problem	.03	.91

Table 15

Moderated Multiple Regression Results of the Unstandardized Regression Coefficients β (SE) Predicting Identifies with Scenario and CSWS: APPw (top panel) and CSWS: ACADw (bottom panel) as Moderators

Variable	State Self-Esteem Scale subscale X		
	Appearance	Social	Performance
SSES subscale X	-0.07 (0.01)***	-0.28 (0.10)**	-0.05 (0.01)***
M = CSWS: APPw	0.01 (0.01)	0.01 (0.02)	0.03 (0.02)
W = Scenario	-0.03 (0.10)	0.01 (0.11)	0.02 (0.11)
X * M	0.00 (0.00)	-0.01 (0.03)	-0.00 (0.00)
X * W	-0.02 (0.02)	-0.04 (0.19)	0.02 (0.03)
M * W	0.03 (0.03)	0.01 (0.03)	0.00 (0.03)
X * M * W	-0.01 (0.01)	-0.08 (0.06)	-0.00 (0.01)
Overall Model F	4.89***	1.42	2.83^{§§}
SSES subscale X	-0.05 (0.01)***	-0.26 (0.10)^{§§}	-0.05 (0.01)***
M = CSWS: ACADw	0.22 (0.32)	0.19 (0.33)	0.21 (0.31)
W = Scenario	0.05 (0.10)	0.04 (0.11)	0.01 (0.11)
X * M	0.07 (0.07)	0.21 (0.57)	0.01 (0.07)
X * W	-0.04 (0.02)	-0.05 (0.20)	0.03 (0.03)
M * W	-0.32 (0.65)	-0.17 (0.66)	-0.16 (0.62)
X * M * W	-0.18 (0.15)	-1.70 (1.13)	-0.14 (0.13)
Overall Model F	3.86^{§§}	1.38	2.46*

Note. $N = 96$. SSES = State Self-Esteem Scale; CSWS = Contingencies of Self-Worth Scale.
* $p < .05$. ^{§§} $p = .01$. ** $p < .01$. *** $p < .001$.

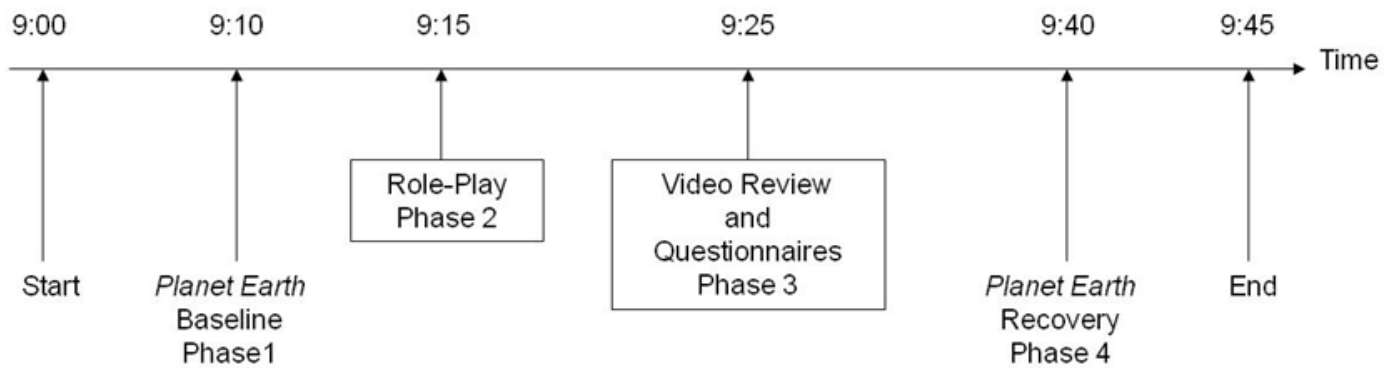


Figure 1. Timeline of laboratory experimental procedures.

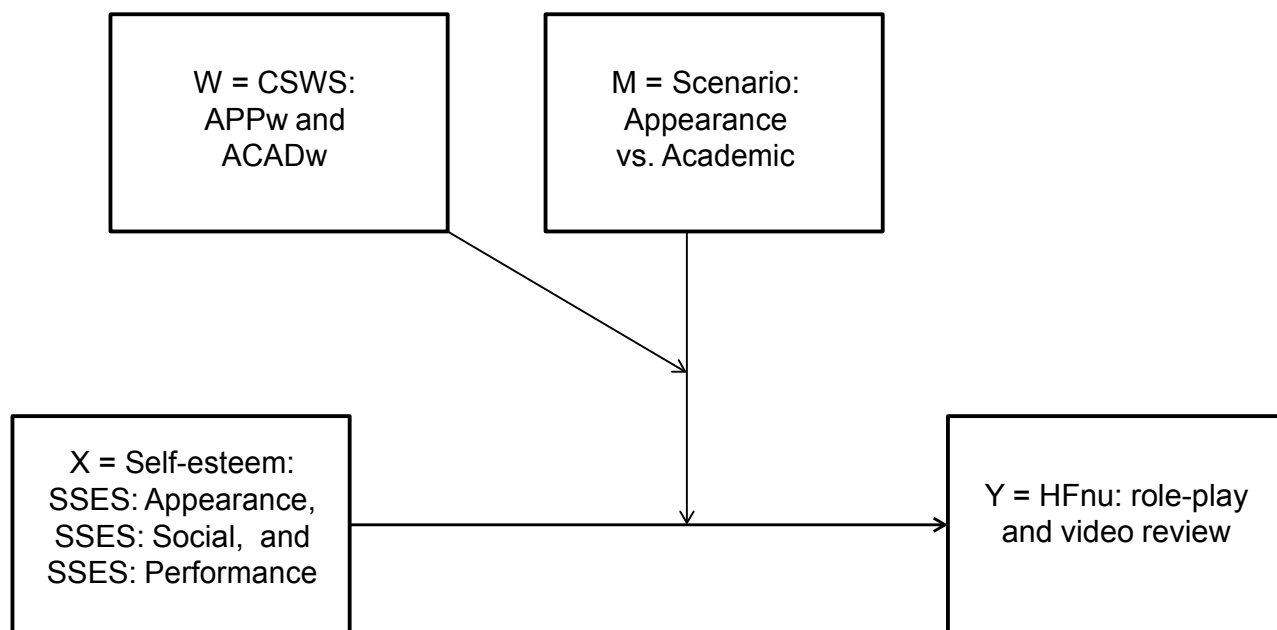


Figure 2. Moderated moderation model of the effects of self-esteem upon HFnu as moderated by scenario and CSWS. M and W = moderator variables; X = predictor variable; Y = criterion variable; SSES = State Self-Esteem Scale; HFnu = high frequency normalized units; CSWS = Contingencies of Self-Worth Scale; APPw = CSWS: Appearance weighted; ACADw = CSWS: Academic weighted. Adapted from “PROCESS: A Versatile Computational Tool For Observed Variable Mediation, Moderation, and Conditional Process Modeling,” by A.F. Hayes, 2012, retrieved from <http://www.afhayes.com/public/process2012.pdf>, p. 61.

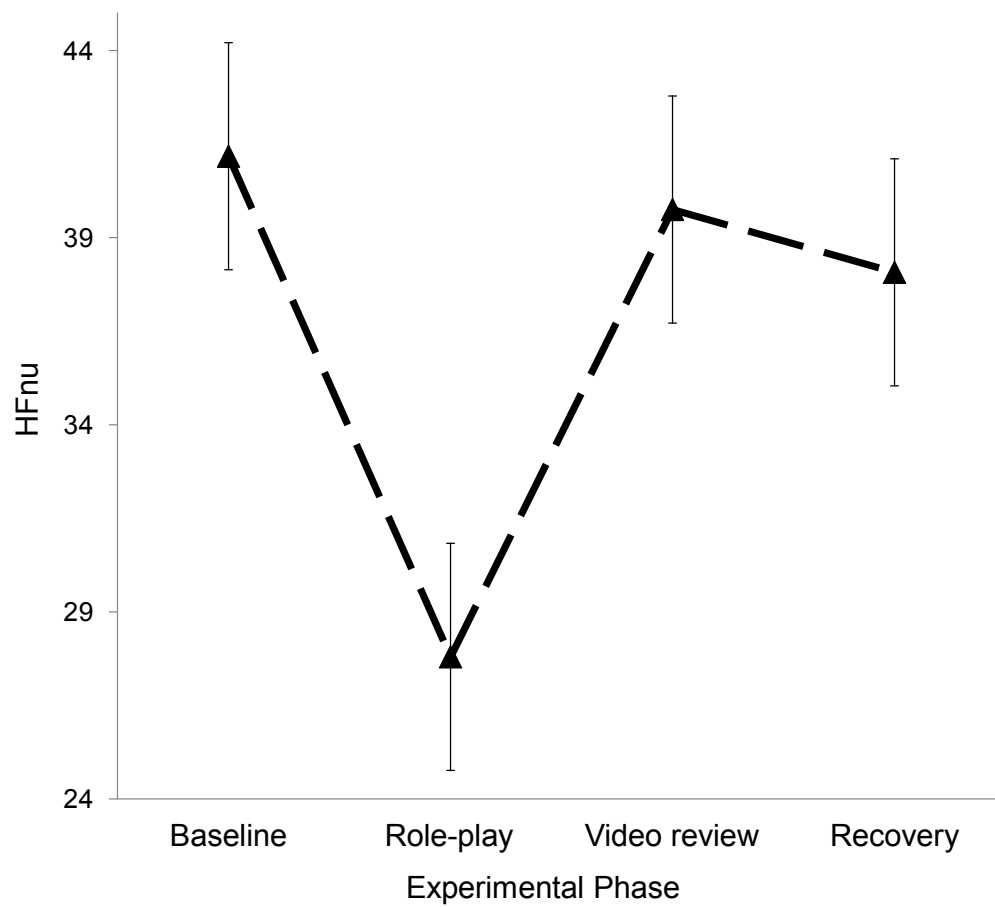
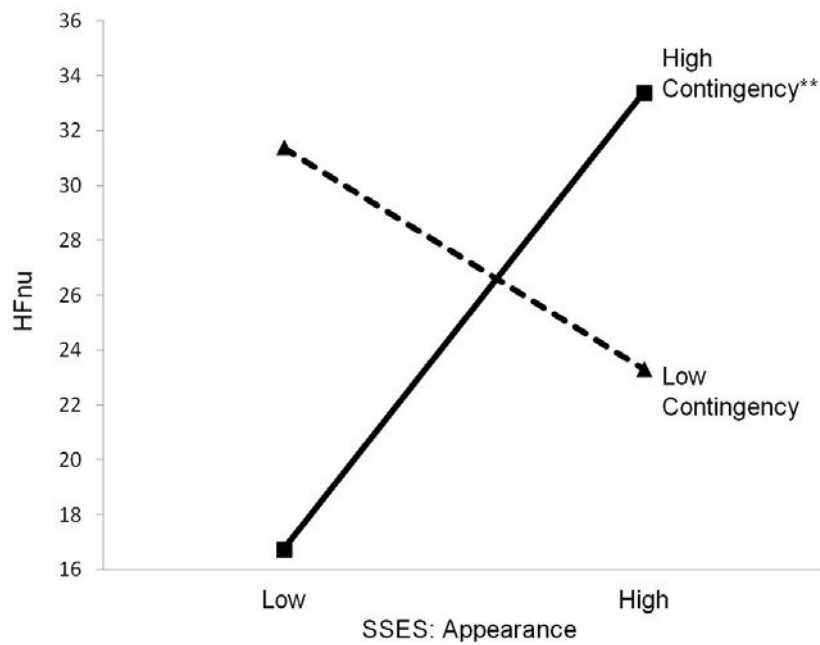


Figure 3. HFnu plotted as a function of phase. Error bars represent +/- 1 standard error.

Appearance Scenario



Academic Scenario

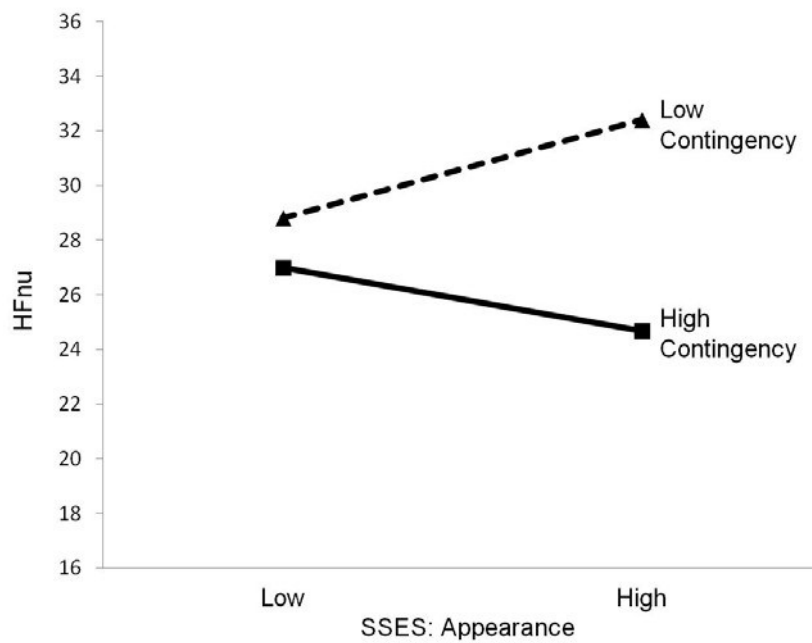
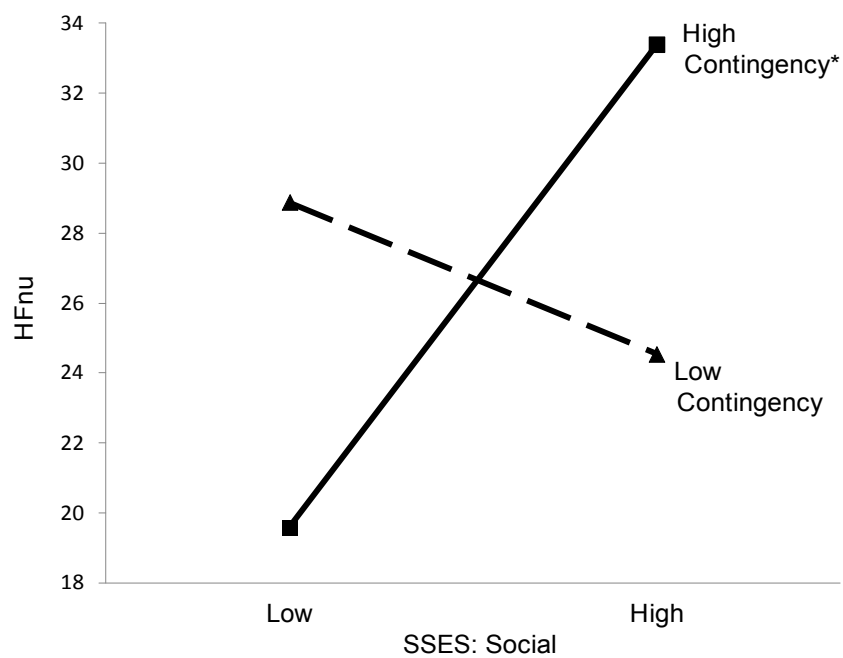


Figure 4. Hfnu during role-play plotted as a function of CSWS: APPw and SSES: Appearance during the appearance (top panel) and academic (bottom panel) scenarios.

** $p < .01$.

Appearance Scenario



Academic Scenario

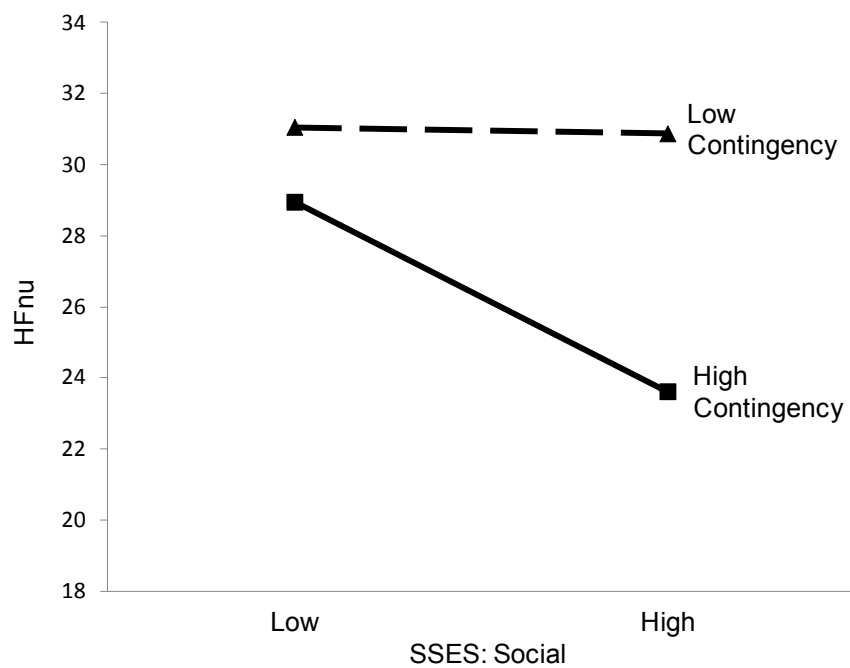
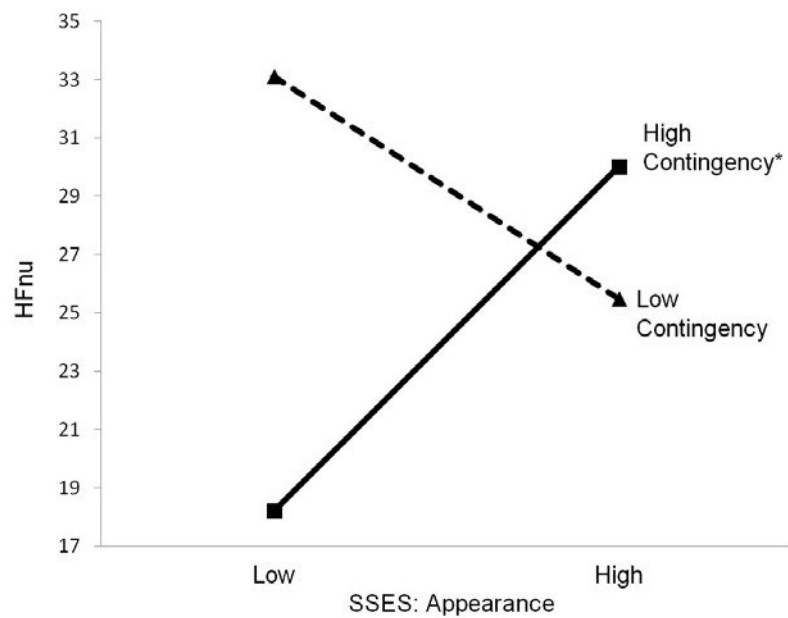


Figure 5. Hfnu during role-play plotted as a function of CSWS: APPw and SSES: Social during the appearance (top panel) and academic (bottom panel) scenarios.

* $p < .05$.

Appearance Scenario



Academic Scenario

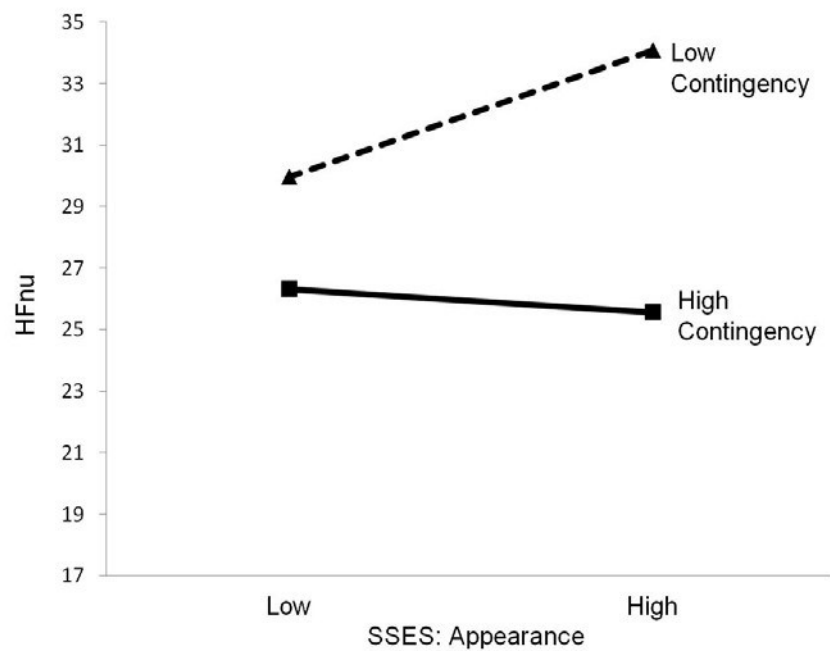


Figure 6. Hfnu during role-play plotted as a function of CSWS: ACADw and SSES: Appearance during the appearance (top panel) and academic (bottom panel) scenarios.

* $p < .05$.

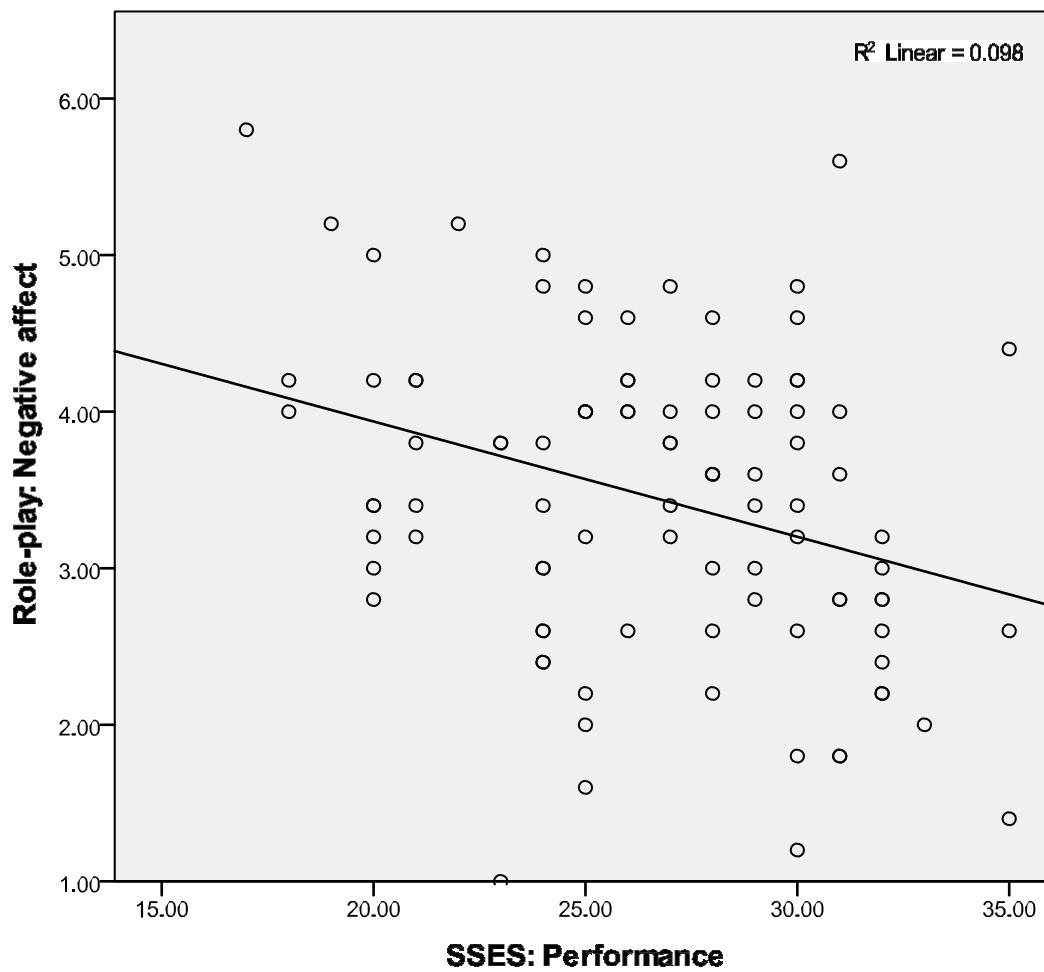


Figure 7. Scatterplot of negative affect during role-play plotted as a function of SSES: Performance.

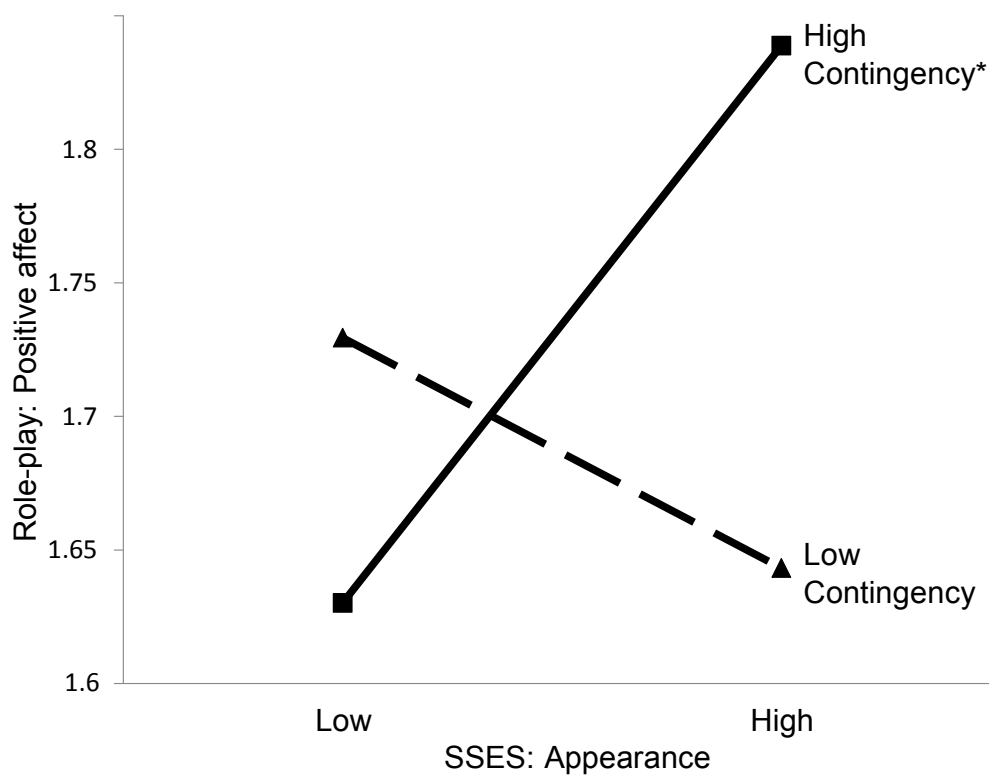


Figure 8. Positive affect during role-play plotted as a function of CSWS: APPw and SSES: Appearance.

* $p < .05$.

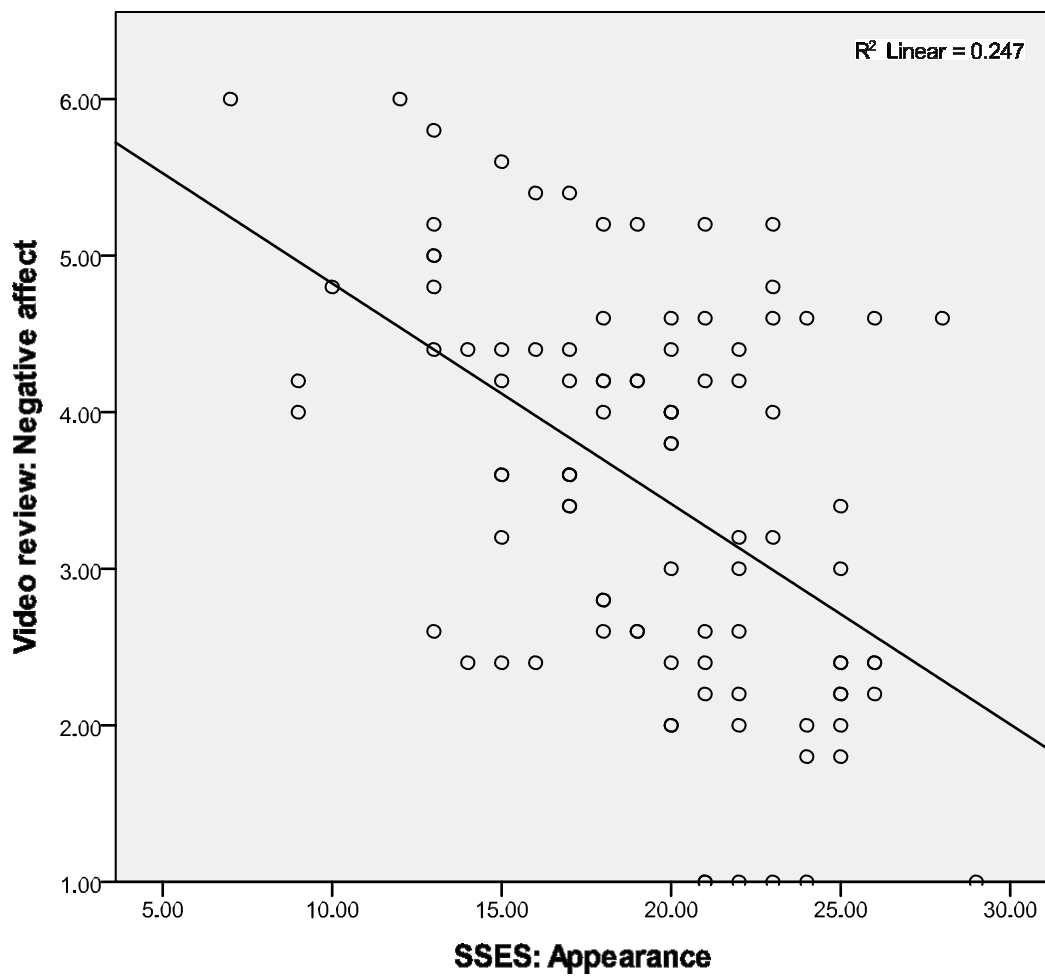


Figure 9. Scatterplot of negative affect during video review plotted as a function of SES: Appearance.

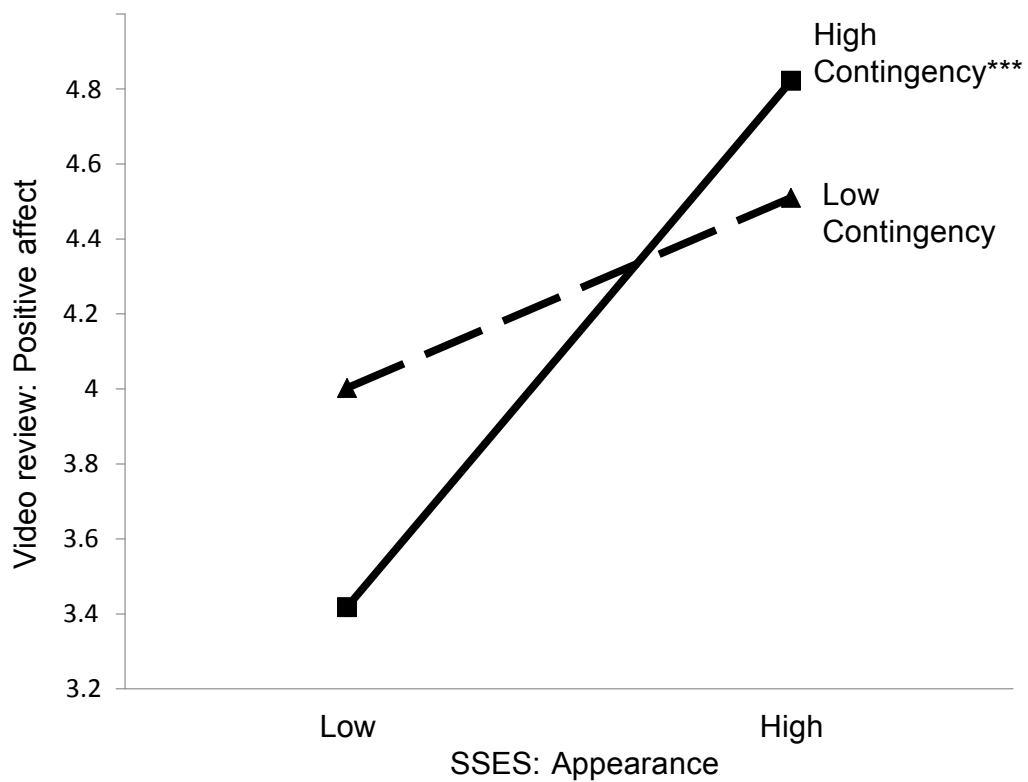


Figure 10. Positive affect during video review plotted as a function of CSWS: APPw and SSES: Appearance.

*** $p < .001$.

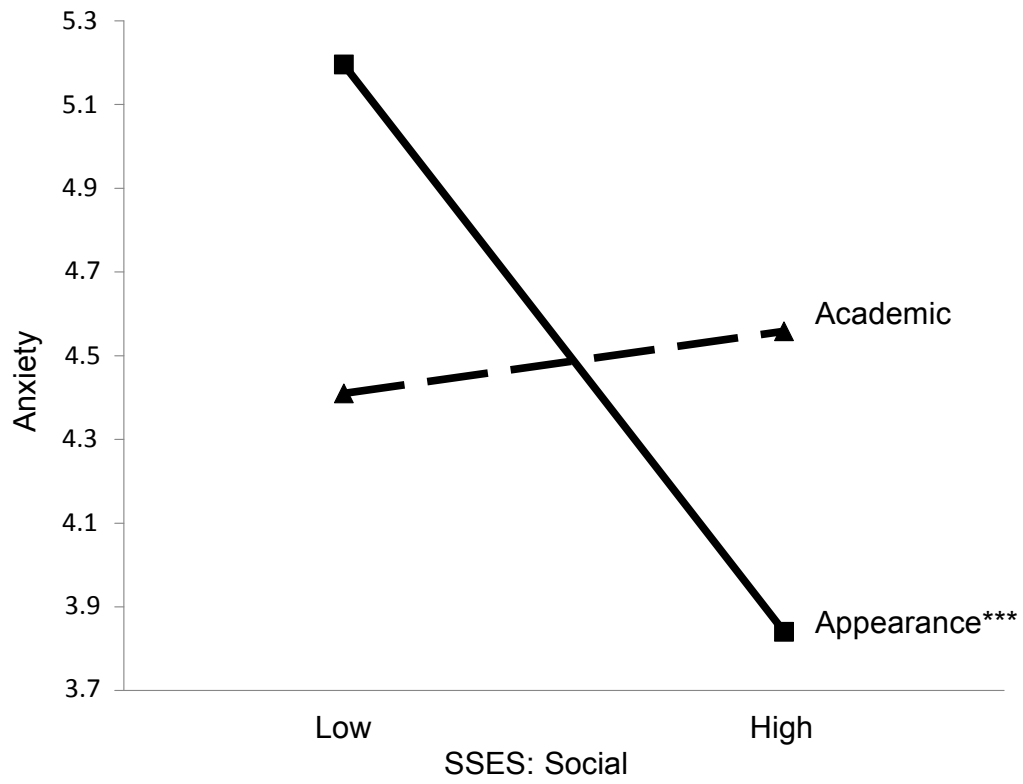


Figure 11. Anxiety plotted as a function of SSES: Social and scenario.
*** $p < .001$.

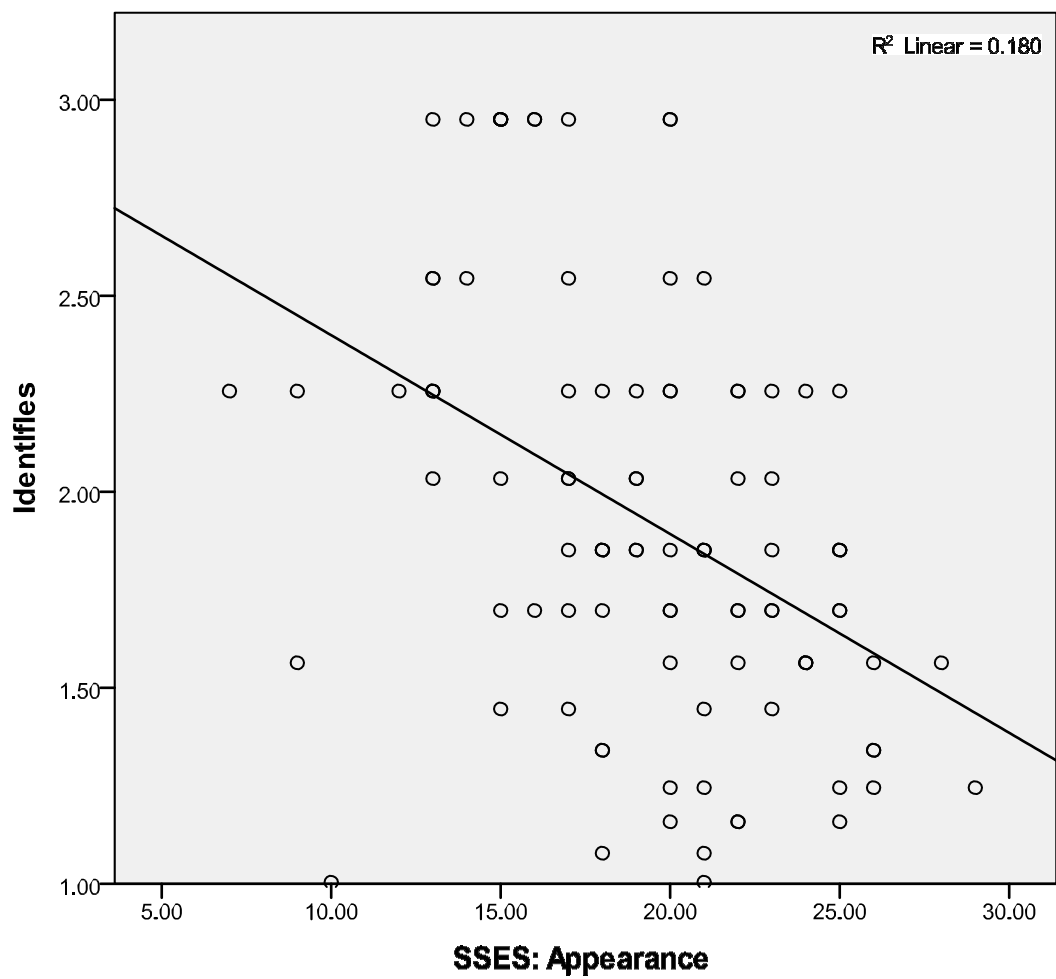


Figure 12. Scatterplot of identifies plotted as a function of SSES: Appearance.

Appendix A

Participant Recruitment E-mail

Hello,

Our names are Kristine and Danielle, graduate students in the Department of Psychology. We are conducting research and looking for women volunteers to participate in our “Therapist Study”. This study looks at the natural helping skills and biological responses of university women who volunteer to participate in a 5 minute role-play by taking on the character of a therapist. For participating in this study, you will earn \$20. If you are in a qualifying Psychology course, you will instead earn 1.5 bonus marks towards your final grade. It will take no more than 1.5 hours of your time (30 minute questionnaire, 1 hour lab visit). To learn more about this study and access the initial questionnaire, visit our website by clicking on this link:

www.surveymonkey.com/s/Therapist_Study

Thank you for your interest in our study. If you have any questions at all, please contact Kristine or Danielle.

Kristine Knauff, M.A.
Department of Psychology, Lakehead University
E-Mail: klknauff@lakeheadu.ca

Danielle Ransom, B.A.
Department of Psychology, Lakehead University
E-Mail: dransom@lakeheadu.ca

Appendix B Participam

Recruitment Flyer

Participants Wanted



Earn
\$20!

Researchers at Lakehead University are looking for females to participate in a project called the Therapist Study.

Participation requires:

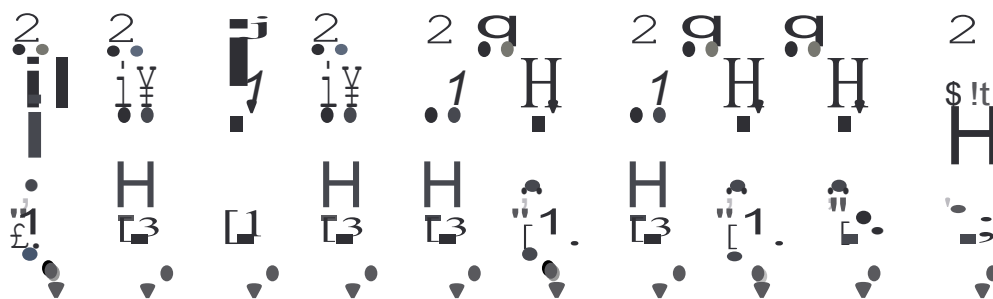
Completion of a 15 minute online survey and a 1 hour lab session

Participants will receive \$20 as compensation for their time.

For more information and online questionnaires go to
https://www.surveymonkey.com/s/Therapist_Study

This study is supported by the Lakehead University Research Ethics Board

Questions? Kristine kknauff@lakeheadu.ca



Appendix C

Participant Information and Consent Forms

Dear Potential Participant:

Our names are Kristine Knauff and Danielle Ransom. We are graduate students working with Dr. Ron Davis in the Department of Psychology here at Lakehead University. We are conducting a research project called the Therapist Study. If you agree to participate in this study, you can earn 1 ½ bonus marks in qualifying Lakehead Psychology courses (Psych 2801 students will receive 1 bonus point as this is the course maximum). If you are not in a qualifying course, you can earn \$20 for your completion of both parts of this study (Please note: Students in Psychology 1100, 2101, 2801 and 3201 are not eligible to complete this study for pay).

The purpose of this study is to examine the natural helping skills and the biological responses of university women who volunteer to participate in a role-play by taking on the character of a therapist.

Participation requires that you first complete this confidential online survey that asks you questions about different aspects of your personality, emotions, and the ways in which you relate to other people. This online survey will take up to ½ hour of your time.

Participation in the Therapist Study also requires you to come into our laboratory where you will:

1. Watch portions of the video Planet Earth,
2. Role-play the part of a professional psychotherapist with a female research assistant who pretends to consult you for help about a problem;
3. Donate small samples of your saliva into special vials;
4. Wear a comfortable chest strap to continuously record your heart rate;
5. Watch and rate your own recorded role-play interview.

Participation in the laboratory portion of this study will take no more than 1 hour of your time. The laboratory portion also requires that you abstain from eating any food or drinking any caffeinated beverages for at least 1 hour prior to visiting our laboratory to participate in the study. Other criteria for participation require that you are:

- female;
- non-smoker;
- not currently taking steroids or other medications for anxiety, depression, sleeping problems, cough, or high blood pressure.

There is no risk to participants of any physical harm. Participants may feel some transient degree of naturally occurring stress that could be expected to occur for some people while engaging in a role-play, viewing oneself on videotape, and/or filling out the questionnaires.

Your participation in this study is completely voluntary and you may withdraw at any time without penalty. All information that you provide will be kept strictly confidential. Only the

researcher and assistants will have access to your information. Your name will only be used to ensure that you receive a bonus mark toward your Psychology course final grade. The information you provide will be coded, analyzed, and securely stored at Lakehead University for 5 years. No individual participant will be identified in any report of the results. The results will be shared with the Psychology department at Lakehead University and an article will be prepared for publication in an academic journal.

This study has been approved by the Lakehead University Research Ethics Board, located in the Office of Research at Lakehead University. If you have any concerns regarding this study you are welcome to contact the Research Ethics Board at 343-8283. You are also free to contact us if you have any questions about the study.

Thank you again for your interest in participating in this study.

Kristine Knauff, M.A.
Department of Psychology, Lakehead University
E-Mail: klknauff@lakeheadu.ca
Phone: 766-9362

Danielle Ransom, B.A.
Department of Psychology, Lakehead University
E-Mail: dransom@lakeheadu.ca

Dr. Ron Davis, C. Psych., Associate Professor
Department of Psychology, Lakehead University
E-mail: ron.davis@lakeheadu.ca; Telephone: 343-8646

I have read the above information and wish to continue with this survey. Click button if you agree.

By providing my name and student number below, I indicate that I have read and understood all of the information in the previous window. I further understand and agree to the following:

1. I agree to participate in this study.
2. I agree to have my image and voice videotaped for later viewing by research assistants.
3. I am a volunteer and can withdraw at any time from this study without penalty or consequence.
4. I may choose not to answer any question asked in the questionnaires without penalty or consequence.
5. There are no anticipated physical risks associated with participation in this study. Should I experience any psychological distress or discomfort, I am entitled to a list of counselling resources from the researcher.
6. My data will remain confidential and will be securely stored in the Department of Psychology at Lakehead University for 5 years.
7. My information will remain anonymous should any publications or public presentations come out of this study.
8. I may receive a summary of this research upon completion of this study.
9. I give my permission to be contacted by email for the purpose of participation in this study.



I have read and understand the above "Consent to Participate."

Appendix D Demographic

Questionnaire

1. What is your current age?
2. What is your relationship status?
 - Married/Common-law
 - Divorced/Separated
 - Single
 - Widowed
3. What is your ethnicity?
 - Caucasian
 - South Asian
 - Hispanic
 - African-Canadian
 - European
 - First Nations
 - East Asian
 - Other. Please Specify:
4. What is your school enrolment?
 - Full-time
 - Part-time
5. What academic program(s) are you in?
6. What is/are your majors?

Appendix E

Contingencies of Self-Worth Scale

INSTRUCTIONS: Please respond to each of the following statements by indicating your answer using the scale from “1 = Strongly Disagree” to 7 = Strongly Agree”. If you haven’t experienced the situation described in a particular statement, please answer how you think you would feel if that situation occurred.

- 1 = Strongly Disagree
 2 = Disagree
 3 = Disagree Somewhat
 4 = Neutral
 5 = Agree Somewhat
 6 = Agree
 7 = Strongly Agree

1. When I think I look attractive, I feel good about myself.
2. My self-worth is based on God’s love.
3. I feel worthwhile when I perform better than others on a task or skill.
4. My self-esteem is unrelated to how I feel about the way my body looks.
5. Doing something I know is wrong makes me lose my self-respect.
6. I don’t care if other people have a negative opinion of me.
7. Knowing that my family members love me makes me feel good about myself.
8. I feel worthwhile when I have God’s love.
9. I can’t respect myself if others don’t respect me.
10. My self-worth is not influenced by the quality of my relationships with my family members.
11. Whenever I follow my moral principles, my sense of self-respect gets a boost.
12. Knowing that I am better than others on a task raises my self-esteem.
13. My opinion about myself isn’t tied to how well I do in school.
14. I couldn’t respect myself if I didn’t live up to a moral code.
15. I don’t care what other people think of me.
16. When family members are proud of me, my sense of self-worth increases.
17. My self-esteem is influenced by how attractive I think my face or facial features are.
18. My self-esteem would suffer if I didn’t have God’s love.
19. Doing well in school gives me a sense of self-respect.
20. Doing better than others gives me a sense of self-respect.
21. My sense of self-worth suffers whenever I think I don’t look good.
22. I feel better about myself when I know I’m doing well academically.
23. What others think of me has no effect on what I think about myself.
24. When I don’t feel loved by my family, my self-esteem goes down.
25. My self-worth is affected by how well I do when I am competing with others.
26. My self-esteem goes up when I feel that God loves me.
27. My self-esteem is influenced by my academic performance.
28. My self-esteem would suffer if I did something unethical.
29. It is important to my self-respect that I have a family that cares about me.
30. My self-esteem does not depend on whether or not I feel attractive.

31. When I think that I'm disobeying God, I feel bad about myself.
32. My self-worth is influenced by how well I do on competitive tasks.
33. I feel bad about myself whenever my academic performance is lacking.
34. My self-esteem depends on whether or not I follow my moral/ethical principles.
35. My self-esteem depends on the opinions others hold of me.

Appendix F

State Self-Esteem Scale

Current Thoughts

This is a questionnaire designed to measure what you are thinking at this moment. There is, of course, no right answer for any statement. The best answer is what you feel is true of yourself at this moment. Be sure to answer all of the items even if you are not sure of the best answer. Again, answer these questions as they are true for you **RIGHT NOW**.

1= Not at all

2= A little bit

3= Somewhat

4=Very much

5=Extremely

1. I feel confident about my abilities.
2. I am worried about whether I am regarded as a success or failure.
3. I feel satisfied about the way my body looks right now
4. I feel frustrated or rattled about my performance.
5. I feel that I am having trouble understanding things that I read.
6. I feel that others respect and admire me.
7. I am dissatisfied with my weight.
8. I feel self-conscious.
9. I feel as smart as others.
10. I feel displeased with myself.
11. I feel good about myself.
12. I am pleased with my appearance right now.
13. I am worried about what other people think of me.
14. I feel confident that I understand things.
15. I feel inferior to others at this moment.
16. I feel unattractive.
17. I feel concerned about the impression that I am making.
18. I feel that I have less scholastic ability right now than others.
19. I feel like I am not doing well.
20. I am worried about looking foolish.

Appendix G

Post-Study Questionnaire

We are interested in finding out your reactions to the study that you just participated in.

1= Strongly Disagree

2= Disagree

3= Disagree Somewhat

4= Neutral

5= Agree Somewhat

6= Agree

7= Strongly Agree

I found the task of being the therapist to be...

1. Difficult.
2. Enjoyable.
3. Stressful.
4. Pleasant.
5. Shameful.
6. Inspiring.
7. Depressing.
8. Positive.
9. Awkward.
10. Enjoyable.

I found the task where I was asked to watch the video and rate myself to be...

1. Difficult.
2. Enjoyable.
3. Stressful.
4. Pleasant.
5. Shameful.
6. Inspiring.
7. Depressing.
8. Positive.
9. Awkward.
10. Enjoyable.

Respond to each of these statements.

1. I understand my "client's" problem.
2. I personally relate to my client's problem.
3. I too have a similar problem to my client
4. If this role-play scenario were the real thing, I believe that I would be able to help my client with her problem.

Appendix H Appearance

Scenario Script

Therapist (Participant)- *So what brings you in here today, Kristine?*

Client (Research Assistant)- Well, it's something I've been struggling with for a long time, but since I came to university, it's gotten much worse. I've never really liked the way I look, but it didn't really affect me that much before I came here and started living in residence. I'm always comparing myself to all of the other girls I live with and feeling like I am so much fatter and uglier than they are. I always hear them getting compliments about how they look, but no one ever says anything like that to me. I'm finding that I'm starting to take any little remark someone makes to me and trying to figure out whether they're commenting about my appearance. It's getting to the point where I'm feeling anxious all the time. I don't want to feel like this any more so I thought I had better come and talk to someone like you about it.

Therapist- *Asks about thoughts/feelings about appearance*

Client- I've really been beating myself up a lot; always thinking that I'm just not good enough. I'll look at myself in the mirror and just hate what I see. My face, my stomach, my legs, are all just disgusting to me. I especially have been telling myself that I'm so lazy. That if I only went to the gym more and actually got in shape, that I would look and better and it would solve all my problems. Then I start looking at my friends and it seems like they don't have to work at it and they're all so beautiful. Then I get jealous and just start feeling like it's hopeless. I could spend 5 hours a day at the gym and I still wouldn't look as good as them.

Therapist- *Asks about how it is affecting life*

Client- When I start feeling like that I just stay in my room and think about everything that's wrong with how I look. My friends will come and invite me out to do things, I guess to cheer me up, but I can't do it because I don't want to be around them and be reminded about how much better looking they are. I also am finding it hard to concentrate on other things. My mind keeps wandering back to how I look, so that even when I do manage to go out or do other things, I don't really enjoy them.

Therapist- *Asks how long this has been going on*

Client- I've felt like this sometimes since I was 13, but it was usually very temporary. I'd say I started feeling like this most of the time since I moved into residence this year. At first I thought I was just having trouble getting used to living here and I would get over it, but it's been getting worse and worse throughout the year. I don't think I've ever felt this ugly before.

Appendix I Academic

Scenario Script

Therapist (Participant)- *So what brings you in here today, Kristine?*

Client (Research Assistant)- Well, it's something I've been struggling with for a long time, but since I came to university, it's gotten much worse. I've never really thought I was smart, but it didn't really affect me that much before I came here and started living in residence. I'm always comparing myself to all of the other girls I live with and feeling like I am so much dumber and incompetent than they are. I always see them getting good feedback from their professors on their papers and exams but no one ever says anything like that to me. I'm finding that I'm starting to take any little remark someone makes to me and trying to figure out whether they're commenting about my grades. It's getting to the point where I'm feeling anxious all the time. I don't want to feel like this any more so I thought I had better come and talk to someone like you about it.

Therapist- *Asks about specific thoughts/feelings about academics*

Client- I've really been beating myself up a lot; always thinking that I'm just not good enough. I'll take a look at my grades online and I just hate what I see. There isn't one course that I'm happy with how I have been doing. I especially have been telling myself that I'm so lazy. That if I only studied more and actually worked harder, that I would get better grades and it would solve all my problems. Then I start looking at my friends and it seems like they don't have to work at it and they're all so smart. Then I get jealous and just start feeling like it's hopeless. I could spend 5 hours a day studying and I still wouldn't do as well as them.

Therapist- *Asks about how it is affecting life*

Client- When I start feeling like that I just stay in my room and think about everything that's wrong my schoolwork. My friends will come and invite me out to do things, I guess to cheer me up, but I can't do it because I don't want to be around them and be reminded about how much smarter they are. I also am finding it hard to concentrate on other things. My mind keeps wandering back to my grades, so that even when I do manage to go out or do other things, I don't really enjoy them.

Therapist- *Asks how long this has been going on*

Client- I've felt like this sometimes since I was 13, but it was usually very temporary. I'd say I started feeling like this most of the time since I moved into residence this year. At first I thought I was just having trouble getting used to living here and I would get over it, but it's been getting worse and worse throughout the year. I don't think I've ever felt this stupid before.

Appendix J

Debriefing Form

Dear Participant:

This sheet gives you brief summary of the experience that you just completed in this study on the *psychobiology of the role-play*. Please read carefully so that you can correctly answer two questions at the bottom of the page.

Role-playing can evoke different psychological and bodily reactions particularly if the situation is novel and videotaped, just like the experience you went through.

Psychological experiences can range from positive (e.g., enjoyment) through negative (e.g., anxiety) mood which can be very different from one individual to the next. Another possible psychological reaction is the changes in the way in which we view ourselves, called self-esteem.

Bodily reactions are much less apparent to us, but can include increases in sympathetic activation of our autonomic nervous system. This manifests itself as increases in heart rate (HR) and decreases in the variability of timing between heart beats (called heart rate variability or HRV). We have your heart rate recordings from the chest strap that you wore so we will be able to look at people's cardiac responses to the role-play.

Over the next many months we plan to analyze the way in which psychological reactions are statistically related to the bodily reactions of people like you who participated in this study.

Just to make sure that you understand the basic science behind this study, we would like you to take a moment and answer the following two questions:

Name one psychological variable that this study is investigating: _____

Name one biological variable that the study is investigating: _____

If you have any questions about the study, please ask now. Do you want a brief summary of the results of this study? If so, print your LU email address and we will send it to you when it is available:

Email address: _____

Again, thank you for participating in our study!