

AN EXPLORATION OF VULNERABILITY TO PANIC DISORDER:  
THE ROLE OF ANXIETY SENSITIVITY AND EMOTION REGULATION

by

Catherine A. Fraser

Bachelor of Science (Honours Psychology), Dalhousie University, 2010

A Dissertation Submitted in Partial Fulfillment of  
the Requirements for the Degree of

Doctor of Philosophy

In the Graduate Academic Unit of Psychology

Supervisor: David A. Clark, Ph.D., Department of Psychology

Examining Board: Daniel Voyer, Ph.D., Department of Psychology  
David Bedford, Ph.D., Department of Political Science  
Kenneth Seaman, Ph.D., Department of Kinesiology

External Examiner: Steven Taylor, Ph.D., Department of Psychiatry  
Faculty of Medicine, University of British Columbia

This dissertation is accepted by the  
Dean of Graduate Studies

THE UNIVERSITY OF NEW BRUNSWICK

May, 2018

© Catherine A. Fraser, 2018

## Abstract

Anxiety sensitivity (AS) is the fear of anxiety-related sensations (Reiss & McNally, 1985; Reiss, 1991) and is a vulnerability factor for anxiety disorders, particularly panic disorder (e.g., Taylor, 1999; McNally, 2002). Emotion regulation has also been linked to anxiety symptomatology, with adaptive regulation strategies associated with the down-regulation of anxiety, and maladaptive strategies linked to the up-regulation and maintenance of anxiety (John & Gross, 2007). While initial research suggests that high AS and emotion regulation difficulties interact to produce a greater expression of anxiety (e.g., Vujanovic, Zvolensky, & Bernstein, 2008), the nature of the AS-emotion regulation relationship requires further investigation. The goal of this dissertation was to determine if AS is associated with heightened fearful responding *and* an inability to effectively regulate fear using an experimental design. Participants ( $N=161$ ) engaged in a 15-minute physiological arousal induction task (i.e., cycling on a stationary bike), and were assigned to either an experimental or control group. Participants in the experimental group were informed that they had an unexpectedly high heart rate, whereas those in the control group were told that the heart rate monitor malfunctioned. In both groups participants were asked to stop cycling after receiving the false feedback. Participants who were assigned to the experimental group were then asked to engage in either an adaptive (i.e., cognitive reappraisal) or maladaptive (i.e., catastrophizing) emotion regulation strategy pertaining to their elevated heart rate. Self-reported fear, anxiety, and threatening cognitions were measured at baseline, after false feedback, and following the emotion regulation task. General Linear Modelling with categorical and continuous independent variables was employed to test study hypotheses. Results

revealed that heightened AS was associated with increased fearful responding to false physiological feedback, providing further support for the association between AS and emotional intensity. However, AS was not associated with the regulation of fearful responding. Clinical implications, limitations, and suggestions for future research are discussed.

To my husband, Andrew.

## Acknowledgements

This dissertation would not have been possible without the involvement and support of many individuals. First, I would like to express sincere gratitude to my supervisor, Dr. David A. Clark, for his encouragement and guidance over the past eight years. I am extremely thankful for his dedication to my professional development and his unwavering belief in my success. I would also like to thank my committee members: Dr. Daniel Voyer, Dr. Kenneth Seaman, Dr. David Bedford, and Dr. Steven Taylor, for their insightful feedback. I am especially grateful for Dr. Daniel Voyer's statistical expertise and guidance over the years. I also wish to acknowledge Dr. Kenneth Seaman's guidance and role in making this study possible by lending me a stationary bicycle for a year. My sincere thanks also go to Dr. Lucia O'Sullivan, for her invaluable contributions during the initial development of the project, and to Dr. E. Sandra Byers for her thorough and helpful comments. I want to thank Cassandra Bullett and Whitney Tucker for their assistance with data collection, and all of the student volunteers who participated in this research project. I also wish to thank Catherine Gallagher for the extremely helpful AS-related discussions. On a more personal note, I would like to thank my colleagues, friends, and family for supporting me through the highs and lows of my grad school experience. To Mom, Dad, Jeff, and Krista: thank you for your endless love, understanding, and encouragement. Finally, I would like to express gratitude to my wonderful husband, Andrew, who has jumped through every hoop with me and celebrated every milestone; thank you for always believing in me (I did it!).

## Table of Contents

ABSTRACT .....	ii
DEDICATION .....	iv
ACKNOWLEDGEMENTS .....	v
LIST OF TABLES.....	viii
LIST OF FIGURES .....	ix
1.0 LITERATURE REVIEW.....	1
Introduction.....	1
Overview of Panic Disorder.....	3
Psychological Theories of Panic Disorder.....	6
Vulnerability.....	10
Cognitive Vulnerability Model for Panic Disorder.....	11
Anxiety Sensitivity: Psychometric Validation.....	13
Anxiety Sensitivity as a Cognitive Vulnerability Factor for Panic.....	15
Emotion Regulation.....	31
Anxiety Sensitivity and Emotion Regulation.....	38
Overall Literature Summary.....	42
Study Purpose.....	44
Hypotheses .....	44
2.0 INITIAL PSYCHOMETRIC INVESTIGATION.....	46
Introduction.....	46
Methodology.....	48
Results.....	54
Conclusion.....	64
3.0 METHODOLOGY .....	66
Participants.....	66
Measures .....	68
Apparatus .....	74
Procedure.....	74
Data Analysis Plan.....	78
4.0 RESULTS.....	81
Data Screening and Conditioning.....	81
Preliminary Analyses.....	82
Manipulation Check.....	84
Hypotheses Testing.....	87
Supplemental Analyses: Emotional Specificity .....	91

5.0 DISCUSSION..... 100  
Hypothesis 1: Anxiety Sensitivity and Emotional Intensity ..... 102  
Hypothesis 2: Anxiety Sensitivity and Emotion Regulation..... 106  
Emotion Specificity of Anxiety Sensitivity ..... 107  
Methodological and Conceptual Limitations ..... 109  
Future Directions ..... 114  
Conclusion..... 117

REFERENCES..... 119

APPENDICES..... 132

CURRICULUM VITAE

List of Tables

Table	Page
Initial Psychometric Investigation:	
1. TCS Item Descriptive Statistics .....	59
2. TCS Item-Total Statistics (Cronbach’s Alpha if Item Deleted) .....	60
3. TCS Item-Total Correlations.....	61
4. Correlations, Means, Standard Deviations, and Ranges of TCS and Trait Measures	62
5. Means, Standard Deviations, and Ranges for State Measures and Correlations with TCS .....	63
Primary Study:	
6. Means, SDs, and Ranges for the ASI-3, BVS, and DERS.....	94
7. Correlations among the ASI-3, BVS, and DERS.....	95
8. Mean Scores of Measures at Baseline by Group (SDs in Brackets) .....	96
9. Frequency of Scores of 0 on Each DV as a Function of Group and Time.....	97
10. Means for Dependent Variables by Feedback Group (SDs in Brackets) .....	98
11. Means for Dependent Variables by Emotion Regulation Condition (SDs in Brackets) .....	99



## List of Figures

Figure	Page
1. Overview of Study Procedure.....	75

## CHAPTER 1: LITERATURE REVIEW

### Introduction

Anxiety sensitivity (AS) is a cognitive vulnerability factor for panic disorder characterized by the fear of arousal-related sensations commonly associated with anxiety (e.g., perspiration, heart palpitations, dizziness) due to the belief that these sensations portend negative consequences pertaining to physical illness, mental dyscontrol, or social ridicule (Reiss & McNally, 1985; Reiss, 1991). Since AS is a vulnerability factor for panic, it is important to uncover mechanisms underlying this relationship. Schmidt and Woolaway-Bickel's (2006) integrated cognitive vulnerability model of panic disorder conceptualizes vulnerability as consisting of interrelated cognitive processes. AS is a distal vulnerability factor that influences catastrophic cognitions, the proximal cognitive vulnerability to panic. Catastrophic cognitions of bodily sensations are defined as an exaggerated interpretation of the dangerousness of bodily sensations, and are key in cognitive theories of panic (D. M. Clark, 1986; Beck, 1988). Individuals with elevated AS are predisposed to interpret bodily sensations in a catastrophic manner, resulting in increased risk for the development of panic disorder (Taylor, 1999).

Although heightened AS is associated with increased anxious and fearful responding, less is known about how individuals with elevated AS regulate their emotions. Emotion regulation refers to a set of processes that influence the presence, type, degree and experience of emotions (Gross, 1998a; Gross & Thompson, 2007). One potentially useful area of research is the relationship between AS and emotion regulation. Does heightened AS lead to greater fear and anxiety because individuals utilize ineffective emotion regulation strategies? It has been speculated that high AS is associated with increased fearful responding *and* an inability to regulate fear (Koole,

2009).

Researchers have examined the contribution of AS and emotion dysregulation to panic symptomatology separately (e.g., Taylor, 1999; Baker et al., 2004), but only a few studies have examined the interplay of these factors (e.g., Catanzaro, 1993; Vujanovic, Zvolensky, & Bernstein, 2008). Findings indicate that individuals with both elevated AS and difficulties with emotion regulation report more symptoms of anxiety (Vujanovic et al., 2008). However, studies examining the relationship within an experimental context are lacking. A better understanding of how these processes may interact will advance our understanding of cognitive vulnerability to panic as well as sharpen cognitive behavioural treatment for this disorder. To better understand the phenomenology of AS, consider the following case example.

#### **Case Vignette of Elevated Anxiety Sensitivity**

*Jane is a 20-year-old university student who describes herself as very anxious. Jane's experiences of anxiety tend to be triggered by certain bodily sensations that are evoked by various activities, during which she has a sense of dread that something bad might happen. For example, whenever Jane participates in physical activity, she becomes very nervous and frightened when she experiences increased ventilation and perspiration. When this occurs, she often worries that she will not be able to breathe properly, and that she might eventually suffocate. She also becomes fearful that others will notice that she is sweating and that she will be ridiculed. When Jane is studying for exams she often drinks multiple cups of coffee, triggering an accelerated heart rate. When this happens, she thinks that something is wrong with her heart and that she will eventually have a heart attack. On one occasion Jane's mind went blank while writing an exam, at which time she believed that she might be "losing her mind." Jane has*

*begun to have panic attacks - short periods of intense fear and anxiety - that come “out of the blue” and she is starting to avoid situations and events that she believes will trigger a panic attack (e.g., going to the gym, drinking coffee).*

Jane is experiencing panic attacks and is at risk for developing panic disorder. One of the contributing factors to Jane’s vulnerability to panic is her elevated AS. Since Jane has high AS, she is predisposed to interpret her bodily sensations in a catastrophic manner. The following literature review will provide an overview of panic disorder and then will focus on AS as a vulnerability factor for the development and maintenance of panic psychopathology.

## **Overview of Panic Disorder**

### **Diagnostic Features**

According to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5; American Psychiatric Association, APA, 2013), individuals with panic disorder experience recurrent and unexpected panic attacks. Panic attacks involve intense fear or discomfort including four or more of the following physical or cognitive symptoms: 1) heart palpitations, 2) sweating, 3) trembling or shaking, 4) shortness of breath, 5) choking sensations, 6) chest pain, 7) nausea, 8) dizziness, 9) chills or heat sensations, 10) paresthesias, 11) derealisation, 12) fear of losing control or going crazy, and 13) fear of dying. During a panic attack, symptoms appear abruptly and reach their peak rapidly (e.g., within ten minutes). Panic attacks are heterogeneous in that the symptoms and associated distress may vary across individuals. DSM-5 specifies two types of panic attacks: expected and unexpected. Expected panic attacks occur in response to an obvious trigger, such as a feared situation or a negative experience. On the other hand, unexpected panic attacks occur for no apparent reason, without an obvious trigger. This

distinction is important because panic disorder is defined by the presence of two or more *unexpected* panic attacks. Panic attacks are not specific to panic disorder as they occur in many types of anxiety and other disorders, as well as in the general population.

However, panic disorder is diagnosed when the fear associated with unexpected panic attacks is so distressing that it is accompanied by at least one month of persistent worry about having additional attacks or their consequences (e.g., having a heart attack) and/or maladaptive changes in behaviour related to the attacks (e.g., avoidance of situations where panic may occur). To receive a diagnosis of panic disorder, an individual's panic attacks cannot be due to the physiological effects of a substance (e.g., caffeine, cocaine) or medical condition (e.g., hypothyroidism), nor be better accounted for by another mental disorder (APA, 2013).

### **Epidemiology**

Epidemiological data from the United States National Comorbidity Survey Replication (NCS-R; Kessler, Chiu, Jin, Ruscio, Shear, & Walters, 2006) indicates that a high percentage of the general population experiences at least one panic attack in their lifetime (28.3%) as well as within the past 12 months (11.2%). However, most individuals who experience panic attacks do not develop panic disorder. Thus, lifetime prevalence rates of panic disorder are approximately 4.7% in the general population, with 12-month rates approximately of 2.8% (Kessler et al., 2006). Similarly, the Canadian Community Health Survey (CCHS 1.2) reported a lifetime prevalence of 3.7% for panic disorder and a 12-month rate of approximately 1.5% (Statistics Canada, 2003). Panic disorder appears to be more prevalent among females, with rates approximately twice as high in women compared to men (Goodwin et al., 2005; Kessler et al., 2006). In Canada, lifetime prevalence rates are approximately 4.6% and 2.8% for women and

men, respectively (Statistics Canada, 2003).

Onset of panic disorder typically occurs between late adolescence and early adulthood, with an average onset age of 24-25 years old (Kessler et al., 2006; Statistics Canada, 2002). The course of panic disorder is generally chronic with some waxing and waning of symptoms over time (Faravelli, Paterniti, & Scarpato, 1995; Nay, Brown, & Roberson-Nay, 2013). The chronic nature of panic disorder is particularly evident if left untreated, with only a minority of untreated individuals remitting without relapse (Katschnig & Amering, 1998). According to the NCS-R data, most individuals in the general population with panic disorder do receive treatment. However, most available treatments do not meet basic treatment guidelines recommended for panic disorder, potentially contributing to the chronicity of the disorder (Kessler et al., 2006).

### **Negative Impact**

Panic disorder has devastating consequences for those affected. The disorder is associated with significant functional impairment and poor quality of life. Panic disorder can follow a lifelong, debilitating path with its symptoms associated with negative consequences on physical health, social relationships, and work (Antony, Roth, Swinson, Huta, & Devins, 1998; Stein et al., 2005). Panic disorder is also associated with comorbid conditions such as other anxiety disorders, mood disorders, and substance use disorders (Kessler et al., 2006). Furthermore, panic attacks without a history of panic disorder also have been associated with poor mental health, distress, and low psychological well-being (Kinley, Cox, Clara, Goodwin, & Sareen, 2009).

Individuals with panic disorder tend to over utilize health care services compared to the general population and to those with other mental disorders (Barsky, Delamater, & Orav, 1999; Deacon, Lickel, & Abramowitz, 2008). Deacon and colleagues (2008)

found that individuals with panic disorder had significantly more medical visits (e.g., cardiology) than those with other anxiety disorders, and proposed that the spontaneous and fearful nature of panic often prompts patients to seek medical attention. Therefore, panic disorder causes a substantial economic burden to health service provision. It is essential that individuals with panic disorder receive appropriate treatment in the initial stages to reduce such costs.

In sum, panic disorder is a particularly debilitating disorder. It is important that research be devoted to better understand the nature of panic disorder given its personal and social cost. Treatment and prevention programs for panic rely on our understanding of the mechanisms that lead to the development and maintenance of the disorder. The present research examined the nature of such factors, specifically those that confer vulnerability to the development of panic psychopathology.

### **Psychological Theories of Panic Disorder**

After panic disorder was first introduced in the *Diagnostic and Statistical Manual of Mental Disorders-3<sup>rd</sup> edition* (DSM-III; APA, 1980), psychological theories emerged to describe the etiology of the disorder. Due to the wide range of psychological models that were published, the current review will focus on prominent models of panic disorder that have been influential in research and clinical practice.

#### **Cognitive Model of Panic**

Cognitive theories of panic disorder propose that symptoms are characterized by biased cognitive functioning: it is the appraisal of physiological symptoms, as opposed to the symptoms alone, that plays a critical role in the pathogenesis of panic disorder. Cognitive models focus on factors that may influence the appraisal process. The cognitive model was first introduced by Beck and colleagues (Beck, 1988; Beck, Emery,

& Greenberg, 1985; Beck & Greenberg, 1988; D. M. Clark & Beck, 1988) and further elaborated by D. M. Clark (1986, 1988). Such models emphasize catastrophic misinterpretation of certain bodily sensations as the central cognitive process in the maintenance of panic. Catastrophic misinterpretation refers to the interpretation of bodily sensations as being much more harmful than they really are, along with the belief that danger is imminent. For example, an individual with panic disorder might catastrophically misinterpret normal fluctuations in heart rate as a heart attack. In his seminal paper, D. M. Clark (1986) articulated the cycle of panic disorder. According to his model, various stimuli can provoke panic attacks with triggers typically involving the recognition of benign physiological sensations (e.g., an individual notices heart palpitations). If the stimulus is perceived as threatening, a state of mild apprehension results, leading to increased physiological arousal, which, in turn is perceived catastrophically (e.g., "I'm having a heart attack"). This results in a vicious cycle that culminates in a panic attack. Beck's (1988) cognitive theory of panic contends that a second cognitive process, loss of reappraisal capacity, is also an important factor in the pathogenesis of panic. According to Beck, vulnerable individuals initially generate a catastrophic misinterpretation of a bodily sensation but then the anxiety producing effects of the misinterpretation persist because the individual fails to correctly reappraise the sensation as benign (see also D. A. Clark & Beck, 2010). In sum, the cognitive model of panic disorder delineates specific primary appraisal and secondary elaborative processes that are responsible for the persistence of panic disorder.

### **Barlow's Integrated Model of Panic**

Barlow (1988, 2002) offers a more integrative conceptualization of panic disorder that incorporates biological, cognitive, and learning processes. Barlow made a



distinction between panic and anxiety, with panic defined as an erroneous alarm reaction to imminent danger (a “false alarm”). On the other hand, anxiety is conceptualized as future-oriented and characterized by a sense that events are uncontrollable and unpredictable. In his model, the etiology of panic can be traced to both general biological and psychological vulnerability to experience a false alarm (i.e., a panic attack) in response to stressful/negative life events. The psychological vulnerability is characterized by anxious apprehension about future attacks due to the sense that events and emotions are uncontrollable and unpredictable. This vulnerability leads to heightened focus of attention on the physiological symptoms associated with a “false alarm” (i.e., panic attack) leading to the development of “learned alarms” through classical conditioning. These “learned alarms” are triggered by physiological symptoms and cognitive cues, and ultimately lead to the development of panic disorder. While the cognitive appraisal of physical symptoms is not a necessary precursor to panic in Barlow’s model, he acknowledged that some panic attacks might be preceded by appraisals of danger, which is consistent with the cognitive model of panic (e.g., Beck, 1988; D. M. Clark, 1986).

### **Reiss’s Expectancy Theory**

Reiss’s expectancy theory identifies factors that create vulnerability to anxiety and panic. The expectancy theory of fear proposes that three fundamental fears (sensitivities) are the basis of all fear and anxiety: 1) the fear of negative evaluation, 2) the fear of injury/illness, and 3) anxiety sensitivity (Reiss & McNally, 1985; Reiss, 1991). Reiss (1991) proposed that the fundamental fears are defined and distinguished from ordinary fears based on two characteristics. First, fundamental fears focus on naturally noxious stimuli. Second, all common fears (e.g., heights, snakes) can be

reduced to the fundamental fears. According to Reiss (1991), fundamental fears provide reason for fearing a wide range of stimuli, whereas common fears do not. That is, individuals fear ordinary events or objects *because* of the fear of negative evaluation, injury/illness, or anxiety sensitivity. Therefore, the fundamental fears represent individual differences underlying fearful responding.

Anxiety sensitivity (AS) is the fear of anxiety-related physiological sensations that arise from enduring beliefs that these sensations have harmful physical, psychological, or social consequences (Reiss, 1991). Examples of these bodily sensations include increased heart rate, ventilatory rate, and perspiration rate. Individuals with elevated AS experience heightened fear in response to sensations that often accompany fear/anxiety due to the belief that the sensations are a sign of an impending negative event. They are more likely to have catastrophic thoughts about the consequences of physiological sensations, such as believing a racing heartbeat is an indicator they are going to have a heart attack, sweating in public will lead to social ridicule, or that feeling “spacey” suggests the presence of mental illness. On the other hand, individuals with low levels of AS may perceive these sensations to be unpleasant, but can recognize their generally harmless and transient nature. Of the fundamental fears, AS has received the most research and is most relevant in the discussion of panic disorder.

### **Summary of Psychological Theories of Panic Disorder**

As noted by Rapee (1993), the psychological theories for panic disorder are more similar than different. It is the association of physiological sensations with threat that is key in the development of panic disorder (Clark, 1986; Beck, 1988; Barlow, 1988).

Taken together, cognitive misappraisal of physiological arousal is the central component

in the development of panic and anxiety. While Barlow's (1988) learning-based model states that cognitive appraisal of sensations is not a necessary precursor to panic, he does note that cognitive misappraisal may cue the experience of panic. This perspective emphasizes cognitive mediation as important in panic disorder etiology and therefore provides a framework for the treatment and prevention of anxiety. Furthermore, a commonality among the psychological theories is the view that risk for panic can be traced to specific psychological vulnerabilities. The cognitive model indicates that some individuals are prone to interpret physical sensations in a catastrophic manner (Clark, 1986; Beck, 1988) and Barlow (1988) identified a general psychological vulnerability of anxious apprehension about panic attacks. Vulnerable individuals are at greater risk for the development of panic due to the association between arousal and threat. Reiss (1991) proposed that AS is a central psychological vulnerability factor in which individuals with elevated AS are more likely to experience physiological sensations as threatening. Psychological vulnerability, then, is a key construct in the etiology of panic.

### **Vulnerability**

Since the present research focuses on vulnerability to anxiety (i.e., AS; Reiss, 1991), it is important to consider the conceptualization of vulnerability more generally. Vulnerability deals with both the causal and maintaining factors of a disorder (Ingram & Price, 2001; 2010). Ingram and Price (2001; 2010) delineate the core features of a vulnerability factor as being 1) a stable trait, 2) endogenous, and 3) latent. First, vulnerability factors are relatively permanent processes that endure across time. Second, endogenous factors are those that reside within the individual. Third, vulnerability factors are latent; that is, they are not easily observable. Researchers aim to identify markers of individuals who are vulnerable, but have not yet developed, a psychological

disorder (Ingram & Price, 2010). Thus, in order to qualify as a vulnerability factor, AS should be: (a) stable across time and situations, (b) premorbid to panic disorder, (c) more trait-like, and (d) nonobservable until activated by a congruent experience like an unexpected physiological sensation.

There is also an important distinction between vulnerability and risk factors. Risk factors are associated with the development of a disorder; that is, they are statistically related to disorder onset (e.g., sex, age, SES). Vulnerability factors, while also being associated with the development of a disorder, play a more causal role (Ingram & Price, 2001). Therefore, vulnerabilities are particularly important when examining the etiology of a disorder. Stress is another important construct when discussing vulnerability. The diathesis-stress perspective in psychopathology states that stress is necessary to initiate processes that underlie vulnerability factors, thereby leading to the development and maintenance of disorders (Ingram & Price, 2001; 2010). Therefore, vulnerability factors do not lead to disorder onset on their own, but interact with environmental influences.

### **Cognitive Vulnerability Model for Panic Disorder**

Schmidt and Woolaway-Bickel (2006) proposed an integrated cognitive vulnerability model of panic disorder that explains the development of panic disorder in terms of various interrelated processes. These processes interact in a cyclical fashion, and fall within three domains: 1) stressful events, 2) distal vulnerability factors, or 3) proximal cognitive vulnerability. Stressful events (e.g., aversive events, negative life experiences) influence etiology by means of interacting with cognitive vulnerabilities: the diathesis-stress model. Distal cognitive vulnerability factors are indirectly related to the pathogenesis of panic. These are trait-like beliefs and cognitive biases that increase the likelihood of the development of more direct cognitive processes involved in the

pathogenesis of panic. In the cognitive vulnerability model of panic disorder, distal cognitive vulnerability factors include AS, predictability and control beliefs, as well as information processing biases. The proximal (i.e., direct) cognitive vulnerability factor is the experience of catastrophic cognitions, which are thoughts pertaining to imminent danger/threat. This view is consistent with cognitive models that identify catastrophic misinterpretations as the central cognitive construct in panic disorder (e.g., Beck, 1988; D. M. Clark, 1986). Catastrophic cognitions occur immediately prior to a fear response whereas distal cognitive vulnerability factors increase the likelihood of such catastrophic cognitions (Schmidt & Woolaway-Bickel, 2006).

AS is the focal cognitive vulnerability factor in the current research project. According to the cognitive vulnerability model of panic disorder, AS potentiates the experience of panic through its influence on more proximal cognitive processes (Schmidt & Woolaway-Bickel, 2006). This model is like Cox's (1996) interactional model, which suggests that AS interacts with a congruent trigger (e.g., internal or external event associated with AS beliefs) to produce catastrophic cognitions and panic symptoms. Therefore, AS is a distal cognitive vulnerability factor for panic disorder that influences more proximal cognitive vulnerabilities such as catastrophic cognitions, the central cognitive component of panic disorder (D. M. Clark, 1986). For example, an individual with high AS who experiences chest pain while exercising is more likely to think the symptoms indicate a deadly heart condition compared to someone with low AS who would be more likely to attribute the chest pain to over-exertion. Cox (1996) suggested that assessment of both trait (e.g., AS beliefs) and state cognitions are important in understanding the contributing and maintaining factors of panic disorder. The Cox (1996) and Schmidt and Woolaway-Bickel (2006) conceptualizations are

consistent with cognitive theories that emphasize catastrophic cognitions in the pathogenesis of panic (e.g., D. M. Clark, 1986) as well as the role of AS as a potential trait-based fear-amplifier (Reiss, 1991).

### **Anxiety Sensitivity Versus Catastrophic Cognitions**

Although closely related, AS and catastrophic cognitions are distinct constructs. AS is a pre-existing belief about the potential consequences of physiological sensations. That is, individuals with elevated AS levels believe that physiological symptoms (e.g., racing heart) *may* have negative consequences *in the future* (e.g., “I’m probably going to have a heart attack”). On the other hand, catastrophic cognitions involve the *immediate* appraisal of an experience of physiological arousal (e.g., “I’m having a heart attack”). AS is thought to increase the risk of generating catastrophic cognitions (Schmidt & Woolaway-Bickel, 2006). Since AS is considered an anxiety amplifier (Reiss, 1991), individuals with elevated levels of AS are prone to develop panic disorder because they have a tendency to make catastrophic misinterpretations (Taylor & Fedoroff, 1999).

### **Anxiety Sensitivity: Psychometric Validation**

AS has become the focus of attention as a primary vulnerability factor that contributes to the development of panic disorder. Therefore, a discussion of the development and psychometric validation of AS measures is warranted. The Anxiety Sensitivity Index (ASI) is the original measure of AS (Peterson & Reiss, 1992). Reiss and McNally (1985) conceptualized AS as an individual difference factor, and so ASI items tapped into aspects of sensitivity to anxiety as opposed to the frequency or intensity of anxiety experiences.

Although the ASI was designed to be unidimensional, AS is now considered a hierarchical multidimensional construct with three lower-order factors loading on a

single higher-order factor (e.g., Rodriguez, Bruce, Pagano, Spence, & Keller, 2004). The lower-order AS factors are: physical concerns (fear of physical symptoms of anxiety), social concerns (fear of negative evaluation and embarrassment related to physical symptoms), and cognitive concerns (mental concerns related to anxiety symptoms; Taylor, 1999). Taylor and colleagues (2007) were critical of the ASI, stating that each of the factors contain a different number of items, thus making between-factor comparisons difficult. The physical concerns subscale consists of eight items, and the social and cognitive concerns subscales have four items each. As expected, the shorter subscales have questionable reliability (e.g., Vujanovic, Arrindell, Berstein, Norton, & Zvolensky, 2007). Additionally, some items load on to multiple factors (Taylor et al., 2007). Because of the multidimensional structure of AS, recommendations were made to expand the ASI to include multiple dimensions (Cox, Parker, & Swinson, 1996). Researchers developed subsequent revisions (e.g., Anxiety Sensitivity Index-Revised; Taylor & Cox, 1998), with the Anxiety Sensitivity Index-3 (Taylor et al., 2007) being the most recent measure.

The Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007) is an 18-item questionnaire developed through factor analysis that assesses the three generally accepted dimensions of anxiety sensitivity: physical, cognitive, and social concerns. Psychometric assessment of the ASI-3 revealed that the subscales had good internal consistency. Alpha coefficients across clinical and nonclinical samples were in the  $\alpha=.76-.86$  range for physical concerns,  $\alpha=.79-.91$  for cognitive concerns, and  $\alpha=.73-.86$  for social concerns. In general, alpha coefficients were larger for the ASI-3 than the ASI on the cognitive and social concerns subscales. Alpha coefficients were comparable on

physical concerns. The ASI-3 subscales were positively correlated with each ASI counterpart ( $r_s=.47-.99, p<.001$ ), providing evidence that the ASI-3 is comparable to the original ASI. Correlations between congruent subscales of the ASI-3 and ASI (e.g., ASI-3 physical concerns and ASI physical concerns) were significantly larger than the correlations between incongruent subscales (e.g., ASI-3 physical concerns and ASI social concerns), supporting the multidimensional nature of AS (Taylor et al., 2007). The psychometric properties of the ASI-3 have been supported in clinical and nonclinical studies by independent researchers (e.g., Kemper, Lutz, Bähr, Rüdell, & Hock, 2012; Wheaton, Deacon, McGrath, Berman, & Abramowitz, 2012). While the ASI-3 and ASI are equally valid when a total score is utilized, the ASI-3 is superior because its subscales have better reliability and validity than the original ASI subscales (Taylor et al., 2007).

### **Anxiety Sensitivity as a Cognitive Vulnerability Factor for Panic**

#### **Prospective Studies**

AS is considered an enduring dispositional variable that is key in the etiology and maintenance of anxiety psychopathology, particularly panic disorder (e.g., Reiss, 1991; McNally, 2002; Taylor, 1999). Evidence that AS is a vulnerability factor comes from longitudinal studies which have demonstrated that individuals with elevated AS are at increased risk for the onset of panic symptoms (e.g., Maller & Reiss, 1992; Schmidt, Lerew, & Jackson, 1999; Li & Zinbarg, 2007). One of the first longitudinal studies was a nonclinical study by Maller and Reiss (1992) who found that ASI scores predicted the frequency and intensity of panic attacks at a three-year follow-up, above and beyond the effects of state and trait anxiety. Schmidt and colleagues provide further evidence for the prospective link between AS and panic in a sample of new cadets ( $N=1401$ ) undergoing



five weeks of highly stressful basic training (Schmidt, Lerew, & Jackson, 1997). Cadets who scored in the upper decile on the ASI were three times more likely to experience panic attacks during the training period compared to the remainder of the sample (20% versus 6%, respectively). The ASI was predictive of spontaneous panic attacks even after controlling for a history of panic attacks and trait anxiety. Schmidt and colleagues replicated these findings using a similar sample ( $N=1296$ ) in a follow-up study (Schmidt, Lerew, & Jackson, 1999). When ASI subscales were examined, the cognitive concerns subscale was the best predictor of panic. Similarly, in a one-year longitudinal study, Li and Zinbarg (2007) found that AS was predictive of later panic onset in a sample of college students, with the ASI cognitive concerns subscale a unique predictor of panic.

AS was also found to predict panic symptomatology over a one-year period in a large community sample (Cox, Taylor, Clara, Roberts, & Enns, 2008), and over a four-year time period in high school students (Hayward, Killen, Kraemer, & Taylor, 2000; Weems, Hayward, Killen, Barr, & Taylor, 2002), confirming an AS-panic link across diverse samples. Although AS is associated with panic onset, above and beyond other risk factors, it is not specific to the development of panic. For example, Schmidt, Zvolensky, and Maner (2006) found that AS predicted the development of panic attacks, anxiety disorders, and other mental disorders over a two-year period in a sample of young adults. Nevertheless, AS remains most relevant to the study of panic psychopathology.

Furthermore, there is evidence that AS may be a malleable construct and so amenable to treatment effects (see Zvolensky, Schmidt, Bernstein & Keough, 2006, for a review). Interventions have been designed to reduce AS (Watt & Stewart, 2008) and

there is evidence that symptom improvement after cognitive behaviour therapy is mediated by reductions in AS levels (Smits, Powers, Cho, & Telch, 2004).

Prospective research, then, suggests that AS constitutes a cognitive vulnerability for anxiety, especially panic (see D. A. Clark & Beck, 2010). However, AS accounts for a modest amount of the variance in panic symptomatology (McNally, 2002), indicating that other factors play a role in the etiology of panic. These findings are consistent with the contemporary cognitive vulnerability model that proposes multiple, interacting factors in the onset and persistence of panic (Schmidt & Woolaway-Bickel, 2006).

### **Biological Challenge Studies**

Biological challenge studies provide experimental evidence for the relationship between AS and fearful responding. Researchers assess the role of cognitive variables on fear and anxiety responses via induction of physiological arousal through ingestion of various chemical agents. Examples of biological agents used include caffeine, yohimbine, sodium lactate, and elevated concentrations of carbon dioxide (CO<sub>2</sub>)-enriched air (e.g., 5-35%). Early research indicated that panic patients had greater reactivity to biological agents compared to non-panic individuals (see McNally, 1994, for a review). At first these findings were interpreted as evidence for a biological basis to panic disorder, with panic patients having a biological sensitivity to certain chemical substances (see Stein & Rapee, 1999, for a review). Only later did researchers argue their effect was through cognitive mediation.

Margraf and colleagues were the first to propose that the induction of physiological arousal by agents triggers panic symptoms in vulnerable individuals because of the catastrophic misinterpretation of physiological arousal (Margraf, Ehlers, & Roth, 1986). That is, individuals with panic disorder experience panic symptoms in

biological challenge studies due to the misinterpretation of the experimentally induced physiological arousal, as opposed to sensitivity to the chemical properties. Such an explanation is in line with research findings demonstrating that panic patients respond with panic to symptom induction exercises (e.g., hyperventilation, breathing through a straw, chair spinning) that involve exposure to physiological sensations without a chemical agent (e.g., Antony, Ledley, Liss, & Swinson, 2006). The cognitive mediation hypothesis is supported by studies that manipulate instructional sets prior to biological challenge (Rapee, Mattick & Murrell, 1986). Such findings demonstrate that beliefs regarding the nature of physiological symptoms can significantly affect fearful responding.

AS is considered an important individual difference factor that triggers catastrophic cognitions and subsequent panic in response to induced physiological arousal (McNally, 2002). This perspective is in line with the cognitive model of panic, which emphasizes the catastrophic misinterpretation of physical symptoms in the development of panic (D. M. Clark, 1986). Individuals with panic disorder demonstrate a bias toward misinterpreting ambiguous sensations in a catastrophic manner (Clark, Salkovskis, Öst, Breitholtz, Kroehler, Westling, & Gelder, 1997). This hypothesis emphasizes cognitive, as opposed to biological, factors that lead to panic in biological challenge studies, providing further support for AS theory. Strong empirical support for the relationship between AS and heightened fear and anxiety is found in biological challenge studies in which panic is provoked in controlled laboratory settings by use of various agents that induce bodily sensations. Researchers have consistently found that AS is associated with fearful responding to biological challenges, irrespective of the

presence of panic disorder. Two commonly used biological challenges used in the examination of AS are carbon dioxide (CO<sub>2</sub>) inhalation and hyperventilation.

**CO<sub>2</sub> inhalation and hyperventilation challenges.** A number of early studies used CO<sub>2</sub> enriched air to induce physiological sensations in individuals with varying levels of AS. Outcome variables (typically fearful responding and panic symptoms) were assessed after induction and compared with baseline. Since elevated CO<sub>2</sub> is associated with physiological arousal sensations commonly observed in panic attacks (e.g., shortness of breath, dizziness), one interpretation is that individuals with high AS respond with more fear and anxiety due to the catastrophic interpretations of their physiological sensations (see Stein & Rapee, 1999, for a review). Similarly, challenge studies using hyperventilation instructed participants to breathe room-air deeply and rapidly for a pre-determined period of time to induce physiological arousal sensations via a reduction of CO<sub>2</sub> in the bloodstream. Across various nonclinical studies using the hyperventilation paradigm, individuals with high AS report more subjective fear and anxiety following hyperventilation compared to individuals with low AS (Asumdson, Norton, Wilson, & Sandler, 1994; Rapee & Medro, 1994; McNally & Eke, 1996; Zvolensky, Goodie, Ruggiero, Black, Larkin, & Taylor, 2002).

In a study by Rapee and colleagues (Rapee, Brown, Antony, & Barlow, 1992), patients with anxiety disorders and non-anxious controls were asked to participate in both 90 seconds of hyperventilation and 15 minutes of 5.5% CO<sub>2</sub> inhalation. Patients with panic disorder responded with more distress compared to individuals with other anxiety disorders and non-anxious controls. In addition, non-panic anxiety patients reported more distress than non-anxious controls. Although all groups experienced similar physiological arousal, subjective measures of physiological sensations were the

best predictors of fearful responses. Specifically, the best predictor of fear in response to each challenge was the ASI. This may explain why panic patients reported elevated distress, as individuals with panic disorder tend to have elevated AS. However, the ASI explained only a modest amount of variance in responding to the challenges. AS accounted for 19% of the variance in response to hyperventilation and 8% in response to the CO<sub>2</sub> challenge, indicating that other factors play a role in predicting subjective responses to biological challenges.

Zinbarg and colleagues reanalyzed the data presented by Rapee and colleagues (1992) to examine the relationship of the ASI subscales to fear responses in the hyperventilation and CO<sub>2</sub> challenges. They found that only AS physical concerns predicted fear responses to these challenges (Zinbarg, Brown, Barlow, & Rapee, 2001). Zvolensky and colleagues also found AS physical concerns to be the only predictor of self-reported fear in response to a 20% CO<sub>2</sub> inhalation challenge in a non-clinical sample (Zvolensky, Felder, Eifert, & Stewart, 2001). Similarly, ASI physical concerns was the best predictor of somatic, cognitive, and affective responses to hyperventilation in a voluntary hyperventilation study (Carter, Suchday, & Gore, 2001). Together, these results suggest that the ASI physical concerns subscale may be the best predictor of response to biological challenges. However, it is important to note that these studies used the original ASI and so the predictive validity of the ASI-3 subscales remains unknown. Furthermore, these findings are inconsistent with the prospective research that found ASI cognitive concerns to be the best predictor of panic (Schmidt, Lerew, & Jackson, 1999; Li & Zinbarg, 2007). These discrepancies may reflect different methodological approaches or variations in samples. For example, ASI physical concerns may be a better predictor in biological challenge studies as physical symptoms

are very salient. On the other hand, the prospective research focused on military (Schmidt, Lerew, & Jackson, 1999) and college student samples (Li & Zinbarg, 2007) where cognitive symptoms may carry the most detrimental consequences.

The ASI has emerged as the best predictor of panic symptoms in response to CO<sub>2</sub> challenges across studies based on panic disorder samples (Rassovsky, Kushner, Schwarze, & Wangenstein, 2000) and healthy controls (Richey, Schmidt, Hofmann, & Timpano, 2010; Shipherd, Beck, & Ohtake, 2001). However, not all studies have found AS to be associated with increased fearful responding. For example, Koszycki and Bradwejn (2001) found that the ASI was not significantly associated with severity of somatic symptoms, subjective levels of anxiety, fear, or fear of somatic symptoms when panic patients were administered a single inhalation of 35% CO<sub>2</sub>. However, they did find a significant positive association between AS and endorsement of catastrophic cognitions. Struzik, Vermani, Duffin, and Katzman (2004) also did not find the ASI or its subscales to predict panic attacks using a hyperventilation task in a sample of 11 panic patients and 10 controls. However, the outcome variable was panic attacks and data were not presented on the prediction of anxiety or fear more generally. Methodological limitations have been implicated in such studies including range restriction of ASI scores and reliance on the original ASI (McNally, 2002). Limited power due to small sample size was evident in these studies as well. The predictive validity of AS increases with more variability and therefore studies examining only panic disorder patients may experience an AS ceiling effect, making results difficult to interpret.

**Acute exercise as arousal induction.** Research examining the link between AS and exercise primarily focuses on the therapeutic effects of exercise for treating AS and

anxiety (e.g., Smits, Berry, Rosenfield, Powers, Behar, & Otto, 2008). However, acute physical activity can induce anxiety symptoms due to the activation of physiological arousal in a manner like biological challenge agents. A review of the research has shown that although physical activity alone does not provoke panic attacks in panic patients, it does induce physiological arousal and symptoms of anxiety (including catastrophic cognitions) that may lead to panic (see O'Connor, Smith, & Morgon, 2000, for a review). Studies have begun to include exercise as a precursor to administration of a biological agent (e.g., CO<sub>2</sub>, drugs that induce arousal) due to its ability to induce physiological arousal and anxiety. Strohle and colleagues (2009) assigned panic disorder patients and matched controls to either an exercise (30 minutes of treadmill walking at 70% VO<sub>2</sub>max) or rest condition followed by an injection of cholecystinin tetrapeptide (CCK-4). While a main goal of the study was to examine the effects of exercise on response to biological challenge, differences were examined between conditions before drug administration. These findings indicated that panic patients reported more panic attacks in the exercise versus rest condition prior to CCK-4 administration, whereas no differences between conditions were observed in the control participants.

The role of AS has also been examined in studies using exercise as an arousal induction task. Smits, Tart, Presnell, Rosenfield and Otto (2010) examined the role of both AS and body mass index (BMI) on distress during exercise. Specifically, the authors predicted that obese individuals would experience greater arousal and exertion during exercise, which would interact with AS resulting in greater distress during the exercise task. In their study, 92 university students were assigned to either 20-minutes of exercise on a treadmill or a 20-minute rest condition. A target of 70% maximum age-adjusted predicted heart rate was used in the exercise condition (70% of HR<sub>max</sub> = 220 -

age x .70), which involved a three-minute warm-up until 70% of HRmax was achieved, followed by 20 minutes at this target heart rate. The authors found a significant Exercise x BMI x ASI interaction, indicating that distress levels were highest for individuals with a high BMI in the exercise condition, but only if they also had an elevated AS level. These findings suggest that heightened AS is associated with greater emotional responding in a high-risk subset of the population.

Numerous studies have examined the relationship between AS and exercise avoidance (e.g., Moshier, Szuhany, Hearon, Smits, & Otto, 2016; Moshier, Hearon, Calkins, Szuhany, Utschig, Smits, & Otto, 2013; Sabourin, Hilchey, Lefaiivre, Watt, & Stewart, 2011). Individuals with high AS tend to avoid exercise due to the unpleasant experience of physiological arousal. However, more research is needed that focuses on the cognitive interpretations generated by individuals with varying levels of AS during exercise.

According to American College of Sports Medicine (ACSM, 2006), the treadmill and cycle ergometer (stationary bike) are the two most commonly used methods for exercise testing. Both offer the ability to gradually increase work rate intensity. The stationary bike has several benefits over the treadmill including lower cost, more efficient use of space, and less noise production. The treadmill has been used in the few studies that have examined the association between AS and post-exercise anxiety (e.g., Smits et al., 2010). However, other researchers have used the bike as a means of inducing arousal (e.g., Esquivel, Dandachi, Knuts, Goossens, Griez, & Schruers, 2012; Esquivel, Schruers, Kuipers, & Griez, 2002). Esquivel and colleagues (2012; 2002) examined the effect of exercise prior to CO<sub>2</sub> inhalation on panic symptoms. The bicycle ergometer was used to adjust workload until participants reached the targeted lactate



blood concentration level (i.e., >6mmol/l, assessed via blood sample). Results showed that vigorous exercise prior to CO<sub>2</sub> inhalation exerted an antipanic effect. These studies used the bicycle in combination with biological markers to target specific levels of physical exertion.

**Summary of biological challenge studies.** A general finding across the biological challenge experiments is that AS is related to post-challenge responding and is a better predictor for fearful responses than other measures such as trait anxiety. Such findings support the role of cognitive variables, specifically AS, in the amplification of fear to physiological arousal. However, AS only predicts a relatively small amount of the variance in response to biological challenges, suggesting that other factors play a role in predicting fearful responses (see McNally, 2002, for a review). The following section will review other factors thought to interact with AS to increase fearful responding to physiological arousal.

### **Context-Sensitivity Model**

The role of cognitive factors in producing anxiety is supported by studies that manipulate cognitive variables during arousal induction challenges. The context in which physiological sensations are experienced (e.g., any internal or external stimulus that influences threat perception) can impact anxious responding. Telch and colleagues (Telch, Harrington, Smits, & Powers, 2011; Telch, Smits, Brown, Dement, Powers, Lee, & Pai, 2010) proposed a context-sensitivity vulnerability model of panic that emphasizes how dispositional characteristics and contextual factors interact in the development of panic symptoms. The model was developed to help explain findings from biological challenge studies where dispositional factors such as AS are associated with increased fear but only in threat-relevant contexts. According to the model, dispositional factors

(e.g., AS) amplify fear responses in potentially threatening contexts, resulting in the development of panic symptomatology. The context-sensitivity matching hypothesis states that the level of fear responding depends on the interplay between individual dispositional characteristics (e.g., AS) and threat-relevant cues (Telch et al., 2010). For example, when physical sensations are perceived as uncontrollable (e.g., an individual believes that the physical sensations cannot be stopped) or unexpected (e.g., physical sensations appear out of the blue), the individual may experience magnified fear and anxiety responses if they also have elevated AS.

**Anxiety sensitivity and perceived control.** Much of the experimental research on the context-sensitivity model of panic comes from biological challenge studies, and the interactive effects of AS and perceived control over threat-related manipulations. For example, perceived control of physiological arousal was varied in a caffeine challenge experiment in which participants with low or high AS levels were randomly assigned to receive either false information that a “caffeine antidote” was available (high perceived control condition) or a no caffeine antidote condition (low perceived control condition). The researchers found an interaction between AS group and perceived control. Specifically, individuals with high AS under the low perceived control condition evidenced greater fearful responding to the caffeine challenge than under the high perceived control condition. There were no differences between perceived control conditions for individuals with low AS (Telch, Silverman & Schmidt, 1996). These findings support the context-sensitivity model with perceived controllability over physiological sensations the contextual feature, and AS the dispositional sensitivity.

**Anxiety sensitivity and expectedness.** Research has examined other contextual features that interact with AS to influence fearful responding. In a CO<sub>2</sub> inhalation

experiment (Telch et al., 2011), the context-sensitivity vulnerability model was supported with manipulation of expectedness of arousal as the contextual variable. Participants were randomly assigned to an expected or unexpected arousal condition associated with gas inhalation. Instructions were given to participants prior to 35% CO<sub>2</sub> inhalation. Individuals in the expected condition were informed that they might experience physiological arousal, whereas those in the unexpected condition were informed that they might experience symptoms of relaxation. Individuals with high AS were affected more by the arousal unexpectedness manipulation. Specifically, high AS individuals in the unexpected arousal condition had significantly higher distress ratings and panic symptoms than did those with high AS in the expected arousal condition. The instructional set did not influence responding in individuals with low AS. Telch and colleagues (2011) concluded that the perception of unexpected arousal contributed to heightened emotional responding in participants with high AS.

The role of expectedness in the context-sensitivity model has been replicated in a study that examined whether the level of expectancy of physical sensations in real life scenarios affects distress ratings and interpretations of panic-related and nonpanic-related sensations for individuals with high and low AS (Hilchey & Clark, 2014). Participants were asked to rate their predicted level of distress and interpretations to hypothetical scenarios that represented either expected or unexpected situations for eliciting physical sensations. A significant interaction was found between AS group and expectancy level for catastrophic misinterpretations, with unexpected scenarios in the high AS group demonstrating the highest catastrophic misinterpretation ratings. Together these findings provide preliminary support for the role of expectancy in the

context-sensitivity model, in which the unexpectedness of physical sensations increases fearful responding and catastrophic cognitions in individuals with high AS.

**Summary of context-sensitivity model.** As reviewed, findings that support the context-sensitivity model indicate that not only is AS a risk factor in the development of panic, but that AS interacts with contextual factors leading to increased risk for panic psychopathology. The additional role of perceived control and expectedness of sensations on fearful responding supports cognitive vulnerability models of panic that emphasize predictability and control beliefs as distal cognitive vulnerability factors (Schmidt & Woolaway-Bickel, 2006). Barlow's (1988) model is also supported, which identifies a psychological vulnerability to panic consisting of anxious apprehension about panic attacks, due to the sense that events and emotions are uncontrollable and unpredictable. The biological challenge studies reviewed primarily measure fearful responding and panic episodes as outcome variables. Even though catastrophic cognitions have generally not been measured in biological challenge studies, it would be expected that AS is associated with elevated anxiety in threatening contexts due to an increase in anxious cognitions in these settings. That is, the context in which sensations are experienced interacts with AS to produce increased catastrophic cognitions, and ultimately panic (Cox, 1996).

### **False Physiological Feedback**

The research previously reviewed examined the role of AS in responding to biological challenges with manipulated contextual features. Such research aims at increasing fearful responding in individuals with high AS by increasing the threatening nature of induced physiological symptoms. Although traditional biological challenge studies examine the role of physiological arousal on fearful responding, studies using

false physiological feedback provide valuable information on reactivity to the perception of physiological sensations based on false cues. That is, does the mere perception of arousal lead to increased emotional reactivity? The research reviewed below demonstrates that perceived physiological arousal, regardless of its accuracy, is associated with anxiety and fearful responding. Studies have shown that it is the perception of physiological arousal as having threatening consequences (as opposed to the physiological arousal itself) that leads to fearful responding (D. M. Clark, 1990; Dixon, Sy, Kemp, & Deacon, 2013). This section will provide a brief review of false physiological paradigms used across samples, followed by a focus on studies that examined the link between AS and false physiological feedback.

Studies have taken two approaches to false physiological feedback: mechanical feedback and verbal feedback. In terms of mechanical feedback, studies attempt to create an analogue of unexpected changes in physiological symptoms (e.g., accelerated heart rate) to determine their impact on emotional responses. For example, Ehlers and colleagues (Ehlers, Margrad, Roth, Taylor, & Birbaumer, 1988) provided panic disorder patients with false feedback about an abrupt increase in heart rate using a heart rate tone produced by EKG. Feedback was associated with increases in anxiety and physiological arousal. In another study, Makkar and Grisham (2013) provided low and high socially anxious participants with false heart rate feedback using an EKG simulation viewed on a computer screen. Participants received information of increased or decreased heart rate prior to an impromptu speech task. Compared to participants who received information about a decreased heart rate, those who received increased heart rate feedback reported higher levels of negative emotion, increased negative performance appraisals, and more ruminative thoughts. Individuals receiving false feedback showed greater symptoms,

mediated by an increase in self-focused attention. Furthermore, these effects were found in both low and high socially anxious groups. Similar findings have been found in socially anxious samples using verbal false feedback of pulse rate (Wells & Papageorgiou, 2001) and heart rate (Papageorgiou & Wells, 2002), providing evidence that false physiological feedback is linked to increases in anxiety and negative appraisals.

Researchers have taken an experimental approach when examining the role of cognitions by inducing beliefs similar to those observed in individuals with high AS. To test the cognitive model of panic disorder, Salkovskis and D. M. Clark (1990) manipulated interpretations of physiological arousal via instructions (positive versus negative interpretations) prior to a hyperventilation induction task in a non-clinical sample. For both groups, participants were given correct information about common symptoms that they may experience but also false information that only a small number of individuals experience sensations such as dizziness and tingling during the hyperventilation task. Individuals assigned to the negative interpretation group were told that individuals who experience these sensations may pass out during the task, whereas those in the positive interpretation group were informed that people who experience such sensations may experience an elevated level of consciousness during the task. Results revealed that both groups experienced similar bodily sensations in response to hyperventilation. However, a positive correlation was found between self-reported intensity of bodily sensations and positive affect for individuals in the positive interpretation group, whereas a negative correlation was found between intensity of bodily sensations and negative affect for those in the negative interpretation group. The authors concluded that catastrophic misinterpretations (i.e., negative interpretations) that

were experimentally induced increased negative emotion. Findings supported the cognitive mediation hypothesis, as the effects of the symptom induction task interacted with manipulated beliefs to influence negative responding.

Similarly, a study conducted by Dixon, Sy, Kemp, and Deacon (2013) examined the link between AS-like beliefs and panic symptoms. Undergraduate university students without a history of panic were assigned to either a group with false physiological feedback (experimental condition) or with false benign feedback (control condition) that was provided after participation in a prolonged hyperventilation challenge. The challenge consisted of a series of three hyperventilation phases. Each phase lasted for five minutes and included five individual hyperventilation trials. Trials involved sixty seconds of hyperventilation followed by a fifteen second break. All participants were provided with feedback after the first hyperventilation phase. In the false physiological condition, participants were informed that they needed to stop due to an elevated heart rate and drop in blood pressure that may result in fainting. In the control condition, participants were asked to stop due to equipment failure. Following feedback, all participants were asked to continue with phase two of the hyperventilation challenge. The final hyperventilation phase assessed behavioural avoidance by allowing participants to stop when they chose. Individuals in the false physiological feedback condition reported more anxiety symptoms following feedback compared to the control condition, including more catastrophic cognitions about fainting. In addition, more concern about fainting (an analogue to AS beliefs) mediated group differences, with individuals in the experimental group reporting greater concerns about fainting.

Story and Craske (2008) used a false heart rate paradigm with individuals with high AS and a history of panic attacks (high risk group) compared to individuals with

low anxiety (low risk group). Participants were informed that the purpose of the study was to examine perceptions of heart rate change following a repeated breath-holding task. Indications of changes in heart rate (increase or decrease) were provided via a feedback light following breath-holding. Participants received more false feedback as the study progressed. The high risk group reported more panic symptoms following false feedback compared to the low risk group. When examined separately, history of panic attack frequency significantly predicted panic reactions, although AS was not found to be a unique predictor. However, individuals with high AS without a history of panic attacks were not included. Therefore, it is unknown if individuals with elevated AS without a history of panic would experience more panic symptoms following false physiological feedback.

In conclusion, cognitive processes clearly play an important role in panic elicitation during symptom induction/biological challenge studies. These findings indicate that elevated AS may interact with the perception of physiological arousal to induce emotional reactivity and panic responses. Together, this research indicates that the manipulation of cognitions can induce panic, which is consistent with cognitive models of panic (e.g., Clark, 1986). Research findings also are consistent with the cognitive vulnerability model of panic, which emphasizes both distal (e.g., AS) and proximal (e.g., catastrophic cognitions) factors in the development of panic (Schmidt & Woolaway-Bickel, 2006).

### **Emotion Regulation**

Anxiety is a common and transient state that typically remits without any conscious effort or control. However, individuals can deliberately reduce the duration and intensity of anxiety via intentional control strategies. When it comes to our



emotional experiences, we often attempt to increase positive feelings and decrease negative feelings (Loewenstein, 2007). Such efforts are considered to fall under the umbrella of emotion regulation. Emotion regulation refers to a set of processes that influence the presence, type, degree and experience of emotions (Gross, 1998a; Gross & Thompson, 2007). There are several types of emotion regulation strategies including reappraisal, distraction, avoidance, suppression, substance use, and the like (Cisler, Olatunji, Felder, & Forsyth, 2010). These strategies typically focus on altering the type and frequency of events that precede emotional responses (antecedent-focused emotion regulation) or altering emotional responses directly (response-focused emotion regulation; Gross, 1998a). Emotion regulation has garnered a great deal of research within the past few decades (see Gross, 1998a; 2007; 2013; Koole, 2009 for reviews).

There are three core features of emotion regulation (Gross & Thompson, 2007). First, emotions may be regulated by attempts to increase (up-regulate) or decrease (down-regulate) the emotional experience. Anxiety researchers have focused on the down-regulation of negative emotions since anxiety is characterized as an excess of negative emotion (Campbell-Sills & Barlow, 2007). Emotion regulation itself does not lead to psychopathology. Instead, emotion regulation can play an etiological role when individuals attempt to rigidly and inflexibly down-regulate emotions, or when regulation strategies interfere with daily functioning (Olatunji, Forsyth, & Feldner, 2007).

Second, emotion regulatory processes lie on a continuum with conscious, effortful and controlled regulation at one pole, and unconscious, effortless, automatic regulation at the other. Controlled emotion regulation strategies are deliberate attempts at altering emotional experience, whereas automatic emotion regulation strategies are employed without conscious thought (for a review see Mauss, Bunge, & Gross, 2007).

More research has focused on effortful regulation due to the difficulty assessing automatic processes (Gross & Thompson, 2007).

Third, emotion regulation strategies are not assumed to be inherently good or bad because strategies may interact with contextual features to determine the nature of the outcome. In this sense emotion regulation strategies should be evaluated in terms of their relative “effectiveness” or “ineffectiveness” based on the outcome. Campbell-Sills and Barlow (2007) noted that ineffective strategies refer to those that are unsuccessful in reducing negative emotion, or that short-term down-regulation of negative emotion is outweighed by longer term associated costs (e.g., up-regulation of negative emotion). Effective strategies are defined as those that produce minimal distress and do not interfere with the individual’s goals. Furthermore, effective emotion regulation likely entails selection of strategies generally considered to be effective, along with a flexibility to use such strategies given the context (Campbell-Sills & Barlow, 2007). Generally, though, emotion regulation strategies associated with positive outcomes are more desirable and adaptive.

### **Emotion Regulation and Anxiety Psychopathology**

Emotion regulation is considered an individual-difference characteristic that may be associated with vulnerability and resiliency to anxiety psychopathology (Campbell-Sills & Barlow, 2007). Research linking emotion regulation to psychopathology emphasizes *emotion dysregulation*, defined as “the failure of emotion regulation that results in undesirable emotional states” (Gross, 2013, p. 362). Such states characterize many mental disorders, including anxiety. A review of emotion regulation and anxiety disorders (Cisler, Olatunji, Feldner, & Forsyth, 2010) concluded that individuals with anxiety disorders are characterized by maladaptive emotion regulation abilities, which

may exacerbate anxiety responses.

A prospective study (Wirtz, Hofmann, Riper, & Berking, 2014) found that emotion regulation deficits predicted anxiety symptom severity above and beyond baseline anxiety symptoms, further supporting the role of emotion regulation difficulties in predicting anxiety symptomatology. Emotion regulation is particularly relevant to the discussion of panic disorder, as an inability to regulate anxious responses exacerbates anxiety and fuels the vicious cycle of panic (D. M. Clark, 1986). Baker, Holloway, Thomas, Thomas, and Owens (2004) found that individuals with panic disorder have difficulties in emotional processing compared to controls, and speculated whether such deficits might contribute to vulnerability to panic disorder.

Research also has demonstrated that emotion regulation comprises a predictor of panic symptom severity above and beyond other predictors of panic (i.e., AS; Tull, 2006), suggesting that the ability to regulate emotions effectively may be an additional vulnerability factor for panic. Researchers have shown that nonclinical individuals with a history of uncued panic report higher levels of experiential avoidance, lack of emotional acceptance and lack of emotional clarity when compared to a nonclinical control group (Tull & Roemer, 2007). Furthermore, those with a history of nonclinical panic (vs. controls) also report more avoidant emotion regulation strategies when exposed to both positive and negative valence films (Tull & Roemer, 2007). These findings were extended in a follow-up study (Tull, Rodman, & Roemer, 2008) where the fear of bodily sensations (as measured by the Body Sensations Questionnaire; Chambless, Caputo, Bright, & Gallagher, 1984) was found to predict experiential avoidance and emotional non-acceptance, above and beyond other panic predictors (e.g., panic symptom severity). If individuals with panic disorder experience catastrophic

thinking (D. M. Clark, 1986) and fear related to physiological sensations that accompany anxiety, such an emotional response (i.e., anxiety) is likely to be less accepted and avoided (Tull & Roemer, 2007; Tull et al., 2008). Emotional avoidance, which involves any strategy aimed at decreasing the intensity of negative emotion during exposure to the provoking stimuli, is often problematic and leads to increases in anxiety symptoms (Campbell-Sills & Barlow, 2007).

### **Emotion Regulation Strategies**

Most of the emotion regulation research has focused on the effects of consciously-controlled strategies (Gross, 1998a; 2007). Two categories of mental strategies that involve down-regulation of negative emotion are 1) altering the appraisal of a situation (i.e., reappraisal), and 2) using distraction or suppression of thoughts and feelings (Loewenstein, 2007). Reappraisal and suppression are the most commonly researched effortful emotion regulation strategies (Gross, 2007). Across studies, reappraisal has been shown to be more effective in down-regulating negative emotions than is suppression (Gross & Thompson, 2007). In fact, suppression has frequently been linked to negative outcomes, rendering it an ineffective emotion regulation strategy in most situations.

The present research focuses on two strategies involved in the regulation of emotion: cognitive reappraisal and catastrophizing. Cognitive reappraisal has well-established positive outcomes, whereas catastrophizing is considered a maladaptive emotion-regulation strategy commonly observed in anxiety disorders. Both reappraisal and catastrophizing have been studied in relation to anxiety. Conventional CBT interventions focus on reappraisal of negative emotions and experiences (e.g., cognitive therapy), along with the reduction of catastrophic thinking.

**Cognitive reappraisal.** Cognitive reappraisal is a widely studied emotion regulation strategy that involves the down-regulation of emotion by “changing how we think about a situation in order to decrease its emotional impact” (Gross, 2002, p. 281). It is defined as “construing a potentially emotion-eliciting situation in nonemotional terms” (Gross, 2002, p. 283). Cognitive reappraisal is a key strategy used in cognitive therapy and cognitive behavioural therapy (CBT) for anxiety disorders. In the context of CBT for anxiety disorders, cognitive reappraisal is termed *cognitive restructuring* and is a central component of CBT with the goal of modifying an individual’s anxious appraisals of threat (Clark & Beck, 2010). For example, a CBT therapist working with an anxious client who misinterprets unexpected accelerations of heart rate as a sign of an impending heart attack would use cognitive restructuring to counter their catastrophic misinterpretation. She/he would teach the client how to question the credibility of the misinterpretation with evidence and replace it with an alternative, more realistic, interpretation (e.g., racing heart due to over exertion). Ultimately, the goal is to reappraise situations or experiences in a more realistic and adaptive way, which in turn reduces negative emotion states such as fear and anxiety (Campbell-Sills & Barlow, 2007).

Reappraisal has been studied in terms of its frequency of utilization (trait cognitive reappraisal) as measured by self-report questionnaires, as well as the ability to engage successfully in a reappraisal task in the laboratory setting (cognitive reappraisal ability). Trait reappraisal is significantly correlated with more positive emotions and fewer negative emotions (John & Gross, 2007). Cognitive reappraisal ability is an individual’s ability to alter emotions successfully using the reappraisal strategy (Troy, Wilhelm, Shallcross, & Mauss, 2010) and it has been linked with positive psychological

outcomes. For example, Gross (1998b) found that participants who were instructed to use reappraisal after watching an emotional film clip reported less negative emotion compared to participants who were instructed simply to watch the film. Similar findings have been reported in other laboratory studies (e.g., Dandoy & Goldstein, 1990; Jackson, Malmstadt, Larson, & Davidson, 2000).

Several meta-analyses have been conducted that examined the relationship between reappraisal and psychopathology. Aldao, Nolen-Hoeksema, and Schweizer (2010) found that reappraisal was negatively associated with psychopathological symptoms, including anxiety. Webb, Miles, and Sheeran (2012) found that various forms of cognitive reappraisal had positive effects on emotional outcomes and was the most effective strategy for reducing negative emotion, exhibiting a small-to-medium effect size ( $d_+ = 0.36$ ). Reappraisal has also been identified as an important mechanism of therapeutic change underlying CBT for anxiety disorders (Smits, Julian, Rosenfield, & Powers, 2012). Thus, the use of cognitive reappraisal as a treatment strategy for anxiety has received empirical support.

**Catastrophizing.** Catastrophic thinking is a type of perseverative thinking that can be conceptualized within an emotion dysregulation perspective. Catastrophizing is characterized by conscious awareness of thoughts but with a lack of control (Peterson & Park, 2007). That is, individuals who engage in catastrophic thinking may be described as having an inability to resist thinking in an extremely negative manner. Individuals with anxiety disorders have a tendency to overestimate the likelihood of harm and its negative consequences (D. A. Clark, & Beck, 2010). Catastrophic thinking involves thinking of the “worst case scenario.” For example, an individual who experiences tightness in his/her chest and has some difficulty catching his/her breath might think that

something is seriously wrong (e.g., “What if I suffocate and die?”). Such catastrophic thinking subsequently leads to elevated symptoms of fear and anxiety.

Maintenance of panic disorder is linked to catastrophic thoughts about the consequences of physical sensations (D. M. Clark, 1986). Such threat-related cognitions in turn lead to avoidance behaviour, which is thought to interfere with the ability to reappraise threat. Therefore, catastrophizing interferes with the ability to use adaptive emotion regulation strategies, such as cognitive reappraisal. Catastrophic thinking may be considered a type of emotion dysregulation as it potentiates and maintains the experience of anxiety. By contrast, cognitive reappraisal is adaptive in that it reduces anxiety symptoms.

### **Anxiety Sensitivity and Emotion Regulation**

The previous discussions suggest that AS influences emotional responding through its role as a fear amplifier. However, less is known about the relationship between AS and the ability to regulate emotions. Does AS influence primary emotional responses as well as the ability to regulate emotions? Initial emotional reactions and secondary emotion regulation processes are influenced by factors such as individual characteristics, the stimuli encountered, and the broader context (Koole, 2009). Is it possible that elevated AS, as an individual difference variable, is associated with increased fearful responding *and* an inability to “down-regulate” such responses? Naragon-Gainey (2010) proposed that emotion dysregulation may be a potential mediator between AS and psychopathology, and so research has begun to address this issue.

One of the first studies to take this integrative perspective on AS and emotion regulation was by Catanzaro (1993), who found that individuals with high AS who also

had negative beliefs about their ability to regulate negative emotions (as measured by the Generalized Expectancy for Negative Mood Regulation Scale; Catanzaro & Mearns, 1990) had the highest anxiety and depressive symptoms. Even though Catanzaro (1993) examined beliefs in emotion regulation strategies as opposed to the actual strategies used, additional research has examined interactive effects of AS and emotion regulation ability. In a nonclinical study, Vujanovic, Zvolensky, and Bernstein (2008) found a synergistic effect between AS and emotion dysregulation (as measured by the Difficulties in Emotion Regulation Scale; Gratz & Roemer, 2004). That is, individuals with both high AS and emotion regulation difficulties reported elevated worry, catastrophic cognitions about bodily sensations, as well as anxious arousal symptoms. Vujanovic and colleagues (2008) concluded that AS and emotion dysregulation may interact to increase risk for anxiety psychopathology. The interactive effect was specific to anxiety symptoms, with no interaction present for depressive symptoms. One limitation was the focus on emotion dysregulation and AS as global factors, with information on the interplay between AS and specific emotion regulation strategies remaining unexplored.

Kashdan, Zvolensky, and McLeish (2008) extended these findings by examining the interactive relationship between AS and various emotion regulation variables on anxiety symptoms (anxious arousal, worry, agoraphobic cognitions). AS and maladaptive emotion regulation strategies were both predictive of anxiety symptoms. Anxiety symptoms were most severe in individuals with both elevated AS and emotion regulation difficulties (e.g., less acceptance of emotional distress, fewer effective strategies available to regulate emotions). Furthermore, individuals with high AS in the absence of these emotion regulation difficulties did not demonstrate elevated anxiety



symptoms. The authors suggest that individuals with high AS are a heterogeneous group, in that risk for anxiety was partially dependent on use of ineffective emotion regulation strategies (Kashdan et al., 2008).

Researchers have also begun to examine the interaction between AS and emotion regulation within specific anxiety disorders. For example, Tull, Stipelman, Salters-Pedneault and Gratz (2009) found that both AS and emotion regulation were significant predictors of generalized anxiety disorder (GAD). However, AS was no longer a significant predictor of GAD when emotion regulation and panic disorder were included in the model. A similar link between AS and emotion regulation difficulties has also been found in a sample of individuals with post-traumatic stress disorder (PTSD) where individuals with probable PTSD demonstrated elevated AS social concerns and emotion regulation difficulties (McDermott, Tull, Gratz, Daughters, & Lejuez, 2009). However, AS social concerns did not explain any unique variance above and beyond reported emotion regulation difficulties. These findings suggest that global emotion dysregulation may play a more important role in the development of certain anxiety disorders (e.g., GAD).

More recently, Allan, Norr, Macatee, Gajewska, and Schmidt (2015) using an online non-clinical sample provided support for the unique contributions of AS and emotion regulation difficulty to anxiety symptoms, with both constructs having unique relationships with worry, panic, and social anxiety. However, negative interactions between AS and emotion regulation difficulty were observed, with high levels of each construct producing an antagonistic effect on the other. In other words, high levels of AS diminished the relationship between emotion regulation difficulty and anxiety, and high levels of emotion regulation difficulty attenuated the impact of AS on anxiety

symptoms. These findings are inconsistent with those demonstrating a synergistic effect between AS and emotion regulation difficulty (Vujanovic et al., 2008; Kashdan et al., 2008), and therefore the status of the literature on the interactive relationship between AS and emotion regulation in predicting anxiety symptoms remains unclear. As suggested by Allan and colleagues (2015), differences across studies may reflect the unique relationship between AS and specific emotion regulation strategies. Clearly, further investigation is needed.

Another recent non-clinical online study by Ouimet, Kane, and Tutino (2016) found that maladaptive beliefs about emotions and emotion regulation strategies partially mediated the relationship between AS and anxiety symptoms. These findings suggest that beliefs about body sensations (i.e., AS) and emotional experiences should both be targets for change in the treatment of anxiety. Similarly, the link between AS and maladaptive perceptions of emotions was also highlighted in a sample of treatment-seeking Latinos, where emotion nonacceptance (i.e., unwillingness to experience unwanted emotions) was indirectly related to anxiety psychopathology through AS (Bakhshaie et al., 2017).

In sum, research findings have demonstrated that emotion regulation difficulties and heightened AS are important factors in predicting greater expression of anxiety. It is possible that individuals with high AS find it difficult to regulate their emotions, and that emotion regulation may account for variance in AS. The literature on the co-occurrence of AS and emotion dysregulation suggests the relationship may be bidirectional. However, there are several limitations in this research including overreliance on self-report questionnaires, as well as use of cross-sectional designs and correlational analyses

(see Catanzaro, 1993; Vujanovic, Zvolensky, & Bernstein, 2008; Kashdan, Zvolensky, & Bernstein, 2008).

Experimental studies are needed to examine the relationship between AS, emotion regulation, and anxious symptoms. For example, in one biological challenge study nonclinical participants completed five minutes of 10% CO<sub>2</sub> inhalation (Feldner, Zvolensky, Stickle, Bonn-Miller, & Leen-Feldner, 2006). Participants were divided into two emotion regulation groups: suppression of challenge-induced emotional responses or observation of such responses. The AS physical concerns factor moderated the effect of suppression on emotional responding. These results indicate that AS is associated with increased emotional distress in response to a maladaptive emotion regulation strategy (i.e., suppression). The link between AS and emotional avoidance in predicting anxiety has been replicated in other experimental studies (e.g., Kelly & Forsyth, 2009). However, comprehensive evaluation of emotion regulation strategies is limited, with emphasis placed on emotional avoidance (e.g., Kashdan et al., 2008; Feldner et al., 2006). The relationship between AS and other adaptive (e.g., cognitive reappraisal) and maladaptive (e.g., catastrophizing) emotion regulation strategies requires further investigation.

### **Overall Literature Summary**

According to the cognitive vulnerability model of panic disorder (Schmidt & Woolaway-Bickel, 2006), catastrophic cognitions are directly linked to the development of panic and are necessary and sufficient for the production of panic attacks. This perspective is consistent with D. M. Clark's (1986) cognitive model of panic. On the other hand, AS is a distal cognitive vulnerability factor that increases the likelihood of the experience of catastrophic cognitions. Therefore, AS plays an indirect role in the

development of panic. In Reiss's (1991) model, the interaction between physiological arousal and AS contributes to the development of catastrophic cognitions, and this in turn leads to panic.

There is accumulating empirical evidence that AS is associated with increased fear and anxiety responses to biological challenges (e.g., see McNally 2002, for a review). In these investigations, evidence indicates that the relationship between physiological arousal and anxiety symptoms is mediated by cognitive appraisals of the situation. That is, individuals have catastrophic cognitions about physiological arousal, which in turn leads to the interpretation of the experience as threatening or dangerous resulting in elevated anxiety. The cognitive mediation hypothesis is supported by studies that manipulate appraisals via cues and information presented to participants (e.g., Telch et al., 2010; 2011; Dixon et al., 2013). In these studies, AS played an important role in predicting the presence and magnitude of fearful responding to physiological arousal.

While the link between AS and emotional responding is well studied, less is known about the relationship between AS and the regulation or control of emotions. Studies that have examined the interaction between AS and emotion regulation remain limited and have focused on the contributing effects to anxiety psychopathology based on retrospective self-report questionnaires (e.g., Vujanovic et al., 2008). Research examining the ability of individuals with varying levels of AS to regulate anxiety using various emotion regulation strategies is lacking. The present experiment aimed to address this gap in the literature by examining the interplay between AS and the use of two emotion regulation strategies in an experimental context. The influence of AS was examined in relation to the use of an adaptive emotion regulation strategy (cognitive reappraisal) and a maladaptive emotion regulation strategy (catastrophizing).

## **Study Purpose**

The purpose of the present experiment was to provide a better understanding of how anxiety sensitivity (AS) confers vulnerability for panic disorder by examining its influence on the ability to regulate emotions. Although past research has identified the contribution of AS and emotion dysregulation to panic symptomatology separately (e.g., Taylor, 1999; Baker et al., 2004), only a few studies have examined the interplay of these factors (e.g., Catanzaro, 1993; Vujanovic, Zvolensky, & Bernstein, 2008; Allan et al., 2015; Ouimet et al., 2016), and findings remain unclear. A better understanding of how these processes interact will advance our understanding of cognitive vulnerability to panic. To this end, 161 university students participated in an exercise-based physiological arousal induction and then received false physiological feedback about their heart rate level or benign feedback. Those participants who were provided false cardiac feedback were randomly assigned to a cognitive reappraisal or catastrophizing emotional regulation condition. There were two main objectives of this research project. The first aim was to replicate and extend previous research by experimentally manipulating threatening cognitions in an arousal induction exercise using false physiological feedback. The second objective was to examine the relationship between AS and emotion regulation strategies following false physiological feedback.

## **Hypotheses**

### **Hypothesis 1 (Emotional Intensity)**

Heightened anxiety sensitivity in the experimental group will be associated with a significant increase in anxiety, fear, and threatening cognitions at Time 2, whereas no change in anxiety, fear, or threatening cognitions is expected in the control group.

Hypothesis 1 will be supported by a significant Group x Time x AS interaction.

**Hypothesis 2 (Emotion Regulation)**

Heightened anxiety sensitivity will be associated with a significant increase in anxiety, fear, and threatening cognitions in the catastrophizing condition at Time 3, whereas low anxiety sensitivity will be associated with a significant decrease in anxiety, fear, and threatening cognitions in the cognitive reappraisal condition. Hypothesis 2 will be supported by a significant Condition x Time x AS interaction.

## **CHAPTER 2: INITIAL PSYCHOMETRIC INVESTIGATION**

### **Introduction**

To investigate whether high AS is associated with greater anxiety because of catastrophic cognitions, it was necessary to assess thought content associated with the exercise-based physiological arousal induction task. A review of the published literature failed to reveal a suitable self-report cognition measure related to exercise. Thus, it was necessary to develop a new measure for the present research that was labelled the Threatening Cognitions Scale (TCS). The TCS is a self-report measure that assesses momentary threatening thoughts related to physiological arousal. The objective was to investigate convergent and discriminant validity of the TCS by evaluating its correlation with measures of related and unrelated constructs. The internal reliability and factorial structure of the TCS was also examined.

### **Convergent Validity**

Evidence for convergent validity is obtained when a measure is correlated with other measures that assess theoretically related constructs. Therefore, a discussion of constructs theoretically related to threatening cognitions is warranted. According to the cognitive vulnerability model for panic disorder (Schmidt & Woolaway-Bickel, 2006), the direct vulnerability factor for panic is the manifestation of catastrophic cognitions pertaining to the threatening nature of physiological arousal. The TCS was developed to measure such threatening cognitions. The vulnerability model also emphasizes the following indirect factors that influence threatening cognitions: 1) anxiety sensitivity, 2) information processing biases, and 3) predictability and control beliefs. In the present investigation, it was predicted that threatening cognitions, as measured by the TCS, would be associated with measures of these constructs. Specifically, the TCS was

expected to be positively correlated with the Anxiety Sensitivity Index-3 (ASI-3) and Body Vigilance Scale (BVS), measures of anxiety sensitivity and attentional biases to physiological arousal, respectively. In contrast, the TCS was expected to be negatively correlated with the Anxiety Control Questionnaire (ACQ) because clinically anxious individuals demonstrate less perceived control over anxiety than non-anxious controls (Rapee et al., 1996). Taken together, such findings would provide support for convergent validity of the TCS.

Since threatening cognitions are a precursor to the development of anxiety, fear, and panic (Schmidt & Woolaway-Bickel, 2006), it was predicted that threatening cognitions, as measured by the TCS, would be associated with elevated levels of state (i.e., momentary) and trait anxiety symptoms. Specifically, it was predicted that the TCS would be positively correlated with the Hyperventilation Questionnaire (HQ), a measure of momentary symptoms of anxiety in response to arousal induction challenges. In addition, the TCS was expected to be positively correlated with state levels of anxiety, fear, and tense feelings on the State Emotion Rating Scales. Trait anxiety symptoms (as measured by the anxiety subscale of the DASS-21) were also expected to be positively correlated with the TCS. Finally, the TCS was predicted to be positively correlated with the Body Sensations Questionnaire (BSQ), a measure of the fear of specific bodily sensations. If supported, such findings would provide further evidence for the convergent validity of the TCS.

### **Discriminant Validity**

Evidence for discriminant validity is obtained when a measure is statistically unrelated to measures that assess theoretically dissimilar constructs. As previously discussed, cognitive models of panic disorder emphasize the central role of threatening



cognitions pertaining to physiological arousal (Schmidt & Woolaway-Bickel, 2006; D. M. Clark, 1986). In contrast, different cognitive mechanisms are implicated in the development of depression (Beck, 1967). Therefore, to demonstrate discriminant validity, it was predicted that scores on the TCS would be unrelated to scores on the DASS-21 depression scale. Furthermore, threatening cognitions, as measured by the TCS, was expected to be unrelated to state levels of sad, happy, tired, relaxed, and energetic feelings on the State Emotion Rating Scales.

## **Methodology**

### **Participants**

Participants were recruited online via Amazon Mechanical Turk®. Mechanical Turk® is a website that connects organizations to individuals who wish to work from their home. This study was advertised on the Mechanical Turk® website (see Appendix A for recruitment posting). Individuals drawn to the study title clicked on a link that brought them to the survey which was hosted on a separate, secure website on the University of New Brunswick server using the Checkbox® survey platform. A total of 207 participants completed the study. Nine individuals were removed from the data set because their completion time was under five minutes, suggesting unreliable responses. Therefore, 198 participants were included in the present analyses. Participation was open to residents of Canada and the United States who were at least 19 years old, with 99% ( $n=196$ ) from the United States. Of the sample, 62% were women ( $n=122$ ), and 82% were White ( $n=162$ ). The mean age of participants was 36 years old ( $SD=11.67$ ) with a range of 19-74 years. Furthermore, 98.5% ( $n=195$ ) completed at least high school or equivalent.

## Measures

**Threatening Cognitions Scale (TCS).** A Threatening Cognitions Scale consisting of 12 items was developed for the present study to measure momentary threatening thoughts related to physiological arousal (see Appendix B). Although there are instruments that measure a general tendency to engage in catastrophic thinking when feeling anxious (e.g., Agoraphobic Cognitions Questionnaire; Chambless, Caputo, Bright, & Gallagher, 1984), there is currently no measure that examines immediate, state-like cognitions of danger/threat related to physiological arousal. Dixon and colleagues (2013) modified the Agoraphobic Cognitions Questionnaire (ACQ) to assess catastrophic thoughts in response to a hyperventilation challenge. However, items on the ACQ tap extreme catastrophic thoughts, which are more relevant to an intense arousal induction such as hyperventilation. Therefore, new items were developed for the present study to assess mildly threatening cognitions that might be associated with a mildly taxing exercise task.

Items for the TCS were developed by the present authors, and were based on the cognitive model of panic, DSM-5 panic attack symptoms, and the Diagnostic Symptom Questionnaire (DSQ; Rapee, Sanderson, McCauley, & DiNardo, 1992). The DSQ is a measure of the frequency and intensity of DSM-IV panic sensations experienced in the present moment, but does not assess beliefs/interpretations related to the sensations. For each item of the TCS, participants were asked to rate the extent to which they had anxious or worrying thoughts about each sensation (e.g., *pounding/racing heart*) during the past few minutes on a 10-point scale ranging from 0 (*no anxious thinking*) to 9 (*thought anxiously all the time*). The total score is calculated by summing responses to all items, with a possible range of 0-108.

**Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007).** The ASI-3 is an 18-item self-report questionnaire that measures the extent of agreement to statements reflecting fear of physiological arousal commonly associated with anxiety (e.g., *when my stomach is upset, I worry that I might be seriously ill*; see Appendix C). Items are rated on a 5-point scale ranging from 0 (*very little*) to 4 (*very much*). The total score was used in the current study and is calculated by summing responses for all items, with a possible range of 0-72. See pages 13-14 for review of psychometric properties. The Cronbach alpha for the ASI-3 total score was  $\alpha=.94$  in the current study.

**Body Vigilance Scale (BVS; Schmidt, Lerew, & Trakowski, 1997).** The BVS is a self-report measure of attention to internal physical sensations and cognitions (see Appendix D). It consists of 4 items, with items 1-3 measuring: 1) degree of attentional focus (i.e., *I am the kind of person who pays close attention to internal bodily sensations*), 2) perceived sensitivity to changes in bodily sensations (i.e., *I am very sensitive to changes in my internal bodily sensations*), and 3) time spent attending to bodily sensations (i.e., *On average, how much time do you spend each day scanning your body for sensations?*). Items 1-2 are rated on an 11-point scale ranging from 0 (*not at all like me*) to 10 (*extremely like me*). Item 3 ratings range from 0 (*no time*) to 100 (*all of the time*). Item 4 is composed of 15 ratings on the degree of attention directed to the 15 symptoms of a panic attack in DSM-IV (e.g., *heart palpitations, numbness, nausea*); each symptom is rated on an 11-point scale ranging from 0 (*none*) to 10 (*extreme*). A mean score is calculated for item 4. The BVS total score is calculated by summing items 1-4, and has a possible range of 0-130. The Cronbach alpha for the BVS was  $\alpha=.78$  in the present study.

**Socially Desirable Response Set-Five Item Survey (SDRS-5; Hays, Hayashi, & Stewart, 1989).** The SDRS-5 is a 5-item measure that assesses an individual's tendency to respond to statements in a socially desirable manner (see Appendix E). Participants are asked to rate how much each statement is true or false for them (e.g., *I am always courteous even to people who are disagreeable*). Items are rated on a 5-point scale ranging from 1 (*definitely true*) to 5 (*definitely false*). Item responses are scored dichotomously with extreme responses (i.e., 1 or 5) considered socially desirable and scored as 1. For items 1 and 5 the extreme score is 1 (*definitely true*), and for items 2, 3, and 4 the extreme score is 5 (*definitely false*). All other responses are scored zero. The total score is transformed from a 0-5 scale to a proportional 0-100 scale. Refer to page 73 for a review of psychometric properties. The SDRS-5 was used in the present study because social desirability bias may influence endorsement of items on the dependent variables.

**Body Sensations Questionnaire (BSQ; Chambless et al., 1984).** The BSQ is an 18-item self-report questionnaire that assesses the intensity of fear associated with specific physical symptoms of arousal. Participants are asked to rate the degree to which they fear specific body sensations (e.g., *feeling short of breath, a dry throat, dizziness*; see Appendix F). Items are rated on a 5-point scale ranging from 1 (*not at all frightened by this sensation*) to 5 (*extremely frightened by this sensation*). The BSQ total score is calculated by obtaining the mean for items 1-18, with a possible range of 1-5. The BSQ has demonstrated acceptable internal consistency and discriminant and construct validity (Chambless et al., 1984). The Cronbach alpha for the BSQ total score was  $\alpha=.95$  in the present study.

**Anxiety Control Questionnaire (ACQ; Rapee, Craske, Brown, & Barlow, 1996).** The ACQ is a 30-item self-report questionnaire that measures perceptions of control over potentially threatening internal and external experiences (e.g., *I am able to control my level of anxiety*; see Appendix G). Participants rate level of agreement to each item statement on a 6-point scale ranging from 0 (*strongly disagree*) to 5 (*strongly agree*). A total score is derived from summing questionnaire items, and can range from 0-100. There is evidence of adequate internal consistency for the ACQ total score (Rapee et al., 1996). The Cronbach alpha for the ACQ was  $\alpha=.79$  in the present study.

**Depression Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995).** The DASS-21 is a 21-item self-report questionnaire that contains three scales of seven items each that measure the negative emotional states of depression, anxiety, and stress (see Appendix H). Participants are asked to rate the extent to which each statement applied to them over the past week (e.g., *I felt down-hearted and blue*). Items are rated on a 4-point scale ranging from 0 (*did not apply to me at all*) to 3 (*applied to me very much, or most of the time*). Total scores for each scale are calculated by summing all of the relevant item scores, with a possible range of 0-21 for each scale. The DASS-21 has strong test-retest reliability as well as convergent and discriminant validity (Antony, Bieling, Cox, Enns, & Swinson, 1998; Lovibond & Lovibond, 1995). Internal consistency estimates in the present study were  $\alpha=.92$  for the depression scale,  $\alpha=.86$  for the anxiety scale, and  $\alpha=.87$  for the stress scale.

**Hyperventilation Questionnaire (HQ; Rapee & Medoro, 1994).** The HQ is a 33-item self-report measure that assesses responses to symptom induction challenges (see Appendix I). Participants are asked to rate the maximum degree to which they are currently experiencing physiological sensations (e.g., *headache, breathlessness, fear*) on

a 4-point scale ranging from 0 (*not at all*) to 3 (*markedly*). The HQ contains three scales: cognitive symptoms, somatic symptoms, and affective symptoms. Total scores for each scale are calculated by summing all relevant item scores. The cognitive symptoms scale contains 6 items, with a possible range of 0-18. The somatic symptoms scale contains 20 items, with a possible range of 0-30. Finally, the affective scale consists of 7 items, with possible range of 0-21. Internal consistency estimates for the scales in the present study were  $\alpha=.87$ ,  $\alpha=.91$ , and  $\alpha=.77$ , respectively. The HQ has shown to be a valid and reliable measure in assessing reactions to symptom induction exercises (see Sabourin, Stewart, Watt, & MacDonald, 2013).

**State Emotion Rating Scales.** The State Emotion Rating Scales were devised for the current study (see Appendix J) to measure the degree to which participants endorsed each emotional state following the breathing task. Participants were asked to rate how they were feeling at the present moment by selecting a number on an 11-point scale ranging from 0 (*not at all*) to 10 (*extremely*) for each of the following feelings: anxious, happy, tired, fearful, energetic, sad, relaxed, and tense.

### **Procedure**

Eligibility for participation was determined via a screening process (see Appendix K). Participants were excluded if they reported a health condition that precludes physical activity as indicated by the Physical Activity Readiness Questionnaire (PAR-Q; see description on page 61). Two additional items to assess for respiratory problems and proneness to dizziness/anxiety attacks were added. Eligibility was confirmed by presenting the age, residence, and health screening questions prior to the informed consent form. Participants who did not meet screening requirements were taken to a page thanking them for their interest (see Appendix K). Participants who did

meet screening requirements were directed to the written consent form (Appendix L). Participants provided written informed consent, and then were taken to a website where they completed the demographic questionnaire (Appendix M), Anxiety Sensitivity Index-3 (ASI-3), Body Vigilance Scale (BVS), Body Sensations Questionnaire (BSQ), Anxiety Control Questionnaire (ACQ), and the Depression Anxiety and Stress Scale-21 (DASS-21). After completing these measures participants were asked to complete a diaphragmatic breathing task for one minute. The purpose of the breathing task was for participants to focus on their bodily sensations and prime physical arousal sensations prior to completing the TCS. Instructions were as follows:

“In this exercise you are asked to breathe in and out deeply for one minute.

We want you to focus on taking deep breaths at a normal breathing rate.

Please begin when you are ready.”

After the breathing task, participants were administered the Threatening Cognitions Scale (TCS), Hyperventilation Questionnaire (HQ), and State Emotion Rating Scales. Participants were also presented with the SDRS-5 as a measure of socially desirable responding. Upon completion, participants were asked to provide their Mechanical Turk ID number to provide compensation (\$0.50) into their Amazon account. Compensation was in line with recommendations for Mechanical Turk payment (University of Waterloo, 2013). Participants were also provided a debriefing form that provided further information about the study (Appendix N).

## **Results**

### **Data Screening and Conditioning**

Mean substitution was employed to deal with missing data even though missing values were infrequent (<5%) and randomly distributed. The presence of univariate

outliers was determined by standardized scores greater than 3.29 standard deviations ( $p < .001$ , two-tailed test; Tabachnick & Fidell, 2012). To determine the impact of all 11 univariate outliers, planned analyses were run with and without these cases. Outliers were included in the final analyses since their exclusion did not influence the general pattern of significant findings. The SDRS-5 total sample mean (23.00) and standard deviation (26.74) were comparable to the published validation studies (Hays et al., 1989) indicating that social desirability was not an extenuating factor in participants' responses.

### **TCS Descriptive Statistics**

The TCS total score had a mean of 6.28 and standard deviation of 13.71, with a range of 0-74. However, 56.6% of participants had a TCS total score of 0. The mean of individual items ranged from .36 (TCS11) to .77 (TCS1). These low values are indicative of a floor effect, suggesting that participants tended not to experience any anxious thoughts about bodily sensations after the deep breathing task. This is not entirely unexpected since the breathing task that was allowed by the university research ethics committee was a very mild, brief and entirely voluntary symptom provocation task. The TCS data are consistent with the HQ, which had total sample means of .74 ( $SD=2.11$ , range=0-12), 3.07 ( $SD=5.59$ ; range=0-29), and 3.02 ( $SD=3.01$ ; range=0-20) for the cognitive, somatic, and affective scales, respectively. Percent of participants scoring 0 on the HQ scales were 79.3% (cognitive), 41.9% (somatic), and 13.6% (affective; 36.9% scored a 1 or below). The HQ is a validated questionnaire that assesses response to symptom induction exercises. Together, the floor effects obtained on the TCS and HQ suggest the breathing task was an ineffective arousal induction task.

Examination of individual items of the TCS revealed a floor effect across all



items, with a range of 73.7% to 86.9% of participants scoring each item a “0”. Descriptive statistics for TCS items are presented in Table 1. The most frequently endorsed item was #1 (*pounding/racing heart*) and the least endorsed was item 11 (*trembling or shaking*). There were 84 participants who had a TCS total score greater than 0. For these “responders”, the mean score was 14.46. The internal consistency was  $\alpha=.931$  when only responders were included in the analysis. The pattern of results for the correlations was similar for responders and the entire sample. Therefore, the entire sample was included in correlational analyses presented below.

Internal reliability for the TCS total score was  $\alpha=.95$ , which indicates the presence of a homogeneous scale. Cronbach’s alpha with each TCS item deleted is presented in Table 2. Removal of any item resulted in minimal change in Cronbach’s alpha (range=.94-.95). Item-total correlations ranged from  $r=.72, p<.01$  to  $r=.87, p<.01$ . See Table 3 for complete correlations among items and the TCS total score. Taken together, the above analyses revealed adequate internal reliability and similar item-total correlations across TCS items. Items appear to have equal contribution to the TCS total score and therefore all items were retained in the scale.

A principal components analysis was conducted to examine the structure of the TCS. Results indicated the presence of one factor, with communalities all above 0.3. The first factor explained 65.6% of the variance, with an eigenvalue of 7.87. All other factors had eigenvalues below 1, indicating that only a one-factor solution was interpretable.

### **Correlational Analyses**

Means and standard deviations for each trait measure are presented in Table 4, as well as correlations among all trait measures. Correlational analyses were conducted to examine the relationships between the TCS total score and the other measures.

As predicted, the TCS was significantly and positively correlated with the Anxiety Sensitivity Index-3 (ASI-3) and Body Vigilance Scale (BVS). Higher levels of AS and self-reported attention to bodily sensations were associated with greater endorsement of threatening cognitions. Furthermore, the TCS was significantly and negatively correlated with the Anxiety Control Questionnaire (ACQ). Lower levels of perceived control over potentially threatening experiences related to anxiety were associated with higher scores on the TCS. These findings are consistent with predictions regarding the association between distal vulnerabilities (AS, attentional biases, control beliefs) and threatening cognitions, and support the convergent validity of the TCS.

The TCS was significantly and positively correlated with the Hyperventilation Questionnaire (HQ) scales. This was expected since both measures assess anxious responding to physiological arousal induction. In addition, the TCS was significantly and positively correlated with state anxiety, fear, tense, and sad emotion ratings. The TCS was not significantly correlated with happy, tired, energetic or relaxed emotion ratings (see Table 5 for correlations between the TCS and the state measures). The association between the TCS and increased anxiety, fear, and tension was expected and supports its convergent validity. However, the significant correlation between the TCS and sad rating suggests that the TCS was not emotion-specific to anxiety. This indicates that the discriminant validity of the TCS is not as strong as its convergent validity.

Correlational analysis with the trait measures revealed that, the TCS total score was significantly and positively correlated with the Body Sensations Questionnaire (BSQ), which is consistent with predictions. All three DASS-21 subscales – depression, anxiety, and stress – were positively correlated with the TCS total score (refer to Table 4). Preacher and Lee's (2013) online calculation tool designed to test the difference

between two dependent correlations with one variable in common was completed to compare the correlation coefficients of the DASS-21 anxiety scale ( $r=.50$ ) and the DASS-21 depression scale ( $r=.32$ ). Analysis revealed a significant difference in the strength of association, with the TCS total score correlating more strongly with DASS-21 anxiety than DASS-21 depression ( $z=-3.57, p<.01$ , two-tailed). These findings provide some support for the measure's discriminant validity, despite its significant correlation with DASS-21 depression scale.

Table 1

*TCS Item Descriptive Statistics*

	<i>N</i>	Minimum	Maximum	Sum	<i>Mean</i>	<i>SD</i>
TCS1	198	.00	9.00	152.00	.77	1.76
TCS2	198	.00	8.00	141.72	.72	1.72
TCS3	198	.00	8.00	101.02	.51	1.43
TCS4	198	.00	8.00	108.55	.55	1.48
TCS5	198	.00	9.00	134.68	.68	1.66
TCS6	198	.00	9.00	74.76	.38	1.26
TCS7	198	.00	8.00	93.00	.47	1.36
TCS8	198	.00	8.00	119.40	.60	1.46
TCS9	198	.00	7.00	74.00	.37	1.09
TCS10	198	.00	9.00	91.00	.46	1.37
TCS11	198	.00	6.00	70.36	.35	1.10
TCS12	198	.00	8.00	83.42	.42	1.31

*Note.* TCS = Threatening Cognitions Scale.

Table 2

*TCS Item-Total Statistics (Cronbach's Alpha if Item Deleted)*

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item- Total Correlation	Cronbach's Alpha if Item Deleted
TCS1	5.51	154.07	.70	.95
TCS2	5.57	151.51	.79	.94
TCS3	5.77	156.71	.81	.94
TCS4	5.73	154.91	.84	.94
TCS5	5.60	153.83	.77	.94
TCS6	5.90	161.13	.79	.94
TCS7	5.81	161.21	.72	.95
TCS8	5.68	160.10	.70	.95
TCS9	5.91	165.02	.78	.94
TCS10	5.82	162.97	.66	.95
TCS11	5.93	163.49	.83	.94
TCS12	5.86	159.46	.81	.94

*Note.* TCS = Threatening Cognitions Scale.

Table 3

*TCS Item-Total Correlations*

TCS Items	TCS Total
TCS Item 1	.77*
TCS Item 2	.84*
TCS Item 3	.85*
TCS Item 4	.87*
TCS Item 5	.81*
TCS Item 6	.82*
TCS Item 7	.77*
TCS Item 8	.75*
TCS Item 9	.81*
TCS Item 10	.72*
TCS Item 11	.85*
TCS Item 12	.84*

*Note.* TCS = Threatening Cognitions Scale.

\* $p < .01$ .

Table 4

*Correlations, Means, Standard Deviations, and Ranges of TCS and Trait Measures*

Measure	1	2	3	4	5	6	7	Mean	SD	Range
1. TCS	–							6.28	13.71	0-74
2. ASI-3	.42*	–						16.95	14.01	0-60
3. BVS	.27*	.43*	–					18.01	7.48	0-39
4. ACQ	-.30*	-.59*		–				92.68	22.66	6-146
5. BSQ	.30*	.62*	.43*		–			2.25	.86	1-5
6. DASS-21-D	.32*	.52*	.34*	-.55*	.35*	–		4.71	5.22	0-21
7. DASS-21-A	.50*	.68*	.38*	-.55*	.45*	.69*	–	3.23	4.11	0-19
8. DASS-21-S	.29*	.58*	.41*	-.61*	.40*	.78*	.71*	5.67	4.80	0-21

*Note.* TCS = Threatening Cognitions Scale; ASI-3 = Anxiety Sensitivity Index-3; BVS = Body Vigilance Scale; ACQ = Anxiety Control Questionnaire; BSQ = Body Sensations Questionnaire; DASS-21-D = Depression Anxiety and Stress Scale, Depression Subscale; DASS-21-A = Depression Anxiety and Stress Scale, Anxiety Subscale; DASS-21-S = Depression Anxiety and Stress Scale, Stress Subscale.

\* $p < .01$ .

Table 5

*Means, Standard Deviations, and Ranges for State Measures and Correlations with TCS*

State Measure	Mean	SD	Range	TCS
HQ-Somatic	3.24	5.73	0-12	.60*
HQ-Affective	3.11	3.04	0-29	.47*
HQ-Cognitive	.81	2.14	0-20	.61*
Anxiety	1.53	2.28	0-10	.36*
Fear	1.04	1.76	0-8	.27*
Tense	1.85	2.43	0-10	.33*
Tired	4.00	2.95	0-10	.09
Sad	1.84	2.60	0-10	.23*
Happy	5.63	2.61	0-10	.04
Energetic	4.12	2.55	0-10	.08
Relaxed	5.86	2.80	0-10	-.07

*Note.* TCS = Threatening Cognitions Scale; HQ-Somatic = Hyperventilation

Questionnaire-Somatic Subscale; HQ-Affective = Hyperventilation Questionnaire-

Affective Subscale; HQ-Cognitive = Hyperventilation Questionnaire-Cognitive

Subscale.

\* $p < .01$ .



## Conclusion

This preliminary psychometric analysis of the Threatening Cognitions Scale (TCS) concluded the measure is a unidimensional scale with high internal consistency. The TCS had a low response distribution, which was consistent with participants' responses to another measure of symptom induction experience (i.e., Hyperventilation Questionnaire). It is unknown whether a floor effect would be evident if a more potent symptom induction task was utilized that produced higher response variability.

The TCS evidenced a high degree of convergent validity and adequate discriminant validity. Specifically, the measure was associated with both state and trait measures of anxious symptoms, which supported predictions related to convergent validity. Evidence for discriminant validity was mixed, with the TCS having no significant associations with happy, tired, energetic or relaxed ratings. Although the TCS had a significant correlation with DASS-21 depression, it was more strongly associated with anxiety symptoms. In summary, findings from the present study provide initial support for the validity of TCS as a self-report measure that assesses momentary threatening thoughts related to physiological arousal.

There were several limitations to this initial psychometric investigation. First, there was no way to verify that participants engaged in the breathing task since the study was completed online. Second, the breathing task was a very mild physiological exercise and was selected primarily to satisfy research ethic constraints imposed on the study. The mild induction may explain the floor effect on the TCS and HQ. It is unknown from this study how participants may respond to the TCS when using an induction protocol that produces greater physiological arousal. Third, we were unable to receive feedback

from participants about their understanding of the TCS and therefore its clarity and ease of use are unknown, factors that are often assessed in a pilot study.

Overall, evidence from the initial psychometric investigation supports the TCS as a useful measure of threatening thought content in response to a mild symptom induction task. However, given the restricted response variability, the pilot study is not particularly informative of the TCS's performance in a more physiologically arousing induction exercise.

## CHAPTER 3: METHODOLOGY

### Participants

A total of 161 participants were recruited from the student population of the University of New Brunswick. Three participants were deleted, leaving a final sample of 158. Of the three participants removed from the dataset, the first withdrew from the study, the second asked about the true purpose of the study leading to early termination of participation, and the third was deleted due to equipment failure (i.e., heart rate monitor fell off participant). Students received course credit or \$10 for their participation in the study.

Sample size estimates were derived to determine sufficient statistical power using repeated measures ANOVA. A priori power analysis was conducted using G\*Power Version 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009). It was determined that a sample of 164 participants was necessary for 80% power to detect statistical significance ( $p < .05$ ) of a small effect size (.1). An alpha of .05 was chosen to maximize power in the context of the novel methodological design. The estimated effect size is comparable with previous research that found AS to be a significant, but modest (e.g., 10-15%) predictor of anxiety symptoms in a university sample (e.g., Olthuis, Stewart, Watt, Sabourin, & Keogh, 2012; Olthuis, Watt, & Stewart, 2014). A total of 131 participants were assigned to the experimental group (false physiological feedback) and 27 participants were assigned to the control group (benign feedback). Participants in the experimental group were randomly assigned to either the catastrophizing emotion regulation condition ( $n=66$ ) or the reappraisal emotion regulation condition ( $n=65$ ). Based on a random number generator, participants were matched to one of three groups:

1) experimental group + catastrophizing emotion regulation condition, 2) experimental group + reappraisal emotion regulation condition, or 3) control group.

**Participant characteristics.** Of the total sample, 60% were women ( $n=91$ ), and 81% were White ( $n=122$ ). The mean age of participants was 21-years-old ( $SD=.49$ , range=18-51). The mean number of years in university was 2.50 ( $SD=1.48$ , range=1-8). Breakdown of participants by faculty revealed the following distribution: Kinesiology (25.8%), Arts (19.9%), Science (18.5%), Business (12.6%), Engineering (7.9%), and the remaining 15.3% were various other faculties (i.e., Computer Science, Nursing, Interdisciplinary Leadership).

Participant fitness-related characteristics were examined. Overall, 86.8% of participants considered themselves to be in good physical health. Body mass index (BMI) was calculated based on self-reported height and weight. Mean BMI was 23.57 ( $SD=3.40$ , range=16-36), which falls in the healthy range. Based on the 2003 Canadian Guidelines for Body Weight Classification in Adults, 64% of participants ( $n=96$ ) had a BMI that fell in the healthy range, 5% ( $n=7$ ) were in the underweight range, and 28% ( $n=42$ ) and 3% ( $n=5$ ) were classified as overweight and obese, respectively. In the present study, 72.2% of participants identified themselves as athletic, and 43% reported that they were currently involved in organized sports. The mean self-reported frequency of engagement in 10 minutes or more of moderate-vigorous exercise was 4.37 times per week ( $SD=2.36$ , range=0-15), and the mean rating on the Perceived Fitness Scale was 5.61 ( $SD=2.20$ , range=0-9).

With regards to mental health, 17.2% of participants reported that they currently had a mental health problem that led them to obtain professional help, including anxiety, depression, ADHD, and learning disorders. Examination of responses on the Panic

History Form (PHF) revealed that 44.4% ( $n=67$ ) of participants reported a lifetime history of at least one unexpected panic attack.

**Screening and exclusionary criteria.** Eligibility for participation was determined via a screening process. Individuals were excluded if they reported a health condition that precluded physical activity. This was determined by item endorsement on the Physical Activity Readiness Questionnaire (PAR-Q; Thomas, Reading, & Shepherd, 1992) or disclosure of a serious medical condition. All those who expressed interest in the study met eligibility criteria and were invited to participate.

### **Measures**

**Physical Activity Readiness Questionnaire (PAR-Q; Thomas, Reading, & Shepherd, 1992).** The PAR-Q is a 7-item screening questionnaire for adults aged 15-69 years that assesses the presence of a health condition that precludes participation in a physical activity (see Appendix O). It was originally developed by the British Columbia Ministry of Health to assess readiness to engage in a physical activity program. The revised PAR-Q produced by the Canadian Society for Exercise Physiology (2002) was used in the present research study. Participants were asked to provide *yes* or *no* responses to each of the 7-items. Individuals who respond *yes* to any item were considered at risk for exercise and should seek medical advice before engaging in strenuous physical activity. Therefore, in the current research, individuals who responded *yes* to any PAR-Q item were screened out of the study. The PAR-Q is also recommended by the American College of Sports Medicine (2006) to determine readiness for moderate physical activity.

**Demographic information.** To obtain demographic information, participants were asked to complete a demographic information sheet (see Appendix P) where they

indicated their age, sex, ethnicity, relationship status, height, weight, participation in organized sports, and frequency of moderate-vigorous exercise participation.

Participants also identified any current physical or mental health problems and whether they were receiving treatment (e.g., medication, therapy).

**Perceived Fitness Scale (PFS; Sabourin, Hilchey, Watt, & Stewart, 2010).**

The PFS is a single-item scale that asks individuals to rate their level of perceived fitness on an 11-point scale ranging from 0 (*no activity*) to 10 (*Olympic calibre athlete*; see Appendix Q). The PFS has demonstrated adequate convergent validity to measures of physical activity (see Sabourin et al., 2010). Although only one item, single item scales as a measure of physical fitness have been used in previous studies (e.g., McWilliams & Asmundson, 2001).

**Panic History Form (PHF; Schmidt & Telch, 1994).** The PHF is a 4-item screening measure used in non-clinical samples to assess: 1) history of spontaneous panic attacks, 2) the presence of four or more panic attacks within a one-month period, 3) the presence of panic-related worry for one month or more, and 4) history of psychological/psychiatric treatment for anxiety or panic (see Appendix R). For each item, *yes* and *no* response options are provided. The PHF demonstrated acceptable reliability between endorsement of panic attacks and a structured diagnostic interview inquiring about the presence of panic attacks in treatment-seeking ( $\kappa=.64$ ) and non-clinical ( $\kappa=.58$ ) samples (Schmidt, Lerew, & Jackson, 1997). The PHF was selected for the current study over a structured interview due to its short administration time (less than five minutes). For the present research, panic attack history was assessed to determine the relation to anxiety sensitivity.

**Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007).** The ASI-3 is an 18-item self-report questionnaire that measures the extent of agreement to statements reflecting fear of physiological arousal commonly associated with anxiety (e.g., *when my stomach is upset, I worry that I might be seriously ill*; see Appendix C). Items are rated on a 5-point scale ranging from 0 (*very little*) to 4 (*very much*). The total score was used in the current study and is obtained by summing responses for all items, with a possible range of 0-72. In the present study, the ASI-3 is an independent variable and was administered at baseline to examine its relationship to anxiety symptoms at three time-points. Please refer to pages 13-14 for review of psychometric properties. In the present study, the Cronbach alpha for the ASI-3 total score was  $\alpha=.88$ .

**Body Vigilance Scale (BVS; Schmidt, Lerew, & Trakowski, 1997).** The BVS is a self-report measure of attention to internal physical sensations and cognitions (see Appendix F). It consists of 4 items, with items 1-3 measuring: 1) degree of attentional focus (i.e., *I am the kind of person who pays close attention to internal bodily sensations*), 2) perceived sensitivity to changes in bodily sensations (i.e., *I am very sensitive to changes in my internal bodily sensations*), and 3) time spent attending to bodily sensations (i.e., *On average, how much time do you spend each day scanning your body for sensations?*). Items 1-2 are rated on an 11-point scale ranging from 0 (*not at all like me*) to 10 (*extremely like me*). Item 3 ranges from 0 (*no time*) to 100 (*all of the time*). Item 4 is composed of 15 ratings on the degree of attention directed to the 15 features of a panic attack in DSM-IV (e.g., *heart palpitations, numbness, nausea*). Ratings for item 4 utilize an 11-point scale ranging from 0 (*none*) to 10 (*extreme*), from which a mean score is calculated. The BVS total score is calculated by summing items 1-4, with a possible range of 0-130. The BVS was included in this study to examine its

relation to anxiety sensitivity. The current Cronbach alpha for the BVS total score was  $\alpha=.83$ .

**Borg Rate of Perceived Exertion Scale (Borg RPE Scale; Borg, 1985).** The Borg RPE scale is a measure of perceived exertion. Prior to the arousal induction exercise, participants were given instructions on the procedures for the Borg RPE rating scale. The scale ranges from 6 (*no exertion at all*) to 20 (*maximal exertion*). The scale is considered an equidistant interval scale and was designed to parallel heart rate by multiplying ratings by 10. Borg ratings are highly correlated with heart rate, a parallel measure of exercise intensity (Borg, 1998). The Borg RPE scale was used to assess moderate perceived physiological arousal (i.e., rating of 13-14). The goal was to achieve similar levels of perceived exertion across participants. Participants were asked to adjust the resistance and their pedalling speed on the stationary bike until they reached a moderate level of exertion. In an early review, Borg (1998) concluded the measure had adequate reliability and validity. See Appendices S and T for the Borg RPE scale and instructions, respectively.

**Threatening Cognition Scale (TCS).** The TCS is a 12-item scale that was developed for the present study to measure momentary threatening thoughts related to physiological arousal. Tendency to think of specific physical sensations in a threatening manner was a dependent variable in the present study. For each item, participants were asked to rate the extent to which they had anxious or worrying thoughts about each sensation (e.g., *chest pain/tightness, sweating*) during the past few minutes on a 10-point scale ranging from 0 (*no anxious thinking*) to 9 (*thought anxiously all the time*). The TCS total score has a possible range of 0-108. The TCS was administered at baseline (T1), then after experimental manipulation (T2), and a final time following the emotion



regulation condition (T3). The psychometric properties of the TCS were evaluated in a preliminary investigation (see Chapter 2). In the present study, the Cronbach alphas at T1, T2, T3 were  $\alpha=.84$ ,  $\alpha=.91$ , and  $\alpha=.90$ , respectively.

**Visual Analogue Scales (VASs).** Seven VASs were used as dependent variables to assess changes in emotion throughout the study (see Appendix U). The VASs were administered at T1, T2, and T3. VASs are a measure often used to determine momentary changes in emotion. Each item is constructed as a continuous scale on a 100mm horizontal line with anchors labelled 0 (*not at all*) and 100 (*extremely*) for each emotion. Participants were asked to place a vertical mark on the horizontal line to indicate the degree to which they were experiencing, at that moment, the emotion labelled on the scale. In the current study, two VASs were especially relevant; *anxious* and *fearful*. Additional emotion labels were used as fillers to help conceal the purpose of the current study (i.e., *sad*, *happy*, *tired*, *energetic*, *tense*). The measurement between the start of the horizontal line and the vertical line marked by the participant is the score for each rating. VASs are efficient in their administration and are sensitive to momentary changes in emotion when compared to Likert scales, which provide fixed response options (Grant et al., 1999). VASs are more sophisticated than Likert scales because they represent a ratio rather than ordinal level of measurement. A review found the VAS to be a reliable measure of state variations in anxiety (Rossi & Pourtois, 2012).

**Socially Desirable Response Set-Five Item Survey (SDRS-5; Hays, Hayashi, & Stewart, 1989).** The SDRS-5 is a 5-item measure that assesses an individual's tendency to respond to statements in a socially desirable manner (see Appendix E). This measure was developed in collaboration with the RAND Cooperation from other short forms of the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1960).

The goal was to develop a measure that could be completed in less than one minute. Participants are asked to rate how much each statement is true or false for them (e.g., *I am always courteous even to people who are disagreeable*). Items are rated on a 5-point scale ranging from 1 (*definitely true*) to 5 (*definitely false*). Item responses are scored dichotomously with extreme responses (i.e., 1 or 5) considered socially desirable and scored as 1. For items 1 and 5 the extreme score is 1 (*definitely true*), and for items 2, 3, and 4 the extreme score is 5 (*definitely false*). All other responses are scored zero. The total score is transformed from a 0-5 scale to a proportional 0-100 scale. In the initial development of the SDRS-5 the internal reliability was adequate for a five-item scale, with alpha coefficients of .66 and .68 in two samples. Re-test reliability was  $r=.75$  (Hays et al., 1989). Hays and colleagues conducted two initial validation studies of the SDRS-5 using Medical Outcomes Survey in a sample of medical/mental health providers. The means for each sample were 17.66 ( $SD=24.97$ ) and 35.80 ( $SD=30.71$ ), respectively. In the present study, social desirability bias may influence endorsement of items on the dependent variables because the purpose of the study may be apparent to participants. However, the internal consistency estimate was  $\alpha=.42$ , which suggests that social desirability was not adequately assessed by the SDRS-5 in the present study.

#### **Difficulties in Emotion Regulation Scale (DERS; Gratz & Roemer, 2004).**

The DERS is a 36-item self-report scale that measures emotional dysregulation (see Appendix V). A total score is calculated by summing all items. Six subscales are also calculated: 1) non-acceptance of emotional responses, 2) difficulties engaging in goal directed behaviour, 3) impulse control difficulties, 4) lack of emotional awareness, 5) limited access to emotion regulation strategies, and 6) lack of emotional clarity. The DERS total score and subscale scores were used in the present study to examine the

relationship between AS and self-reported emotion regulation difficulties at baseline. The current Cronbach alpha for the DERS total score was  $\alpha=.87$ , with internal consistency estimates for the subscales ranging from  $\alpha=.77$  to  $\alpha=.90$ .

### **Apparatus**

**Monark model 828E bike.** An upright stationary bike was used as the arousal induction exercise. Participants were asked to increase the work rate manually by changing the resistance level and speed of pedalling to maintain a moderate level of perceived exertion based on the Borg RPE scale. Participants biked for a total of 15 minutes.

**Heart rate monitor.** A Polar heart rate monitor was used to enhance false cardiac feedback. Participants were asked to wear a chest strap and only the investigator had access to continuous heart rate data via a watch. The investigator monitored heart rate throughout the 15-minute exercise period. The main purpose of the heart rate monitor was for credibility of false feedback about heart rate provided verbally by the investigator, but it was also monitored to ensure normal heart rate during the biking task.

### **Procedure**

An overview of the study procedure is presented in Figure 1.

**Phase I: Screening and baseline measurement.** Participants were recruited from the University of New Brunswick student population. The majority of participants were students enrolled in the Introductory Psychology course (87%), who scheduled a time to participate using the online research recruitment system and received course credit for their participation. The remainder of participants (13%) were students who were recruited via advertisements on campus, and received \$10 for their participation. When participants first arrived to their appointment, eligibility was determined by

screening for medical conditions that are contraindicative of exercise, using the PAR-Q. Participants who were physically able to do 15 minutes of bike riding were invited to read and sign the informed consent form (see Appendix W). Volunteers were informed that the study investigates psychological factors that influence the experience of body movement. After introduction to the study, participants were given a baseline questionnaire battery to complete consisting of the two state measures (VAS, TCS) followed by the demographic questionnaire, Panic History Form (PHF), Perceived Fitness Scale (PFS), Anxiety Sensitivity Index-3 (ASI-3), Body Vigilance Scale (BVS), and Difficulties in Emotion Regulation Scale (DERS). Phase I took approximately 20 minutes to complete.

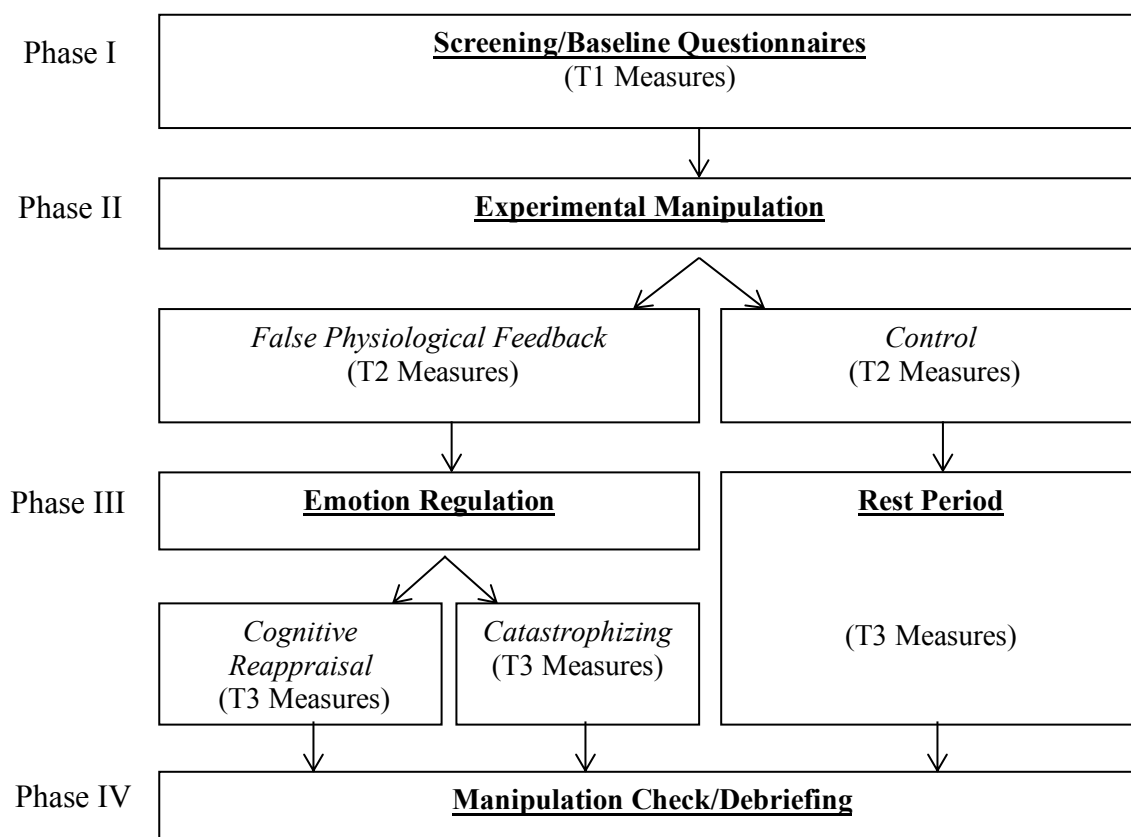


Figure 1. Overview of study procedure.

**Phase II: Experimental manipulation.** Participants were randomly assigned to either the experimental group (false physiological feedback) or the control group (benign feedback). All participants were asked to participate in the arousal induction exercise (i.e., stationary bike), which lasted 15 minutes. Individuals were informed that they would be asked to spend 20 minutes on the bike. Participants were provided with the Borg RPE instructions and were asked to maintain a moderate level of physical exertion, using the Borg RPE scale as a guide (see Appendices S and T). After 15 minutes on the bike participants in the experimental group were asked to stop and were provided with false, unexpected negative feedback about their heart rate. Participants in the control group received benign feedback pertaining to malfunctioning of the heart rate monitor. Participants in both groups were instructed to stop biking. The investigator presented feedback verbally (see below for feedback scripts). The feedback was an elaboration of scripts used in a similar experiment by Papageoriou and Wells (2002). Following feedback all participants were given a second questionnaire battery to complete, consisting of a second set of VASs and the TCS. Phase II completion time was approximately 20 minutes.

***Experimental feedback script.*** Participants in the experimental group were told:

“Oh, this is interesting. I’m getting a reading that your heart rate is *much* higher than I expected for your age and how long you’ve been biking. We better stop to be safe.”

***Control feedback script.*** Participants in the control group were told:

“Oh, this is interesting. I’m no longer getting a reading from the heart rate monitor. It doesn’t seem to be working properly. Since I’m not getting a reading you can stop.”

**Phase III: Emotion regulation task.** Participants who were in the experimental group in Phase II were also randomly assigned to one of two emotion regulation conditions: cognitive reappraisal or catastrophizing. Participants were given the appropriate instructions for each condition and then asked to use the emotion-regulation strategy for five minutes (see below for instructions). Participants in the control group did not complete the emotion regulation task and instead were asked to complete a five-minute rest period.

***Catastrophizing instructions.*** Students in the catastrophizing condition were asked to generate harmful thoughts regarding the false physiological feedback. The following instructions were provided:

“I want to follow up with you and ask that you spend a few minutes reflecting on your experience on the bike. Because we had to stop due to your heart rate increase, I want you to think of as many potentially *harmful, serious* reasons why your heart rate was higher than expected, and write them down. Keep going until I tell you to stop. Do you have any questions?”

After the five-minute period, participants were asked to provide a belief rating for each recorded reason on a scale from 1 (*not at all*) to 5 (*very much*): “Rate the extent to which you believe each reason.”

***Cognitive reappraisal instructions.*** Participants in the cognitive reappraisal condition were asked to generate harmless thoughts regarding the false physiological feedback and were given the following instructions:

“I want to follow up with you and ask that you spend a few minutes reflecting on your experience on the bike. Because we had to stop due to your heart rate increase, I want you to think of as many *harmless, practical* reasons why your

heart rate was higher than expected, and write them down. Keep going until I tell you to stop. Do you have any questions?”

After the five-minute period, participants were asked to provide a belief rating for each reason on a scale from 1 (*not at all*) to 5 (*very much*): “Rate the extent to which you believe each reason.”

Finally, all participants completed another set of VASs and the TCS, and the SDRS-5. Completion time for Phase III was approximately ten minutes.

**Phase IV: Post-experimental measurement and debriefing.** A manipulation check was conducted to determine the credibility of the false feedback manipulation. Individuals were asked whether they had any doubts about the heart rate feedback (*yes* or *no*): “When I told you that your heart rate was unexpectedly high, did you have any doubts that this was true?” Participants were also asked to rate on a 5-point scale how much they believed the false feedback was true, ranging from 1 (*not at all*) to 5 (*very much*). This manipulation check was adapted from similar instructions developed by Papageorgiou and Wells (2002). Finally, students were debriefed regarding the incomplete disclosure (i.e., false feedback) and the false advertisement of the study. All participants were provided with a debriefing form (see Appendix X) and a post-debrief consent form to sign (See Appendix Y). The approximate completion time for Phase IV was ten minutes.

### **Data Analysis Plan**

**Preliminary analyses.** Descriptive statistics were calculated and correlations were examined among self-report measures. Associations between AS and emotion dysregulation were evaluated at baseline by examining the correlations between the ASI-3 total score and the Difficulties in Emotion Regulation Scale (DERS) total and subscale

scores. The correlation between the ASI-3 and the Body Vigilance Scale (BVS) was also examined to determine the relationship between AS and attention to bodily sensations. To examine the relationship between AS and self-reported history of panic, a one-way ANOVA was conducted to determine if participants differ in AS based on their history of panic attacks (as measured by the PHF).

Correlations between the Anxiety Sensitivity Index-3 and fitness-related variables also were examined (Perceived Fitness Scale, self-reported frequency of exercise, BMI). Fitness-related variables are important to consider as they could interact with AS to influence anxious responding to the exercise task.

The three groups in the present study were compared on baseline measures to determine if groups were comparable prior to study manipulations. Specifically, chi-square analyses and one-way ANOVAs were conducted to examine differences on age, sex, fitness-related variables, ASI-3, DERS total score, VAS Fear T1, VAS Anxiety T1, and TCS total T1. Finally, the effect of sex on the dependent variables (ASI-3, VAS Anxiety, VAS Fear and the TCS at all time points) was also examined using a MANOVA.

**Manipulation check.** The credibility of the false physiological feedback was verified using the post-experimental questions. The number of participants who indicated that they doubted the validity of the feedback was examined using a frequency count. The extent to which participants believed the feedback was also examined using the 5-item scale. Range and average were computed as a representation of the validity of the manipulation.

Responses recorded in the emotion-regulation task were examined to determine whether participants engaged in the task correctly, as well as the extent to which they



endorsed the emotion-regulation task via examination of belief in responses. In addition, SDRS-5 scores were examined to determine the degree that participants may have engaged in socially desirable responding. A one-way ANOVA was conducted to examine group differences on the SDRS-5.

**Hypothesis testing.** Hypothesis 1 (Emotional Intensity) was tested using General Linear Modelling (GLM) with categorical and continuous independent variables. Categorical independent variables are feedback group (experimental, control) and time (T1, T2). Feedback group is a between-subjects independent variable and time is a within-subjects independent variable. The continuous independent variable is AS (as measured by the ASI-3). Hypotheses 2 (Emotion Regulation) was also tested using General Linear Modelling (GLM) with categorical and continuous independent variables. The categorical independent variables are emotion regulation condition (cognitive reappraisal vs. catastrophizing), and time (T2, T3). Emotion regulation condition is a between-subjects independent variable and time is a within-subjects independent variable. The continuous independent variable is AS level (measured by the ASI-3). Three analyses for each hypothesis were conducted to examine each of the dependent variables: fear, anxiety and threatening cognitions.

## CHAPTER 4: RESULTS

### Data Screening and Conditioning

The data were screened and conditioned prior to running the analyses based on guidelines offered by Tabachnick and Fidell (2012). Data were examined for accuracy and completeness, missing values, and outliers. First, the data were screened for out of range values for all variables using descriptive and frequency statistics. When errors were identified, raw data were examined and errors corrected. Next, missing values analysis in SPSS was used to determine the amount and pattern of missing data. Overall, less than 5% of data were missing from the dataset, and missing values were completely random as indicated by a non-significant Little's MCAR value,  $\chi^2(2589)=2664.09$ ,  $p=.15$ . According to Tabachnick and Fidell, if less than 5% of data are missing randomly analyses can proceed with mean substitution to handle missing values. Consequently, mean substitution was used in the present study. Since mean substitution could not be employed for the single-item VASs, pairwise deletion was utilized.

Univariate outliers were examined by inspection of histograms as well as stem-and-leaf plots. In addition, cases that were more than 3.29 standard deviations ( $p<.001$ ) from the mean and discontinuous from other scores were considered outliers. Seven univariate outliers were identified (5 from the experimental group, 2 from the control group). To determine the impact of all univariate outliers, planned analyses were run with and without these cases. Inclusion of outliers did affect the pattern of significant findings compared to their exclusion, and therefore they were deleted from the data set. A total of 151 participants remained: 126 in the experimental group ( $n=66$  catastrophizing,  $n=60$  reappraisal) and 25 in the control group.

### Preliminary Analyses

Means, standard deviations, and ranges for the Anxiety Sensitivity Index- 3 (ASI-3), Body Vigilance Scale (BVS), and Difficulties in Emotion Regulation Scale (DERS) are presented in Table 6. The mean for the ASI-3 total score was 18.13.

Although AS was used as a continuous variable in the statistical analyses, for comparison purposes the number of participants that can be categorically classified as having high AS was examined using a cut-off value proposed by Bernstein and colleagues (2010). In the present study, 26.5% of participants were classified as having high AS.

Correlations between the ASI-3, DERS, and BVS are presented in Table 7. As expected, the ASI-3 total score was significantly and positively correlated with the DERS total and subscale scores, except for the lack of emotional awareness subscale, which was not significantly correlated with the ASI-3. These results suggest that heightened AS is associated with increased difficulties in regulating emotions. However, the non-significant correlation between the ASI-3 and the DERS lack of emotional awareness subscale suggests that AS is not associated with difficulties in identifying emotions. A small but significant positive correlation was found between the ASI-3 and BVS total scores. This finding was expected, and suggests that heightened AS is associated with elevated attention to internal sensations and cognitions.

To determine the relationship between AS and self-reported history of panic attacks, a one-way ANOVA was conducted. As expected, the analysis revealed that individuals who self-reported a history of panic attacks had significantly higher levels of AS,  $F(1, 151)=24.37, p<.001$ , compared to individuals who reported no history of panic attacks.

### **AS and Fitness-Related Variables**

Although a relationship between AS and low levels of physical fitness was expected, the only significant finding was a small negative correlation between the ASI-3 total score and the Perceived Fitness Scale (PFS),  $r=-.17, p=.04$ . The ASI-3 was not significantly correlated with BMI ( $r=-.02, p=.78$ ) or exercise frequency ( $r=-.09, p=.26$ ), suggesting that AS and fitness-related variables were not highly associated in the present study.

### **Group Comparisons**

The three groups (control, reappraisal, catastrophizing) were compared on demographic characteristics at baseline using one-way ANOVAs and chi-square analyses. Please refer to Table 8 for means and standard deviations. The groups did not differ on age,  $F(2,146)=0.51, p=.60$ , or sex,  $\chi^2(1)=0.18, p=.07$ . There were no significant differences between groups on the ASI-3 total score, T1 VAS Fear score, T1 VAS Anxiety score, or T1 TCS total score, with  $ps>.19$ . Finally, there was no significant difference between groups on the DERS total score, suggesting that the groups were similar on self-rated difficulties using emotion regulation strategies at baseline.

Participants were also compared on fitness-related variables. There was a significant finding for self-reported frequency of exercise,  $F(2, 146)=6.99, p<.01$ . Simple main effects revealed that individuals in the catastrophizing condition ( $M=5.11, SD=2.80$ ) reported more frequent moderate-to-vigorous exercise per week than individuals in the reappraisal condition ( $M=3.59, SD=1.65$ ),  $p<.01$ . The other group comparisons were non-significant. When the Perceived Fitness Scale (PFS) and BMI were examined, no significant group differences were found ( $ps>.34$ ). Taken together,

while individuals in the catastrophizing condition reported more frequent exercise than those in the reappraisal condition, groups were comparable on BMI and self-reported fitness level.

### **Sex Differences**

A MANOVA was conducted to determine if there were sex differences on the ASI-3 total score, and the VAS Fear, VAS Anxiety and TCS scores T1, T2, and T3. The multivariate  $F$  test was non-significant,  $F(10, 138)=1.36, p=.20$ , precluding further examination of the univariate tests.

### **Manipulation Check**

#### **False Feedback**

Several post-experimental questions examined the credibility of the false physiological feedback. Inspection of the frequency distributions indicated that 40.6% of participants had doubts about the validity of the feedback. The extent to which participants believed the feedback was also examined using the 5-item scale ranging from 1 (*did not believe the information*) to 5 (*believed the information very much*). A mean of 3.71 ( $SD=1.19$ ; range=1-5; median=4; mode=5) confirmed a mixed response to the credibility of the false feedback. Results of a Wilcoxon rank-sum test revealed that belief ratings for the benign feedback ( $M=4.12, SD=1.13$ ) were significantly higher than belief ratings for the false physiological feedback ( $M=3.62, SD=1.19, Z=-2.09, p=.04$ ). Furthermore, when the emotion regulation conditions were compared, participants in the reappraisal condition ( $M=3.92, SD=1.07$ ) had significantly higher belief ratings than participants in the catastrophizing condition ( $M=3.34, SD=1.24, Z=-2.51, p=.01$ ). These results suggest that the benign feedback (control group) was more believable than the physiological feedback (experimental group). Furthermore, participants in the

experimental group were more likely to believe the false physiological feedback when assigned to the reappraisal condition compared to the catastrophizing condition. It is likely that the catastrophizing instructions made the true nature of the study more apparent to participants. Manipulation check questions were added as covariates to the main analyses (i.e., hypotheses testing) to examine whether the believability of false feedback influenced results. The pattern of the results did not change, and therefore manipulation check questions were not included in final analyses.

### **Emotion Regulation**

In terms of the emotion regulation task, the mean number of reasons that were recorded by participants was 5.72 ( $SD=2.34$ ; range=1-14). Results of a one-way ANOVA revealed that the number of reasons generated by the catastrophizing ( $M=5.44$ ;  $SD=2.60$ ; range=1-15) and reappraisal conditions ( $M=6.03$ ;  $SD=2.00$ ; range=3-11) were not significantly different,  $F(1, 124)=2.05, p=.16$ . With regards to believability of the reasons, a one-way ANOVA indicated that individuals in the reappraisal condition had significantly higher mean belief ratings ( $M=3.13, SD=.64$ ) than those in the catastrophizing condition ( $M=2.75, SD=.75$ ),  $F(1, 122)=9.10, p<.01$ . Two participants were not included in the analyses due to missing belief ratings. These results suggest that individuals in the reappraisal condition had a stronger belief in the reasons they generated for why their heart rate may have been elevated than did individuals in the catastrophizing condition.

An exploratory investigation of the emotion regulation responses was conducted by the author to determine whether participants complied with the experimental instructions. For example, participants in the reappraisal condition were instructed to think of harmless, practical reasons for their elevated heart rate, but may have

inadvertently generated harmful reasons. Therefore, participants' reasons were examined with each reason classified as a reappraisal or catastrophizing response. Benign, transient, situational attributions (e.g., *I didn't sleep well last night; I'm out of shape*) were classified as reappraisal responses, whereas more permanent, negative, internal attributions (e.g., *Maybe my health isn't as good as I thought; I have a family history of cardiovascular disease*) were classified as catastrophizing responses. Since participants provided multiple reasons for why their heart rate could be elevated, each participant was classified into one of three categories: 1) all reasons provided by the participant were in line with the assigned emotion regulation condition, 2) all reasons were discrepant from the assigned emotion regulation condition, 3) participants provided a mix of responses that fell under both catastrophizing and reappraisal types.

Overall, 45.5% ( $n=60$ ) completed the task as instructed, 20.5% ( $n=27$ ) had completely discrepant responses, and 34% ( $n=45$ ) provided mixed responses. Of the 60 participants who completed the task correctly, 53 were in the reappraisal condition and only 7 were in the catastrophizing condition. This suggests further that the manipulation failed to induce a catastrophizing response in most of the participants assigned to that condition, whereas reappraisal was a more successful manipulation.

### **Social Desirability**

The SDRS-5 was not significantly correlated with the TCS total score, Fear VASs, or Anxiety VASs. Therefore, social desirability, as measured by the SDRS-5, was unrelated to any of the dependent variables. The SDRS-5 mean (20.79) and standard deviation (21.54) were consistent with those reported in the SDRS-5 validation studies (Hays et al., 1989). A one-way ANOVA revealed that SDRS-5 scores did not differ by group,  $F(2, 148)=1.20, p=.03$ .

## Hypotheses Testing

**Assumptions.** A set of tests assessed skewness and kurtosis of each variable for violations of normality. Z-scores were obtained by dividing the skew and kurtosis values by the standard error. The distribution was deemed non-normal if the z-values were above 1.96 (Tabachnick & Fidell, 2012). All the dependent variables at all three time-points deviated substantially from a normal distribution. The data were positively skewed, indicating a floor effect (see Table 9). It is likely that the mild nature of the experimental manipulation resulted in the violation of the normality assumption. The data remained non-normal after logarithm and inverse transformations were conducted. Therefore, all subsequent analyses were based on the untransformed data.

The assumption of homoscedasticity was examined via the Levene's test. For Hypothesis 1, the Levene's test revealed that the assumption was met for T1 VAS Fear and VAS Anxiety but was violated at T2. The results indicate that the variances of the control and experimental groups were similar at T1 but not at T2. For the TCS, the assumption was met at both T1 and T2. For Hypothesis 2, the Levene's test revealed that the assumption for VAS Fear scores was met at T2 but violated at T3 indicating variances between reappraisal and catastrophizing conditions at T3 were discrepant. For VAS Anxiety scores, the assumption was met at both T2 and T3. Finally, for the TCS, the assumption was met for T2, but violated at T3.

### Hypothesis 1: Emotional Intensity

Hypothesis 1 predicts that heightened anxiety sensitivity in the experimental group will be associated with a significant increase in anxiety, fear, and threatening cognitions at T2, whereas no change in anxiety, fear, or threatening cognitions is expected in the control group. General linear modelling (GLM) with categorical and



continuous independent variables was used to test this hypothesis. Group (experimental, control) is a between-group factor, time (T1, T2) is a repeated measures factor, and AS (as measured by the ASI-3 total score) is the continuous independent factor. The dependent variables are the VAS Fear score, VAS Anxiety score, and TCS total score. A significant Group x Time x AS interaction is predicted. The results of the separate analyses for each dependent variable to test Hypothesis 1 are reported below. Means and standard deviations of the relevant dependent variables can be found in Table 10.

**Fear.** Hypothesis 1 was supported for fear because the Group x Time x AS interaction was significant,  $F(1, 146)=4.13, p=.044, \eta_p^2=.03$ . Simple main effects showed a significant increase in fear from T1 to T2 for the experimental group,  $F(1, 146)=36.63, p<.001, \eta_p^2=.20$ , but not the control group,  $F(1, 146)=.01, p=.91, \eta_p^2=.00$ , suggesting that the experimental manipulation was effective in inducing a fear response in participants. To disentangle the three-way interaction, the time factor was transformed into a T2-T1 difference score for the VAS Fear rating. With this difference score as a dependent variable, the ASI-3 was positively correlated with the change in VAS Fear in the experimental group ( $r=.23, p=.01$ ). This finding supports Hypothesis 1, indicating that heightened AS was associated with increased fear after false physiological feedback. In contrast, a negative correlation was found between the ASI-3 and the change in VAS Fear for the control group ( $r=-.26, p=.22$ ; lack of significance due to low power). Heightened AS was associated with a reduction in fear in response to benign feedback. The only other significant findings were a Group x AS interaction,  $F(1, 146)=6.96, p<.01, \eta_p^2=.05$ , and a significant main effect of AS,  $F(1, 146)=7.67, p<.01, \eta_p^2=.05$ .

**Anxiety.** Hypothesis 1 was not supported for anxiety because the three-way interaction of Group x Time x AS was not significant,  $F(1, 146)=3.45, p=.065, \eta_p^2=.02$ . The only significant finding was a main effect of AS,  $F(1, 146)=11.83, p<.01, \eta_p^2=.08$ . Pearson correlations revealed a significant correlation between the ASI-3 and VAS Anxiety at T1 ( $r=.39, p<.01$ ) and T2 ( $r=.27, p<.01$ ) for the total sample.

**Threatening cognitions.** Hypothesis 1 was not supported for threatening cognitions because the predicted Group x Time x AS interaction was not significant,  $F(1, 147)=.98, p=.32, \eta_p^2=.01$ . There was a significant main effect of time,  $F(1, 147)=5.97, p=.02, \eta_p^2=.04$ , showing that, overall, participants reported an increase in threatening cognitions from T1 to T2, regardless of group. In addition, there was a significant main effect of AS,  $F(1, 147)=14.78, p<.001, \eta_p^2=.09$ . The ASI-3 and the TCS total score were significantly correlated at both T1 ( $r=.35, p<.01$ ) and T2 ( $r=.42, p<.01$ ), suggesting that individuals with high AS levels tended to endorse more threatening cognitions for their current physical sensations. All other effects were non-significant.

**Hypothesis 1 summary.** Overall, Hypothesis 1 was partially supported. As predicted, a greater increase in fear was observed across time in the experimental group (false physiological feedback) than the control group (benign feedback). In contrast, group assignment did not influence self-reported anxiety or threatening cognitions, indicating that the experimental manipulation was effective for fear responses only. As predicted, heightened AS was associated with fearful responding in the experimental group. AS significantly predicted fear, anxiety, and threatening cognitions regardless of time or group. Please refer to Appendix Z for Hypothesis 1 results using the ASI-3 physical concerns subscale score instead of the total score. Overall, the pattern and significance of results were the same. The only discrepant finding when using the ASI-3

physical concerns subscale score was a significant AS x Time interaction for Anxiety responses.

### **Hypothesis 2: Emotion Regulation**

Hypothesis 2 predicts that heightened anxiety sensitivity will be associated with a significant increase in anxiety, fear, and threatening cognitions in the catastrophizing condition, whereas low anxiety sensitivity will be associated with a significant decrease in anxiety, fear, and threatening cognitions in the cognitive reappraisal condition. GLM with categorical and continuous independent variables was used to test this hypothesis. Emotion regulation condition (catastrophizing vs. cognitive reappraisal) is a between-group independent factor, time (T2, T3) is a repeated measures factor, and AS (as measured by the ASI-3 total score) is the continuous independent factor. The dependent variables are VAS Fear score, VAS Anxiety score, and TCS total score. A significant Condition x Time x AS interaction was predicted. The results of three separate analyses for each dependent variable to test Hypothesis 2 are reported below. Means and standard deviation for all dependent variables are presented in Table 11.

**Fear.** Hypothesis 2 was not supported for fear because the Condition x Time x AS interaction was not significant,  $F(1, 121) < 1, p = .56, \eta_p^2 = .003$ . The only significant finding was a main effect of AS,  $F(1, 121) = 20.84, p < .001, \eta_p^2 = .15$ . Correlations revealed that the ASI-3 total score had a significant positive correlation with VAS Fear both at T2 ( $r = .41, p < .001$ ) and T3 ( $r = .30, p < .01$ ).

**Anxiety.** Hypothesis 2 was not supported for anxiety, because the Condition x Time x AS interaction was not significant,  $F(1, 121) < 1, p = .98, \eta_p^2 = .00$ . There was a main effect of time,  $F(1, 121) = 5.15, p = .03, \eta_p^2 = .04$ , with anxiety scores decreasing from T2 to T3 (see Table 11). There was also a significant main effect of AS,  $F(1,$

121)=25.79,  $p<.001$ ,  $\eta_p^2=.18$ ; the ASI-3 was significantly and positively correlated with anxiety at both T2 ( $r=.35$ ,  $p<.001$ ) and T3 ( $r=.44$ ,  $p<.001$ ). All other effects were non-significant.

**Threatening cognitions.** The Condition x Time x AS interaction was again not significant,  $F(1, 122)=.23$ ,  $p=.63$ ,  $\eta_p^2=.002$ ; Hypothesis 2 was not supported for threatening cognitions. There was a main effect of time,  $F(1, 122)=12.16$ ,  $p<.01$ ,  $\eta_p^2=.09$ , with threatening cognitions higher at T2 than T3 for the entire sample. There was also a main effect of AS,  $F(1, 122)=37.82$ ,  $p<.001$ ,  $\eta_p^2=.24$ . The ASI-3 was significantly and positively correlated with the TCS total score at both time periods,  $r_s \geq .38$ . All other effects were non-significant.

**Hypothesis 2 summary.** Hypothesis 2 was not supported in any of the analyses. Cognitive reappraisal and catastrophizing had no effect on subjective VAS Fear or Anxiety scores, or endorsement of threatening cognitions on the TCS. However, AS was robust in showing a positive correlation with fear, anxiety, and threatening cognitions regardless of the time or emotion regulation condition, which is consistent with the fear amplification interpretation of anxiety sensitivity. Please refer to Appendix Z for Hypothesis 2 results using the ASI-3 physical concerns subscale score. Overall, the pattern of results remained the same. The only discrepant finding was a significant AS x Time interaction for anxiety responses when using the ASI-3 physical concerns subscale score.

### **Supplemental Analyses: Emotional Specificity**

To determine emotion specificity of AS to anxiety-related symptoms, supplemental analyses were conducted with the distractor VAS ratings (Tense, Sad,

Tired, Energetic, and Happy). As with the planned analyses conducted for Hypothesis 1 and 2, GLM with categorical and continuous independent variables was employed.

### **AS Specificity: False Physiological Feedback**

GLM analyses were conducted to determine specificity of AS during the experimental manipulation. Group (experimental, control) remained the between-group factor, time (T1, T2) a repeated measured factor, and AS (as measured by the ASI-3 total score) the continuous independent factor. The five VASs were the dependent variables.

Overall, there were no significant main effects of AS on the VAS ratings. However, AS x Group interactions were observed for VAS Tense,  $F(1, 146)=9.31$ ,  $p<.01$ ,  $\eta_p^2=.06$ , and Sad ratings,  $F(1, 146)=4.12$ ,  $p<.05$ ,  $\eta_p^2=.03$ . AS was significantly and positively correlated with VAS Tense and Sad ratings in the experimental group at both T2 and T3 ( $r_s=.32$ - $.35$ ). AS was not significantly correlated with Tense or Sad ratings in the control group at either time period. The only other significant finding was a main effect for group, with participants in the experimental group reporting higher Tense ( $F(1, 146)=4.04$ ,  $p<.05$ ,  $\eta_p^2=.03$ ), and lower Happy ratings ( $F(1, 145)=4.84$ ,  $p<.05$ ,  $\eta_p^2=.03$ ) than participants in the control group.

In summary, supplemental analyses of the VAS distractor items provide partial support for AS specificity to anxious responding following false feedback. The AS x Group interaction in predicting Tense ratings is to be expected, given that tension is a physical component of anxiety. However, the AS x Group interaction in predicting Sad ratings was not expected, and suggests that heightened AS was associated with negative emotionality more broadly. Further interpretation of these results is provided in the discussion section.

### AS Specificity: Emotion Regulation

GLM analyses were also conducted to determine specificity of AS during the emotion regulation manipulation. Emotion regulation (catastrophizing vs. cognitive reappraisal) was a between-group independent factor, time (T2, T3) was a repeated measures factor, and AS (as measured by the ASI-3 total score) was the continuous independent factor. The dependent variables were the five VAS distractor items.

There was a significant main effect of AS on VAS Tense ( $F(1,121)= 19.31$ ,  $p<.001$ ,  $\eta_p^2=.14$ ), Sad ( $F(1,121)= 23.82$ ,  $p<.001$ ,  $\eta_p^2=.17$ ), Tired ( $F(1,121)= 9.06$ ,  $p<.01$ ,  $\eta_p^2=.07$ ), and Happy ( $F(1,121)= 9.87$ ,  $p<.01$ ,  $\eta_p^2=.08$ ) ratings. AS was significantly and positively correlated with self-reported levels of Tense, Sad, and Tired ratings at T2 and T3 ( $r_s>.19$ ). In contrast, AS was significantly and negatively correlated with Happy ratings at both time periods ( $r_s>.24$ ), and there was no significant relationship between AS and Energetic ratings. These findings suggest that AS was robust in its association with various mood states during the emotion regulation manipulation. However, AS did not significantly interact with time or emotion regulation condition in predicting mood states. The only other significant finding was a main effect of time, with a significant decrease in VAS Tense ( $F(1,121)=6.40$ ,  $p<.05$ ,  $\eta_p^2=.05$ ), and Tired ratings ( $F(1,121)= 11.13$ ,  $p<.01$ ,  $\eta_p^2=.08$ ), from T2 to T3.

Table 6

*Means, SDs, and Ranges for the ASI-3, BVS, and DERS*

	<i>Mean</i>	<i>SD</i>	<i>Range</i>
ASI-3 Total	18.13	10.70	0-45
BVS Total	17.54	7.51	0-36.33
DERS Total	80.68	19.38	44-133
DERS Non-Acceptance	12.87	5.27	6-30
DERS Goals	15.32	4.73	5-25
DERS Impulse	10.73	4.33	6-27
DERS Strategies	16.28	6.18	8-32
DERS Clarity	10.50	3.30	5-22
DERS Awareness	14.97	4.42	6-28

*Note.* ASI-3 = Anxiety Sensitivity Index-3; BVS = Body Vigilance Scale; DERS =

Difficulties in Emotion Regulation Scale.

Table 7

*Correlations among the ASI-3, BVS, and DERS*

	1	2	3	4	5	6	7	8	9
1. ASI-3 Total	<b>.88</b>								
2. BVS Total	.37**	<b>.83</b>							
3. DERS Total	.56**	.12	<b>.87</b>						
4. DERS Non-Acceptance	.46**	.16*	.81**	<b>.90</b>					
5. DERS Goals	.40**	.18*	.66**	.43**	<b>.89</b>				
6. DERS Impulse	.41**	.19*	.71**	.46**	.49**	<b>.86</b>			
7. DERS Strategies	.55**	.19*	.86**	.65**	.52**	.60**	<b>.88</b>		
8. DERS Clarity	.37**	.03	.68**	.50**	.20*	.40**	.52**	<b>.77</b>	
9. DERS Awareness	.06	-.34**	.30**	.14	-.09	-.06	.06	.314	<b>.80</b>

*Note.* Alpha coefficients reported on the diagonal. ASI-3 = Anxiety Sensitivity Index-3; BVS = Body Vigilance Scale; DERS = Difficulties in Emotion Regulation Scale.

\* $p < .05$ . \*\* $p < .01$ .



Table 8

*Mean Scores of Measures at Baseline by Group (SDs in Brackets)*

	Control	Experimental: Catastrophizing	Experimental: Reappraisal	<i>F</i>
Age	21.08 (6.37)	20.47 (3.38)	21.27 (4.64)	0.51
ASI-3 Total Score	19.03 (11.89)	17.23 (9.56)	18.75 (11.45)	0.42
VAS Fear T1	5.92 (10.71)	7.47 (11.26)	7.43 (9.12)	0.23
VAS Anxiety T1	15.08 (17.93)	17.12 (17.50)	16.75 (18.76)	0.12
TCS Total T1	4.84 (6.28)	8.64 (10.66)	6.68 (8.52)	1.71
DERS Total Score	84.72 (20.48)	79.48 (20.82)	80.30 (17.26)	0.68
PFS	5.86 (2.38)	5.80 (2.41)	5.28 (1.84)	1.08
BMI	23.03 (3.31)	23.93 (3.94)	23.40 (2.77)	0.75
Exercise Frequency	4.31 (1.95)	5.11 (2.80)	3.59 (1.65)	6.99*

*Note.* ASI-3 = Anxiety Sensitivity Index-3; VAS = Visual Analogue Scale; TCS = Threatening Cognitions Scale; DERS = Difficulties in Emotion Regulation Scale; PFS = Perceived Fitness Scale; BMI = Body Mass Index.

\* $p < .01$ .

Table 9

*Frequency of Scores of 0 on Each DV as a Function of Group and Time*

	Control Group		Experimental Group		
	T1	T2	T1	T2	T3
VAS Fear	7 (28%)	3 (12%)	30 (23.8%)	18 (14.3%)	26 (20.6%)
VAS Anxiety	5 (20%)	2 (8%)	12 (9.5%)	12 (9.5%)	16 (12.7%)
TCS Total	4 (16%)	2 (8%)	24 (19%)	6 (4.8%)	16 (12.7%)

*Note.* VAS = Visual Analogue Scale; TCS = Threatening Cognitions Scale.

Table 10

*Means for Dependent Variables by Feedback Group (SDs in Brackets)*

	Group		
	Control <sup>a</sup>	Experimental <sup>b</sup>	Total <sup>c</sup>
VAS Fear T1	5.92 (10.71)	7.51 (10.27)	7.25 (10.33)
VAS Fear T2	5.32 (7.27)	15.85 (18.79)	14.09 (17.83)
VAS Anxiety T1	15.08 (17.93)	16.96 (18.11)	16.65 (18.03)
VAS Anxiety T2	9.16 (11.46)	25.99 (23.44)	23.19 (22.76)
TCS T1	4.84 (6.28)	7.71 (9.71)	7.23 (9.28)
TCS T2	15.48 (14.10)	18.29 (15.60)	17.83 (15.35)

*Note.* VAS = Visual Analogue Scale; TCS = Threatening Cognitions Scale.

<sup>a</sup>*n* = 25. <sup>b</sup>*n* = 125 for VAS Fear and VAS Anxiety; <sup>b</sup>*n* = 126 for TCS. <sup>c</sup>*n* = 150 for VAS Fear and VAS Anxiety; <sup>c</sup>*n* = 151 for TCS.

Table 11

*Means for Dependent Variables by Emotion Regulation Condition (SDs in Brackets)*

	Condition		
	Catastrophizing <sup>a</sup>	Reappraisal <sup>b</sup>	Total <sup>c</sup>
VAS Fear T2	16.14 (19.58)	15.53 (18.04)	15.85 (18.79)
VAS Fear T3	16.75 (22.44)	12.39 (15.65)	14.70 (19.58)
VAS Anxiety T2	25.45 (23.81)	26.59 (23.22)	25.99 (23.44)
VAS Anxiety T3	22.44 (23.87)	22.54 (21.52)	22.49 (22.70)
TCS T2	18.09 (15.51)	18.52 (15.83)	18.29 (15.60)
TCS T3	12.45 (15.00)	10.73 (11.34)	11.63 (13.35)

*Note.* VAS = Visual Analogue Scale; TCS = Threatening Cognitions Scale.

<sup>a</sup>*n* = 66. <sup>b</sup>*n* = 59 for VAS Fear and VAS Anxiety; <sup>b</sup>*n* = 60 for TCS. <sup>c</sup>*n* = 125 for VAS Fear and VAS Anxiety; <sup>c</sup>*n* = 126 for TCS.

## CHAPTER 5: DISCUSSION

Why is it that people with high anxiety sensitivity are so frightened by unexpected physiological arousal? Is it because they experience anxious, even catastrophic thinking when aroused, or are they relying on ineffective coping strategies to regulate their heightened fear? Could it be a combination of the two? The answers to these questions are important for improving the effectiveness of cognitive behavioural therapy (CBT) for panic disorder. The goal of this dissertation was to provide a better understanding of how AS creates vulnerability for panic disorder by examining its influence on emotion regulation. Past research has identified the contribution of AS and emotion dysregulation to panic symptomatology separately, (e.g., Taylor et al., 1999; Baker et al., 1993), but only a few studies have examined the interplay between these factors (e.g., Catanzaro, 1993; Vujanovic et al., 2008; Allan et al., 2015; Ouimet et al., 2016). This study examined the relationship between AS and emotion regulation within an experimental context. The first objective was to better understand the link between AS and emotional intensity, by priming threatening cognitions in an arousal induction exercise using false physiological feedback. The second objective was to examine the relationship between AS and emotion regulation after presentation of false physiological feedback.

In the present study, the emotional intensity hypothesis was supported for fearful responses. Heightened AS was associated with increased fearful responding to threat-related physiological feedback, and a decrease in fearful responding to benign feedback. These findings are consistent with cognitive theories for panic disorder that emphasize the importance of cognitive mediation in amplifying panic symptoms when physiologically aroused (D. M. Clark, 1986). Cognitive theories focus on vulnerabilities

that influence the appraisal process, with catastrophic misinterpretation of bodily sensations considered the central cognitive process in the development and maintenance of panic disorder (Beck, 1988; D. M. Clark, 1986; 1988). The present findings found that heightened AS was associated with increased fearful responding when aroused, but only when threatening cognitions were primed (i.e., false physiological feedback). These results are consistent with the cognitive vulnerability model of panic disorder, which states that AS is a distal vulnerability factor that influences the development of panic symptomatology by increasing the likelihood of catastrophic cognitions (Schmidt & Woolaway-Bickel, 2006).

In contrast, the emotion regulation hypothesis was not supported. Heightened AS was not related to increased emotional responding in the catastrophizing condition, and low AS was not related to decreased emotional responding in the cognitive reappraisal condition. These findings are not consistent with previous self-report research that found AS was related to difficulties in emotion regulation (Catanzaro, 1993; Vujanovic et al., 2008; Allan et al., 2015; Ouimet et al., 2016). The present findings suggest that heightened AS is not associated with the inability to effectively regulate emotions, and therefore emotion dysregulation may not be an important mechanism in the link between AS and the development of panic and anxiety symptoms. However, this conclusion would be premature because of significant methodological limitations. The best conclusion is the link between AS and the regulation of emotions requires further investigation.

Taken together, the results of the present research have important implications for cognitive theories of panic disorder. Both the primary appraisal process (i.e., catastrophic misinterpretation) and the secondary elaborative process (i.e., loss of

reappraisal capacity) are emphasized as being important in the development and maintenance of panic disorder (Beck, 1988; D. M. Clark, 1986). The present findings suggest that AS may be more closely associated with an initial amplification of fear due to the primary appraisal of bodily sensations, but may play a less significant role in the secondary elaborative processes in the persistence of panic. Instead, other distal cognitive vulnerability factors may be associated with the inability to correctly reappraise physical sensations as benign (e.g., information processing biases; anxiety control beliefs; Schmidt & Woolaway-Bickel, 2006). It is important that future research investigates other vulnerability factors for panic. Further discussion of the research findings is organized according to the hypotheses presented in Chapter 1.

### **Hypothesis 1: Anxiety Sensitivity and Emotional Intensity**

Hypothesis 1 states that heightened anxiety sensitivity in the experimental group will be associated with a significant increase in anxiety, fear, and threatening cognitions at T2, whereas no change in anxiety, fear, or threatening cognitions is expected in the control group. Hypothesis 1 was partially supported. Results supported predictions for fear responses, but not for anxiety or threatening cognitions. The findings replicate and extend findings in the literature that show AS is associated with fearful responding in response to threat-relevant cues (Telch et al., 2011; 2010). However, the current results suggest that heightened AS may not be associated with the presence of threatening cognitions or anxious responding more broadly. Alternatively, the negative findings may be due to methodological limitations in assessing changes in anxiety and cognition, as discussed below.

### **Fear Versus Anxiety**

In the present study, heightened AS was associated with an increase in self-

reported fear, but not anxiety, in response to false physiological feedback. Therefore, a discussion of possible reasons for these discrepant findings is warranted. Barlow's integrated model of panic (1988, 2002) emphasized the distinction between panic and anxiety. Panic is an intense, short-lived, fearful reaction to imminent danger (a "false alarm"), whereas anxiety is conceptualized as more enduring and focused on future events. Individuals with high AS levels may have demonstrated a spike in fear consistent with an alarm reaction to the false physiological feedback, and a constant level of anxiety due to more diffuse future-oriented distress throughout the experimental period. Psychological theories of panic disorder emphasize fear as the central emotion to panic experience (Reiss & McNally, 1985; Reiss, 1991; Beck; Barlow, 1988; 2002).

According to cognitive theory, fear is more centrally related to the experience of panic because panic attacks are immediate "fight-or-flight" responses to perceived immediate danger (Clark & Beck, 2010). The state measure of fear in the present study may be a better analogue to panic symptoms than the state anxiety measure.

### **Fear**

In terms of self-rated fear, heightened AS was associated with an increase in fear in response to false physiological feedback (experimental group). In contrast, heightened AS was associated with a reduction in fear in response to benign feedback (control group). These findings are consistent with previous studies indicating that it is the perception of physiological arousal as having threatening consequences, regardless of its accuracy, that leads to increased emotional reactivity (Ehlers et al., 1988; Wells & Papageorgiu, 2001; Papageorgiou & Wells, 2002; Dixon et al., 2013; Story & Craske, 2008). Results support the contention that cognition plays a central role in the expression of panic-related symptoms (e.g., D.M. Clark, 1986). Furthermore, the results are



consistent with the proposition that AS is a distal vulnerability factor for the development of panic (Schmidt & Woolaway-Bickel, 2006).

As predicted, the present results are consistent with the context-sensitivity model of panic. Previous research suggests that AS is associated with fearful responding in response to threat-relevant cues (Hilchey & Clark, 2014; Telch et al., 2011; 2010; 1996). Since heightened AS was associated with increased fearful responses to threatening physiological information, and decreased fearful responses when provided with benign information, the results highlight the important role that the contextual information has on emotional responding. This supports the cognitive mediation hypothesis and the cognitive vulnerability models of panic disorder (Schmidt and Woolaway-Bickel, 2006). In fact, individuals with high AS levels demonstrated a reduction in fear in the benign feedback condition, which further supports the importance of the threatening context in amplifying fear.

It is possible that individuals with high AS levels experienced fear reduction to benign feedback because they have an intolerance of physiological arousal (Reiss & McNally, 1985; Reiss, 1991). Stopping the study early due to benign reasons therefore may have resulted in a sense of relief that the biking task was over, leading to a drop in fear. For individuals with high AS, the benign feedback manipulation may have acted as an analogue to safety-seeking, which is defined as “unnecessary actions taken to prevent, escape from, or reduce the severity of a perceived threat” (Telch & Lancaster, 2012). Safety behaviours are related to anxious beliefs. Individuals who believe that physiological sensations signal a catastrophe tend to engage in arousal reduction or avoidance behaviours (Blakey & Abramowitz, 2016). In the present study, for those individuals with elevated AS, instructions to stop the arousal induction may have acted

as safety-relevant information, thereby reducing any fear or distress associated with physiological sensations present during the task. Future research may benefit from examining the relationship between AS and safety behaviours, and their influence on emotion regulation.

### **Threatening Cognitions**

The false physiological feedback manipulation was not effective in generating threat-related cognitions, which is inconsistent with cognitive theory for panic disorder (D. M. Clark, 1986). The present findings suggest that threatening cognitions did not contribute to fearful responses and challenges the centrality of catastrophic misinterpretation in the development of panic (Beck, Emery, & Greenberg, 1985; Beck 1988; D. M. Clark, 1988; 1986). Another explanation for the negative findings is that the measure of threatening cognitions, the TCS, was more sensitive to the experience of physiological arousal than interpretations of physiological arousal. This possible limitation of the TCS did not emerge in the initial investigation, as the mild symptom induction task was ineffective in inducing arousal, and resulted in a floor effect. Further discussion of the methodological challenges in measuring catastrophic thinking is presented below.

According to the cognitive vulnerability model for panic disorder (Schmidt & Woolaway-Bickel, 2006), AS is a distal vulnerability factor that increases development of more direct cognitive processes involved in the pathogenesis of panic. Catastrophic cognitions are threat-related thoughts associated with physiological arousal (i.e., catastrophic misinterpretations) that occur immediately prior to a fear or panic response (D. M. Clark, 1986). According to cognitive theory, catastrophic cognitions are the product of preconscious processing and may occur without interpretive awareness (D.

M. Clark, 1988) and therefore are difficult to measure. McNally (1999) noted that state-oriented cognitive variables are not as easily assessed as trait variables.

Biological challenge studies have attempted to induce catastrophic misinterpretations of physical symptoms experimentally by providing information prior to or during arousal induction (e.g., Salkovskis & D. M. Clark, 1990; Story & Craske, 2008). However, these studies do not directly measure catastrophic cognitions; they are inferred based on experimental manipulation of instructional set. Dixon and colleagues (2013) attempted to address this limitation by modifying trait-like measures of catastrophic cognitions so that individuals reported the frequency of specific catastrophic thoughts during the arousal induction exercise. The present study attempted a more rigorous assessment of threatening cognitions in a specific context at a moment in time. The Threatening Cognitions Scale (TCS) was developed to assess participants' experience of state-like catastrophic cognitions about physical sensations. The validity of moment-by-moment cognition measures is a problem for investigating the role of catastrophic misinterpretation in panic disorder. Further discussion of the drawbacks of the TCS and difficulties in measuring cognition is presented in the limitations section.

### **Hypothesis 2: Anxiety Sensitivity and Emotion Regulation**

Hypothesis 2 states that heightened anxiety sensitivity will be associated with a significant increase in anxiety, fear, and threatening cognitions in the catastrophizing condition, whereas low anxiety sensitivity will be associated with a significant decrease in anxiety, fear, and threatening cognitions in the cognitive reappraisal condition.

Hypothesis 2 would be supported by a Condition x Time x AS interaction.

The present study did not support the prediction that individuals with high AS would have more difficulty regulating their emotions. AS was not associated with

emotional responding in either of the emotion regulation conditions. These findings suggest that AS is not associated with emotion dysregulation, and that individuals with high AS do not engage in ineffective coping strategies to regulate their heightened fear. However, this conclusion is inconsistent with baseline data that revealed that AS was significantly and positively correlated with self-reported emotion dysregulation, as measured by the Difficulties in Emotion Regulation Scale (DERS). Results found in previous studies using retrospective, self-report, trait-like measures have shown an association between AS and difficulties with emotion regulation exists (e.g., Catanzaro, 1993; Vujanovic et al., 2008; Ouimet et al., 2016). It is possible that individuals with high AS report more difficulties coping with their emotions but not do demonstrate such difficulties in practice, as found in the present study. Alternatively, the current negative findings may be due to problems with the effectiveness of the emotion regulation manipulation. Further discussion of issues with the experimental emotion regulation manipulation are presented in the limitations section.

Although Hypothesis 2 was not supported, it is important to acknowledge that AS was robust in showing a positive association with fear, anxiety, and threatening cognitions regardless of the time or emotion regulation condition, which is consistent with the fear amplification interpretation of anxiety sensitivity (Reiss, 1997).

### **Emotion Specificity of Anxiety Sensitivity**

AS is considered a vulnerability factor that is most relevant to the development of panic disorder (Schmidt & Woolaway-Bickel, 2006). Specifically, AS is a cognitive vulnerability factor that increases the likelihood that individuals will engage in catastrophic misinterpretation, which is necessary for panic development. However, AS has been implicated as a risk factor for other anxiety disorders, depression, health

anxiety, chronic pain, and substance use disorder (for a review, see Watt & Stewart, 2008). The relationship between AS and these other disorders is less well known. Therefore, supplemental analyses were conducted to examine AS's specificity in predicting fearful responding, versus other emotion states. The purpose of the supplemental analyses was to examine the association between AS and the distractor VAS items (i.e., Tense, Sad, Happy, Energetic, Tired).

Analyses pertaining to the experimental manipulation (i.e., false physiological feedback) revealed that AS interacted with group to predict elevated VAS Tense and Sad ratings. Specifically, AS was associated with these mood states in the experimental group only. The findings for tension was expected, as tension is a physical component of anxiety. However, its association with sadness ratings indicate that AS was not specific to anxiety, but instead was related to negative emotional responses more broadly. Similarly, supplemental analyses of the alternate VAS mood states during the emotion regulation component of the study revealed that AS was not specific to anxious responding. The ASI-3 was associated with increased levels of VAS Tense, Sad, Tired ratings, and decreased Happy ratings. Despite the predominant focus on AS and anxiety, previous research has identified a relationship between AS and measures of negative emotionality broadly, including symptoms of depression (for a review, see Naragon-Gainey, 2010). Negative emotionality is also considered to be a broad, trait-like distal vulnerability factor for anxiety disorders, and theoretically associated with more specific vulnerability factors such as AS (Clark & Beck, 2010).

The present findings are consistent with research studies that have found AS to be associated with various emotional difficulties, which has implications for treatment. Researchers are beginning to study a transdiagnostic cognitive behavioral treatment

approach that targets AS as a mechanism in reducing both symptoms of anxiety and depression (Olthuis, Watt, Mackinnon, Stewart, 2014).

### **Methodological and Conceptual Limitations**

#### **Sample Characteristics**

There are several reasons why the participant sample threatened the external validity of the current experiment. University samples are not representative of the population and so constrain generalizability. The majority of participants were White, educated, young adults. The health of the experimental sample also is a significant factor to consider in exercise-based studies. Participants in the present study were predominantly healthy, as indicated by the self-report fitness measures. Previous researchers have found AS to interact with health-related variables (e.g., obesity, cardiovascular disease) to predict fear and anxiety responses (Smits et al., 2010; Farris & Abrantes, 2017). It is possible that a more diverse sample pertaining to age and health-status would have resulted in greater variability in distress to the 15-minute stationary cycling task than the predominantly young, fit sample in the present experiment. Future studies should recruit a diverse sample that is more representative of the general population.

Due to the exercise component of the study, it is possible that some individuals with high AS may have chosen not to participate because of their tendency to avoid exercise (e.g., Moshier et al., 2016; Moshier et al., 2013; Sabourin et al., 2011), thereby limiting the number of individuals with elevated AS scores. Previous studies have found that individuals with high AS represent approximately 10-20% of the population (e.g., Bernstein et al., 2006; 2010). Application of the cut-off value proposed by Bernstein and colleagues (2010) revealed that 26.5% of the current participants could be considered as

having high AS, suggesting an adequate number of participants with high AS scores. A range in AS scores is important, as the predictive validity of AS increases with more variability (McNally, 2002). Although there was a small but significant correlation between AS and perceived fitness level in the present study ( $r=-.17, p=.04$ ), AS was not significantly related to BMI or self-reported frequency of exercise, suggesting that self-reported fitness level likely did not play a role in influencing the relationship between AS and emotional responding. Future research studies may benefit from measuring participants' physical capacity to engage in exercise in addition to self-reported fitness variables.

### **Arousal Induction**

There were several shortcomings associated with the stationary biking exercise intended to induce a state of physiological arousal. The first problem encountered was insuring that participants experienced a moderate level of exertion with 15-minutes of cycling. Despite instruction to engage in physical exertion at a moderate level, the actual level of physical exertion was not standardized. This contrasts with previous arousal induction studies where objective levels of moderate to high exertion levels have been targeted and monitored, including 70% maximum of age-adjusted predicted heart rate (Smits et al., 2010) or 70%  $VO_2$ max (Strohle et al., 2009). However, the Borg Rating of Perceived Exertion Scale (RPE) used to achieve moderate perceived physiological arousal has adequate reliability and validity (Borg, 1998). Furthermore, it is the perception of physiological activity, regardless of physical activity level, that is associated with anxiety and fearful responding (e.g., D. M. Clark, 1990; Dixon, Sy, Kemp, & Deacon, 2013). What is unknown is whether participants truthfully worked at what they perceived to be a moderate level of exertion. Panic patients have been found

to respond with only mild panic symptoms to brief symptom induction exercises (e.g., hyperventilation, breathing through a straw, chair spinning; Antony et al., 2006). Thus, relatively brief physical exercise performed at moderate exertion may have been too benign to induce significant fearful responding in high AS individuals, and may explain the observed floor effects.

It may be beneficial in future research to examine both perceived and actual levels of exertion, and to ensure that physical activity is sufficient to activate a high arousal level. However, research ethics considerations prevail in physiological arousal induction, especially when combined with incomplete disclosure. Thus, asking individuals to engage in “strenuous” physical activity followed by false physiological feedback sets off special concerns with research ethic panels. In the present study, this required that a less strenuous physical activity be utilized, which then threatened the arousal potency of the procedure.

Another methodological limitation pertains to contextual features associated with the arousal induction task. The context-sensitivity model (Telch et al., 2011; 2010) states that AS potentiates fearful responding but only in threatening contexts. Although the false physiological feedback was a threat-inducing cognitive manipulation, physiological arousal was associated with the cycling task. In previous biological challenge studies, individuals with high AS who had the perception of low controllability over physiological arousal demonstrated greater fearful responding to the induction (Telch et al., 1996). In the present study, individuals had control over their level of physiological arousal; they were able to adjust their level of exertion to what they perceived to be a moderate level. Similarly, the level of expectedness of physiological arousal interacts with AS in its association with the level of distress in response to arousal induction, with



high AS individuals responding more fearfully to unexpected symptoms of physiological arousal (Telch et al., 2011). Individuals with high AS also demonstrated increased fearful responding and catastrophic cognitions in response to vignette scenarios that depicted unexpected arousal (Hilchey & Clark, 2014). In the present study, the experience of physiological arousal was expected. Taken together, the experimental context may not have been threatening enough to interact with AS to produce significant and long-lasting distress. Without feeling sufficient levels of distress, participants would not be motivated to engage in serious emotion regulation.

### **False Physiological Feedback**

Individual differences in the believability of the false physiological feedback is another potential shortcoming. Students differed in self-awareness of their heart rate, fitness level, and familiarity with the heart rate monitor. Such factors likely influenced whether participants believed the false physiological feedback, as those who were more familiar with the effects of exertion on their physiological arousal and with the equipment might be less likely to believe the false feedback. The manipulation check found that numerous participants either had doubts about the false physiological feedback or did not believe it fully. The plausibility of the false physiological feedback was a prerequisite for eliciting an emotion regulation response. However, when the believability ratings were added as covariates in the analyses the pattern of results remained unchanged. This finding suggests that believability ratings did not influence the findings. It is important to note that even though manipulation check questions were administered, participants may have been reluctant to admit they knew the false feedback was bogus. In future studies, it would be important to minimize demand characteristics by attempting to mask the true nature of the study better. A pilot study

comparing various false feedback manipulations might be required to improve plausibility of the false feedback.

### **Emotion Regulation Procedure**

Several limitations were evident with the emotion regulation manipulation. Participants were instructed to engage in catastrophic thinking or cognitive reappraisal in response to false physiological feedback. Catastrophic cognitions have not been directly manipulated in previous AS arousal induction studies. The cognitive model contends that AS contributes to elevated fearful responding in threatening contexts due to an increase in catastrophic cognitions. For example, manipulation of the experimental context such as perceived control (Telch et al., 1996) and expectancy (Telch et al., 2011) of arousal have interacted with AS to produce elevated panic-like symptoms. The present experiment was one of the few in which participants with varying AS levels were instructed explicitly to engage in specific thought processes associated with emotion regulation. It is difficult to ensure that individuals comply with a cognitive instructional set. Examination of participant responses during the emotion regulation tasks revealed that participants' report of what they actually thought often did not correspond to the assigned instructional set, particularly in the catastrophic condition. Future studies would benefit from pilot testing of the instructional sets.

An additional limitation to consider is that emotion regulation can happen automatically without effortful control (Mauss, Bunge, & Gross, 2007). It is possible that automatic reappraisal occurred for many participants and this played a role in their failure to engage in catastrophizing. Individuals differ in their preferred use of emotion regulation strategies, which may not be easily manipulated in an experimental context. A key element that characterizes catastrophizing is a lack of control and inability to resist

thinking in an extremely negative manner (Peterson & Park, 2007). Therefore, deliberate, instructed use of catastrophizing may not be a valid representation of naturalistic catastrophizing. That is, it may be hard for individuals to catastrophize when this is not the usual response style. Similarly, cognitive reappraisal involves modifying anxious appraisals of threat, and is targeted via numerous sessions in CBT (Clark & Beck, 2010). Therefore, such appraisals may not be easily altered within a brief experimental study. An avenue for future research could be to select individuals with pre-existing tendencies to catastrophize or engage in cognitive reappraisal.

### **Threatening Cognitions Scale**

Another limitation pertains to the TCS measure, which was developed for the present study to tap into actual threatening cognitions in an arousal induction. The findings for the TCS were not consistent with the fear responses. It is possible that the TCS was not a valid measure of momentary threatening cognitions. Qualitatively, participants had more difficulty understanding the instructions of the TCS and often asked for clarification. This problem was not encountered in the initial psychometric investigation, as it was conducted online. Future studies would benefit from receiving in-person feedback regarding the TCS during a pilot study. Furthermore, the initial psychometric study had a mild induction that was not effective in inducing arousal. Therefore, the TCS requires further psychometric validation using a moderate to severe arousal induction procedure.

### **Future Directions**

While a relationship between AS and maladaptive emotion regulation has been established in the literature primarily via self-report research, less is known about how the two constructs are related and may interact in real-life scenarios. More research is

needed that examines the tendency of individuals with high AS to engage in various adaptive and maladaptive emotion regulation strategies. The present study exhibited numerous limitations, as reviewed above, and so a discussion of future directions is warranted. Experimental studies aimed at better understanding the link between AS and emotion regulation remain difficult to implement due to ethical and methodological constraints. The intensity of the arousal induction and nature of the feedback in the present study may not have been sufficiently distressing to induce panic-related responses. Therefore, future research should ensure that the experimental manipulation is threatening and anxiety-inducing, while at the same time adhering to established principles and policies of human research set by the Canadian Psychological Association (CPA, 2017) and the American Psychological Association (APA, 2016). Furthermore, the success of the emotion regulation component of the study hinged on numerous factors, including: plausibility of the false feedback, participant engagement in a moderate level of physical exertion, perception of the false information as threatening, and correct use of the emotion regulation strategy. A simplified experimental design is suggested for future research to provide preliminary information on the nature of the AS-emotion regulation relationship. Given the results and limitations of the present study, alternative ideas for an improved study design are presented below.

From a methodological perspective, biological challenge studies primarily use chemical agents such as CO<sub>2</sub> inhalation, as they have been well studied and considered to be precise in their ability to induce bodily sensations (e.g., Telch et al., 2011). Therefore, with access to appropriate equipment and no ethical constraints, CO<sub>2</sub> would provide a more controlled option to induce arousal when compared to exercise. Alternatively, participants could be asked to exercise until various biological markers

are met, such as targeted heart rate or blood lactate, or until they report they are physically exhausted (Smits et al., 2010; Esquivel et al., 2002; Esquivel et al., 2012). It is suggested that future research build upon previous biological challenge research to inform methods pertaining to objective arousal induction. Inducing higher levels of arousal may be sufficient to produce emotional responding in high AS individuals, and therefore incomplete disclosure or false feedback may not be required. Instead, participants could be instructed to engage in different emotion regulation strategies during the experience of physiological arousal.

It may be more appropriate for participants to engage in different emotion regulation strategies during the arousal induction rather than afterwards, so that strategies are employed while distress levels are elevated. In a recent study examining the link between AS and use of emotion regulation strategies during a cold presser task on pain experience, participants were instructed to engage in distraction (i.e., direct attention away from pain), reappraisal (i.e., alter appraisals of pain) or were assigned to a control condition (i.e., no instruction; Hovaspaiian & Levine, 2016). Hovaspaiian and Levine's (2016) emotion regulation instructions for pain could be used as a guideline, with information altered to focus on arousal rather than pain. For example, verbal instructions for reappraisal stated, *"While your hand is in the water, think about how brief exposure to cold helps the body adjust to cold temperature. So even though the cold water can be painful, this is good for your health. Remember to focus on the benefits to your body."* Participants could be instructed to focus on the positive effect of physiological arousal on health (reappraisal) or instructed to focus on the negative effects of arousal (catastrophizing).

Some change may be warranted in the dependent variables investigated. Similar to Hovasapaian and Levine (2016), study participants could be asked to rate their level of anxiety after the task on a 0 (*no anxiety*) to 10 (*extreme anxiety*) scale. Due to difficulty in measuring cognitions, it may be best to examine emotional responding (e.g., fear, anxiety) initially. A manipulation check could also be adapted from the Hovasapaian and Levine (2016) study in which participants are asked to rate the degree that they engaged in the assigned emotion regulation strategies on a scale ranging from 1 (*not at all*) to 7 (*all the time*). In sum, the emotion regulation task was ineffective in the present study, and therefore further investigation is recommended. It would be beneficial to simplify the methodology and provide better control of extraneous variables that may influence results in future research designs.

### **Conclusion**

The present research sought to better understand vulnerability to panic disorder by examining the relation between AS and emotion regulation within an experimental context. Treatment and prevention programs for panic disorder rely on our understanding of the mechanisms that lead to the development and maintenance of the disorder. In the present study, further evidence was provided for the association between heightened AS and emotional intensity. However, the relationship between AS and emotion regulation difficulties remains less clear. Previous studies using self-report measures, cross-sectional designs, and correlational analyses suggest that AS and emotion dysregulation are associated, and that the presence of both high AS levels and emotion regulation difficulties is associated with greater expression of anxiety (Catanzaro, 1993; Vujanovic, Zvolensky, & Bernstein, 2008; Kashdan, Zvolensky, & Bernstein, 2008). Future experimental research is needed to determine whether

individuals with high AS utilize less effective regulation strategies when confronted with personally threatening physiological sensations. A better understanding of such mechanisms is important for improving treatment programs targeting both AS and panic disorder. While treatment programs exist that target AS (Watt & Stewart, 2008), both AS-related beliefs and maladaptive regulation strategies are important targets in treating panic and other anxiety-related symptoms. Until more rigorous experimental designs are pursued, an understanding of how heightened AS creates vulnerability for fearful responses during physiological arousal remains speculative.

## References

- Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review, 30*, 217-237. doi:10.1016/j.cpr.2009.11.004
- Allan, N. P., Norr, A. M., Macatee, R. J., Gajewska, A., & Schmidt, N. B. (2015). Interactive effects of anxiety sensitivity and emotion regulation on anxiety symptoms. *Journal of Psychopathology and Behavioral Assessment, 37*, 663-672. doi:10.1007/s10862-015-9484-z
- American College of Sports Medicine. (2006). ACSM's guidelines for graded exercise testing and exercise prescription (7th ed.). Baltimore: Williams & Wilkins.
- American Psychiatric Association (1980). *Diagnostic and statistical manual of mental disorders* (3<sup>rd</sup> ed.). Washington, DC: American Psychiatric Publishing.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5<sup>th</sup> ed.). Arlington, VA: American Psychiatric Publishing.
- American Psychological Association. (2016). Ethical principles of psychologists and code of conduct. Washington, DC: Author
- Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment, 10*, 176-181.
- Antony, M. M., Ledley, D. R., Liss, A., & Swinson, R. P. (2006). Responses to symptom induction exercises in panic disorder. *Behaviour Research and Therapy, 44*, 85-98. doi:10.1016/j.brat.2004.12.005
- Antony, M., Roth, D., Swinson, R. P., Huta, V., & Devins, G. M. (1998). Illness intrusiveness in individuals with panic disorder, obsessive-compulsive disorder, or social phobia. *The Journal of Nervous and Mental Disease, 186*, 311-315. doi:10.1097/00005053-199805000-00008
- Asmundson, G. G., Norton, G., Wilson, K. G., & Sandler, L. S. (1994). Subjective symptoms and cardiac reactivity to brief hyperventilation in individuals with high anxiety sensitivity. *Behaviour Research and Therapy, 32*, 237-241. doi:10.1016/0005-7967(94)90117-1
- Asmundson, G. G., Weeks, J. W., Carleton, R., Thibodeau, M. A., & Fetzner, M. G. (2011). Revisiting the latent structure of the anxiety sensitivity construct: More evidence of dimensionality. *Journal of Anxiety Disorders, 25*, 138-147. doi:10.1016/j.janxdis.-2010.08.013
- Baker, R., Holloway, J., Thomas, P. W., Thomas, S., & Owens, M. (2004). Emotional processing and panic. *Behaviour Research and Therapy, 42*, 1271-1287. doi:10.1016/j.brat.-2003.09.002
- Bakhshaie, J., Paulus, D. J., Medvedeva, A., Otal, T., Lemaire, C., Garza, M., & ... Zvolensky, M. J. (2017). The differential role of anxiety sensitivity and its components in the relation between emotional nonacceptance and anxiety and depressive symptoms and disorders among Latinos in primary care. *Journal of Psychopathology and Behavioral Assessment, 39*, 563-574. doi: 10.1007/s10862-017-9592-z
- Barlow, D. H. (1988). *Anxiety and its disorders: The nature and treatment of anxiety and panic*. New York, NY, US: Guilford Press.



- Barlow, D. H. (2002). *Anxiety and its disorders: The nature and treatment of anxiety and panic* (2nd ed.). New York, NY, US: Guilford Press.
- Barsky, A. J., Delamater, B. A., & Orav, J. E. (1999). Panic disorder patients and their medical care. *Psychosomatics*, *40*, 50-56. doi:10.1016/S0033-3182(99)71271-5
- Beck, A. T. (1967). *Depression: Clinical, experimental, and theoretical aspects*. Philadelphia: University of Pennsylvania Press.
- Beck, A. T. (1988). Cognitive approaches to panic: Theory and therapy. In S. Rachman & J. Maser (Eds.), *Panic: Psychological perspectives*. Hillsdale, NJ: Erlbaum.
- Beck, A. T., Emery, G., & Greenberg, R. L. (1985). *Anxiety disorders and phobias: A cognitive perspective*. New York, NY US: Basic Books.
- Beck, A. T., & Greenberg, R. L. (1988). Cognitive therapy of panic disorder. In R. E. Hales & A. J. Frances (Eds.), *Review of psychiatry* (Vol. 7). Washington, DC: American Psychiatric Press.
- Bernstein, A., Cárdenas, S., Coy, P., & Zvolensky, M. J. (2011). Test of a factor mixture-based taxonomic-dimensional model of anxiety sensitivity and panic attack vulnerability among university and clinical samples in Mexico City. *Journal of Psychopathology and Behavioral Assessment*, *33*, 491-500. doi:10.1007/s10862-011-9235-8
- Bernstein, A., Stickle, T. R., & Schmidt, N. B. (2013). Factor mixture model of anxiety sensitivity and anxiety psychopathology vulnerability. *Journal of Affective Disorders*, *149*, 406-417. doi:10.1016/j.jad.2012.11.024
- Bernstein, A., Stickle, T. R., Zvolensky, M. J., Taylor, S., Abramowitz, J., & Stewart, S. (2010). Dimensional, categorical, or dimensional-categories: Testing the latent structure of anxiety sensitivity among adults using factor-mixture modeling. *Behavior Therapy*, *41*, 515-529. doi:10.1016/j.beth.2010.02.003
- Bernstein, A., Zvolensky, M. J., Kotov, R., Arrindell, W. A., Taylor, S., Sandin, B., & ... Schmidt, N. B. (2006). Taxonicity of anxiety sensitivity: A multi-national analysis. *Journal of Anxiety Disorders*, *20*, 1-22. doi:10.1016/j.janxdis.2004.11.006
- Bernstein, A., Zvolensky, M. J., Stewart, S., & Comeau, N. (2007). Taxometric and factor analytic models of anxiety sensitivity among youth: Exploring the latent structure of anxiety psychopathology vulnerability. *Behavior Therapy*, *38*, 269-283. doi:10.1016/j.beth.2006.08.005
- Blakey, S. M., & Abramowitz, J. S. (2016). The effects of safety behaviors during exposure therapy for anxiety: Critical analysis from an inhibitory learning perspective. *Clinical Psychology Review*, *49*, 1-15. doi: 10.1016/j.cpr.2016.07.002
- Borg, G. (1985). *An introduction to Borg's RPE-scale*. Ithaca, NY: Movement.
- Borg, G. (1998). *Borg's perceived exertion and pain scales*. Champaign, IL: Human Kinetics.
- Broman-Fulks, J. J., Deacon, B. J., Olatunji, B. O., Bondy, C. L., Abramowitz, J. S., & Tolin, D. F. (2010). Categorical or dimensional: A reanalysis of the anxiety sensitivity construct. *Behavior Therapy*, *41*, 154-171. doi:10.1016/j.beth.2009.02.005
- Broman-Fulks, J. J., Green, B. A., Berman, M. E., Olatunji, B. O., Arnau, R. C., Deacon, B. J., & Sawchuk, C. N. (2008). The latent structure of anxiety sensitivity--revisited. *Assessment*, *15*, 188-203. doi:10.1177/1073191107311284

- Campbell-Sills, L., & Barlow, D. H. (2007). Incorporating Emotion Regulation into Conceptualizations and Treatments of Anxiety and Mood Disorders. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 542-559). New York, NY, US: Guilford Press.
- Canadian Psychological Association (2017). Canadian code of ethics for psychologists – Fourth Edition. Ottawa, Canada: Author.
- Canadian Society for Exercise Physiology. (2002). PAR-Q Forms. Retrieved from <http://www.csep.ca/english/view.asp?x=698>
- Carter, M. M., Suchday, S., & Gore, K. L. (2001). The utility of the ASI factors in predicting response to voluntary hyperventilation among nonclinical participants. *Journal of Anxiety Disorders, 15*, 217-230. doi:10.1016/S0887-6185(01)00061-5
- Catanzaro, S. J. (1993). Mood regulation expectancies, anxiety sensitivity, and emotional distress. *Journal of Abnormal Psychology, 102*, 327-330. doi:10.1037/0021-843X.102.2.327
- Catanzaro, S. J., & Greenwood, G. (1994). Expectancies for negative mood regulation, coping, and dysphoria among college students. *Journal of Counseling Psychology, 41*, 34-44. doi:10.1037/0022-0167.41.1.34
- Chambless, D. L., Caputo, G. C., Bright, P., & Gallagher, R. (1984). Assessment of “fear of fear” in agoraphobics: The Body Sensations Questionnaire and the Agoraphobic Cognitions Questionnaire. *Journal of Consulting and Clinical Psychology, 52*, 1090-1097. doi:10.1037/0022-006X.52.6.1090
- Cisler, J. M., Olatunji, B. O., Feldner, M. T., & Forsyth, J. P. (2010). Emotion regulation and the anxiety disorders: An integrative review. *Journal of Psychopathology and Behavioral Assessment, 32*, 68-82. doi:10.1007/s10862-009-9161-1
- Clark, D. A., & Beck, A. T. (2010). *Cognitive Therapy of Anxiety Disorders: Science and practice*. New York, NY US: Guilford Press.
- Clark, D. M. (1986). A cognitive approach to panic. *Behaviour Research and Therapy, 24*, 461-470. doi:10.1016/0005-7967(86)90011-2
- Clark, D. M. (1988). A cognitive model of panic attacks. In S. S. Rachman, J. D. Maser (Eds.), *Panic: Psychological perspectives* (pp. 71-89). Hillsdale, NJ, England: Lawrence Erlbaum Associates, Inc.
- Clark, D. M., & Beck, A. T. (1988). Cognitive approaches. In C. G. Last (Ed.), *Handbook of anxiety disorders* (pp. 362-385). Elmsford, NY, US: Pergamon Press.
- Clark, D. M., Salkovskis, P. M., Öst, L., Breitholtz, E., Koehler, K. A., Westling, B. E., & Gelder, M. (1997). Misinterpretation of body sensations in panic disorder. *Journal of Consulting and Clinical Psychology, 65*, 203-213. doi:10.1037/0022-006X.65.2.203
- Cox, B. J. (1996). The nature and assessment of catastrophic thoughts in panic disorder. *Behaviour Research and Therapy, 34*, 363-374. doi:10.1016/0005-7967(95)00075-5
- Cox, B. J., Parker, J. A., & Swinson, R. P. (1996). Anxiety sensitivity: Confirmatory evidence for a multidimensional construct. *Behaviour Research and Therapy, 34*, 591-598. doi:10.1016/0005-7967(96)00006-X
- Cox, B. J., Taylor, S., Clara, I. P., Roberts, L., & Enns, M. W. (2008). Anxiety sensitivity and panic-related symptomatology in a representative community-based sample: A 1-year longitudinal analysis. *Journal of Cognitive*

- Psychotherapy*, 22, 48-56. doi:10.1891/0889.8391.22.1.48
- Crowne, D. P., & Marlowe, D. (1960). A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology*, 24, 349-354. doi:10.1037/h0047358
- Dandoy, A. C., & Goldstein, A. C. (1990). The use of cognitive appraisal to reduce stress reactions: A replication. *Journal of Social Behavior and Personality*, 5, 275-285.
- Deacon, B., Lickel, J., & Abramowitz, J. S. (2008). Medical utilization across the anxiety disorders. *Anxiety Disorders*, 22, 344-350. doi:10.1016/j.janxdis.2007.03.004
- Dixon, L. J., Sy, J. T., Kemp, J. J., & Deacon, B. J. (2013). Does anxiety sensitivity cause panic symptoms? An experimental investigation. *Journal of Experimental Psychopathology*, 4, 208-223. doi:10.5127/jep.027512
- Ehlers, A., Margraf, J., Roth, W. T., Taylor, C., & Birbaumer, N. (1988). Anxiety induced by false heart rate feedback in patients with panic disorder. *Behaviour Research and Therapy*, 26, 1-11. doi:10.1016/0005-7967(88)90028-9
- Esquivel, G., Dandachi, A., Knuts, I., Goossens, L., Griez, E., & Schruers, K. (2012). Effects of acute exercise on CO<sub>2</sub>-induced fear. *Depression and Anxiety*, 29, 155-158. doi:10.1002/da.20860
- Esquivel, G., Schruers, K. K., Kuipers, H. H., & Griez, E. (2002). The effects of acute exercise and high lactate levels on 35% CO<sub>2</sub> challenge in healthy volunteers. *Acta Psychiatrica Scandinavica*, 106, 394-397. doi:10.1034/j.1600-0447.2002.01333.x
- Faravelli, C., Paterniti, S., & Scarpato, A. (1995). 5-year prospective, naturalistic follow-up study of panic disorder. *Comprehensive Psychiatry*, 36, 271-277. doi:10.1016/S0010-440X(95)90072-1
- Farris, S. G., & Abrantes, A. M. (2017). Anxiety sensitivity in smokers with indicators of cardiovascular disease. *Psychology, Health & Medicine*, 22, 961-968. doi:10.1080/13548506.2017.1300672
- Faul, F., Erdfelder, E., Buchner, A., & Lang, A. G. (2009). Statistical power analyses using G\*Power 3.1: tests for correlation and regression analyses. *Behavior Research Methods*, 41, 1149-60. doi: 10.3758/BRM.41.4.1149
- Feldner, M. T., Zvolensky, M. J., Stickle, T. R., Bonn-Miller, M. O., & Leen-Feldner, E. W. (2006). Anxiety sensitivity-physical concerns as a moderator of the emotional consequences of emotion suppression during biological challenge: An experimental test using individual growth curve analysis. *Behaviour Research and Therapy*, 44, 249-272. doi:10.1016/j.brat.2005.02.003
- Goodwin, R. D., Faravelli, C., Rosi, S., Cosci, E., Truglia, R., de Graaf, H., & Wittchen, H. U. (2005). The epidemiology of panic disorder and agoraphobia in Europe. *European Neuropsychopharmacology*, 15, 435-443. doi:10.1016/j.euroneuro.2005.04.006
- Gorman, J. M., Fyer, M. R., Goetz, R., Askanazi, J., Liebowitz, M. R., Fyer, A. J., & ... Klein, D. F. (1988). Ventilatory physiology of patients with panic disorder. *Archives of General Psychiatry*, 45, 31-39. doi:10.1001/archpsyc.1988.01800250035006
- Grant, S., Aitchison, T., Henderson, E., Christie, J., Zare, S., McMurray, J., & Dargie, H. (1999). A comparison of the reproducibility and the sensitivity to change of

- visual analogue scales, borg scales, and likert scales in normal subjects during submaximal exercise. *Chest*, *116*, 1208-1217.
- Gratz, K. L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the difficulties in emotion regulation scale. *Journal of Psychopathology and Behavioral Assessment*, *26*, 41–54.
- Gross, J. J. (1998a). The emerging field of emotion regulation: An integrative review. *Review Of General Psychology*, *2*, 271-299. doi:10.1037/1089-2680.2.3.271
- Gross, J. J. (1998b). Antecedent and response-focused emotion regulation: Divergent consequences for experience, expression, and physiology. *Journal of Personality and Social Psychology*, *74*, 224–237. doi:10.1037/0022-3514.74.1.224
- Gross, J. J. (2002). Emotion regulation: Affective, cognitive, and social consequences. *Psychophysiology*, *39*, 281-291. doi:10.1017/S0048577201393198
- Gross, J. J. (2007). *Handbook of emotion regulation*. New York, NY, US: Guilford Press.
- Gross, J. J. (2013). Emotion regulation: Taking stock and moving forward. *Emotion*, *13*, 359-365. doi:10.1037/a0032135
- Gross, J. J., & Thompson, R. A. (2007). Emotion Regulation: Conceptual Foundations. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 3-24). New York, NY, US: Guilford Press.
- Hays, R. D., Hayashi, T., & Stewart, A. L. (1989). A five-item measure of socially desirable response set. *Educational and Psychological Measurement*, *49*, 629-636. doi:10.1177/001316448904900315
- Hayward, C., Killen, J. D., Kraemer, H. C., & Taylor, C. (2000). Predictors of panic attacks in adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry*, *39*, 207-214. doi:10.1097/00004583-200002000-00021
- Hilchey, C. A., & Clark, D. A. (2014). Context in anxiety sensitivity: The role of expectancy, catastrophic misinterpretations and diminished reappraisal in response to hypothetical physical arousal scenarios. *Cognitive Therapy and Research*, *38*, 343-348. doi:10.1007/s10608-013-9594-4
- Hovasapian, A. & Levine, L. J. (2016). Reappraisal mitigates overestimation of remembered pain in anxious individuals. *Cognition and Emotion*, *30*, 1222-1231. doi:10.1080/02699931.2015.1049937
- Ingram, R. E., & Price, J. M. (2001). The role of vulnerability in understanding psychopathology. In R. E. Ingram, J. M. Price (Eds.), *Vulnerability to psychopathology: Risk across the lifespan* (pp. 3-19). New York, NY, US: Guilford Press.
- Ingram, R. E., & Price, J. M. (2010). Understanding psychopathology: The role of vulnerability. In R. E. Ingram, J. M. Price (Eds.), *Vulnerability to psychopathology: risk across the lifespan (2nd ed.)* (pp. 3-17). New York, NY, US: Guilford Press.
- Jackson, D. C., Malmstadt, J. R., Larson, C. L., & Davidson, R. J. (2000). Suppression and enhancement of emotional responses to unpleasant pictures. *Psychophysiology*, *37*, 512–522. doi:10.1017/S0048577200990401
- John, O. P., & Gross, J. J. (2007). Individual Differences in Emotion Regulation. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 351-372). New York, NY, US: Guilford Press.

- Kashdan, T. B., Zvolensky, M. J., & McLeish, A. C. (2008). Anxiety sensitivity and affect regulatory strategies: Individual and interactive risk factors for anxiety-related symptoms. *Journal of Anxiety Disorders, 22*, 429-440. doi:10.1016/j.janxdis.2007.03.011
- Katschnig, H., & Amering, M. (1998). The long-term course of panic disorder and its predictors. *Journal of Clinical Psychopharmacology, 18*(6, Suppl 2), 6-11. doi:10.1097/00004714-199812001-00003
- Kelly, M. M., & Forsyth, J. P. (2009). Associations between emotional avoidance, anxiety sensitivity, and reactions to an observational fear challenge procedure. *Behaviour Research and Therapy, 47*, 331-338. doi:10.1016/j.brat.2009.01.008
- Kemper, C. J., Lutz, J., Bähr, T., Rüdell, H., & Hock, M. (2012). Construct validity of the anxiety sensitivity index-3 in clinical samples. *Assessment, 19*, 89-100. doi:10.1177/1073191111429389
- Kessler, R. C., Chiu, W. T., Jin, R., Ruscio, A. M., Shear, K., & Walters, E. E. (2006). The epidemiology of panic attacks, panic disorder, and agoraphobia in the national comorbidity survey replication. *Archives of General Psychiatry, 63*, 415-424. doi:10.1001/archpsyc.63.4.415
- Kinley, D. J., Cox, B. J., Clara, I., Goodwin, R. D., & Sareen, J. (2009). Panic attacks and their relation to psychological and physical functioning in Canadians: Results from a nationally representative sample. *The Canadian Journal of Psychiatry, 54*, 113-122.
- Koole, S. L. (2009). The psychology of emotion regulation: An integrative review. *Cognition and Emotion, 23*, 4-41. doi:10.1080/02699930802619031
- Koszycki, D., & Bradwejn, J. (2001). Anxiety sensitivity does not predict fearful responding to 35% carbon dioxide in patients with panic disorder. *Psychiatry Research 101*, 137-143.
- Li, W., & Zinbarg, R. E. (2007). Anxiety sensitivity and panic attacks: A 1-year longitudinal study. *Behavior Modification, 31*, 145-161. doi:10.1177/0145445506296969
- Loewenstein, G. (2007). Affect Regulation and Affective Forecasting. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 180-203). New York, NY, US: Guilford Press.
- Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy, 33*, 335-343.
- Makkar, S. R., & Grisham, J. R. (2013). Effects of false feedback on affect, cognition, behavior, and postevent processing: The mediating role of self-focused attention. *Behavior Therapy, 44*, 111-124. doi:10.1016/j.beth.2012.07.005
- Maller, R. G., & Reiss, S. (1992). Anxiety sensitivity in 1984 and panic attacks in 1987. *Journal of Anxiety Disorders, 6*, 241-247. doi:10.1016/0887-6185(92)90036-7
- Margraf, J., Ehlers, A., & Roth, W. T. (1986). Biological models of panic disorder and agoraphobia: A review. *Behaviour Research and Therapy, 24*, 553-567. doi:10.1016/0005-7967(86)90036-7
- Masson, M. E. J. (2011). A tutorial on a practical Bayesian alternative to null-hypothesis significance testing. *Behaviour Research, 43*, 679-690. doi:10.3758/s13428-010-0049-5

- Mauss, I. B., Bunge, S. A., & Gross, J. J. (2007). Automatic emotion regulation. *Social And Personality Psychology Compass*, *1*, 146-167. doi:10.1111/j.1751-9004.2007.00005.x
- McDermott, M. J., Tull, M. T., Gratz, K. L., Daughters, S. B., & Lejuez, C. W. (2009). The role of anxiety sensitivity and difficulties in emotion regulation in posttraumatic stress disorder among crack/cocaine dependent patients in residential substance abuse treatment. *Journal of Anxiety Disorders*, *23*, 591-599. doi:10.1016/j.janxdis.2009.01.006
- McNally, R. J. (1994). *Panic disorder: A critical analysis*. New York, NY, US: Guilford Press.
- McNally, R. M. (1999). Theoretical approaches to the fear of anxiety. In S. Taylor (Ed.), *Anxiety sensitivity: Theory, research, and treatment of the fear of anxiety*. London: Lawrence Erlbaum Associates, Inc.
- McNally, R. J. (2002). Anxiety sensitivity and panic disorder. *Biological Psychiatry*, *52*, 938-946. doi:10.1016/S0006-3223(02)01475-0
- McNally, R. J., & Eke, M. (1996). Anxiety sensitivity, suffocation fear, and breath-holding duration as predictors of response to carbon dioxide challenge. *Journal of Abnormal Psychology*, *105*, 146-149. doi:10.1037/0021-843X.105.1.146
- McWilliams, L. A., & Asmundson, G. G. (2001). Is there a negative association between anxiety sensitivity and arousal-increasing substances and activities?. *Journal of Anxiety Disorders*, *15*, 161-170. doi:10.1016/S0887-6185(01)00056-1
- Moshier, S. J., Hearon, B. A., Calkins, A. W., Szuhany, K. L., Utschig, A. C., Smits, J. J., & Otto, M. W. (2013). Clarifying the link between distress intolerance and exercise: Elevated anxiety sensitivity predicts less vigorous exercise. *Cognitive Therapy and Research*, *37*, 476-482. doi:10.1007/s10608-012-9489-9
- Moshier, S. J., Szuhany, K. L., Hearon, B. A., Smits, J. J., & Otto, M. W. (2016). Anxiety sensitivity uniquely predicts exercise behaviors in young adults seeking to increase physical activity. *Behavior Modification*, *40*, 178-198. doi:10.1177/0145445515603704
- Myers, J. L. (1972). *Fundamentals of experimental design*. (2nd ed.). Oxford, England: Allyn & Bacon.
- Naragon-Gainey, K. (2010). Meta-analysis of the relations of anxiety sensitivity to the depressive and anxiety disorders. *Psychological Bulletin*, *136*, 128-150. doi:10.1037/a0018055
- Nay, W., Brown, R., & Roberson-Nay, Roxann (2013). Longitudinal course of panic disorder with and without agoraphobia using the national epidemiologic survey on alcohol and related conditions (NESARC). *Psychiatry Research*, *208*, 54-61.
- O'Connor, P. J., Smith, J. C., & Morgan, W. P. (2000). Physical activity does not provoke panic attacks in patients with panic disorder: A review of the evidence. *Anxiety, Stress & Coping: An International Journal*, *13*, 333-353. doi:10.1080/10615800008248340
- Office of Nutrition Policy and Promotion. (2003). *Canadian guidelines for body weight classification in adults*. Retrieved from [https://preventdisease.com/pdf/weight\\_book-livres\\_des\\_poids\\_e.pdf](https://preventdisease.com/pdf/weight_book-livres_des_poids_e.pdf)
- Olatunji, B. O., Forsyth, J. P., & Feldner, M. T. (2007). Implications of emotion regulation for the shift from normative fear-relevant learning to anxiety-related

- psychopathology. *American Psychologist*, *62*, 257-259. doi:10.1037/0003-066X.62.3.257
- Olthuis, J. V., Stewart, S. H., Watt, M. C., Sabourin, B. C., & Keogh, E. (2012). Anxiety sensitivity and negative interpretation biases: Their shared and unique associations with anxiety symptoms. *Journal of Psychopathology and Behavioral Assessment*, *34*, 332-342. doi:10.1007/s10862-012-9286-5
- Olthuis, J. V., Watt, M. C., Mackinnon, S. P., & Stewart, S. H. (2014). Telephone-delivered cognitive behavioral therapy for high anxiety sensitivity: A randomized controlled trial. *Journal of Consulting and Clinical Psychology*, *82*, 1005-1022, doi:10.1037/a0037027
- Olthuis, J. V., Watt, M. C., & Stewart, S. H. (2014). Anxiety Sensitivity Index (ASI-3) subscales predict unique variance in anxiety and depressive symptoms. *Journal of Anxiety Disorders*, *28*, 115-124. doi:10.1016/j.janxdis.2013.04.009
- Ouimet, A. J., Kane, L., & Tutino, J. S. (2016). Fear of anxiety or fear of emotions? Anxiety sensitivity is indirectly related to anxiety and depressive symptoms via emotion regulation. *Cogent Psychology*, *3*: 1249132. doi: 10.1080/23311908.2016.1249132
- Papageorgiou, C., & Wells, A. (2002). Effects of heart rate information on anxiety, perspective taking, and performance in high and low social-evaluative anxiety. *Behavior Therapy*, *33*, 181-199. doi:10.1016/S0005-7894(02)80024-7
- Peterson, C., & Park, N. (2007). Explanatory Style and Emotion Regulation. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 159-179). New York, NY, US: Guilford Press.
- Peterson, R. A. & Reiss, S. (1992). *Anxiety Sensitivity Index manual* (2<sup>nd</sup> ed.). Worthington, OH: International Diagnostic Services.
- Rapee, R. M. (1993). Psychological factors in panic disorder. *Advances In Behaviour Research and Therapy*, *15*, 85-102. doi:10.1016/0146-6402(93)90005-M
- Rapee, R. M., Brown, T. A., Antony, M. M., & Barlow, D. H. (1992). Response to hyperventilation and inhalation of 5.5% carbon dioxide-enriched air across the DSM- III—R anxiety disorders. *Journal of Abnormal Psychology*, *101*, 538-552. doi:10.1037/0021-843X.101.3.538
- Rapee, R., Mattick, R., & Murrell, E. (1986). Cognitive mediation in the affective component of spontaneous panic attacks. *Journal of Behavior Therapy and Experimental Psychiatry*, *17*, 245-253. doi:10.1016/0005-7916(86)90059-5
- Rapee, R. M., & Medoro, L. (1994). Fear of physical sensations and trait anxiety as mediators of the response to hyperventilation in nonclinical subjects. *Journal of Abnormal Psychology*, *103*, 693-699. doi:10.1037/0021-843X.103.4.693
- Rapee, R. M., Sanderson, W. C., McCauley, P. A., & di Nardo, P. A. (1992). Differences in reported symptom profile between panic disorder and other DSM-III-R anxiety disorders. *Behaviour Research and Therapy*, *30*, 45-52. doi:10.1016/0005-7967(92)90095-X
- Rassovsky, Y., Kushner, M. G., Schwarze, N. J., & Wangenstein, O. D. (2000). Psychological and physiological predictors of response to carbon dioxide challenge in individuals with panic disorder. *Journal of Abnormal Psychology*, *109*, 616-623. doi: 10.1037/0021-843X.109.4.616
- Reiss, S. (1991). Expectancy model of fear, anxiety, and panic. *Clinical Psychology Review*, *11*, 141-153. doi:10.1016/0272-7358(91)90092-9

- Reiss, S. (1997). Trait anxiety: It's not what you think it is. *Journal of Anxiety Disorder*, *11*, 201-214. doi.org/10.1016/S0887-6185(97)00006-6
- Reiss, S., & McNally, R. J. (1985). Expectancy model of fear. In: S. Reiss, & R. R. Bootzin (Eds.), *Theoretical issues in behavior therapy*. San Diego, CA: Academic Press.
- Richey, J., Schmidt, N. B., Hofmann, S. G., & Timpano, K. R. (2010). Temporal and structural dynamics of anxiety sensitivity in predicting fearful responding to a 35% CO<sub>2</sub> challenge. *Journal of Anxiety Disorders*, *24*, 423-432. doi:10.1016/j.janxdis.2010.02.007
- Rodriguez, B. F., Bruce, S. E., Pagano, M. E., Spencer, M. A., & Keller, M. B. (2004). Factor structure and stability of the Anxiety Sensitivity Index in a longitudinal study of anxiety disorder patients. *Behaviour Research and Therapy*, *42*, 79-91. doi:10.1016/S0005-7967(03)00074-3
- Rossi, V., & Pourtois, G. (2012). Transient state-dependent fluctuations in anxiety measured using STAI, POMS, PANAS or VAS: A comparative review. *Anxiety, Stress & Coping: An International Journal*, *25*, 603-645. doi:10.1080/10615806.2011.582948
- Sabourin, B. C., Hilchey, C. A., Lefavre, M., Watt, M. C., & Stewart, S. H. (2011). Why do they exercise less? Barriers to exercise in high-anxiety-sensitive women. *Cognitive Behaviour Therapy*, *40*, 206-215. doi:10.1080/16506073.2011.573572
- Sabourin, B. C., Stewart, S. H., Watt, M. C., & MacDonald, A. B. (2013). Development and psychometric evaluation of a brief version of the hyperventilation questionnaire: The HVQ-B. *Cognitive Behaviour Therapy*, *42*, 193-202. doi:10.1080/16506073.2012.756059
- Sabourin, B. C., Stewart, S. H., Sherry, S. B., Watt, M. C., Wald, J., & Grant, V. V. (2008). Physical exercise as interoceptive exposure within a brief cognitive-behavioral treatment for anxiety sensitive women. *Journal of Cognitive Psychotherapy*, *22*, 303-320. doi:10.1891/0889-8391.22.4.303.
- Salkovskis, P. M., & Clark, D. M. (1990). Affective responses to hyperventilation: A test of the cognitive model of panic. *Behaviour Research and Therapy*, *28*, 51-61. doi:10.1016/0005-7967(90)90054-M
- Schmidt, N. B., & Lerew, D. R. (2002). Prospective evaluation of perceived control, predictability, and anxiety sensitivity in the pathogenesis of panic. *Journal of Psychopathology and Behavioral Assessment*, *24*, 207-214. doi:10.1023/A:-1020795114296
- Schmidt, N. B., Lerew, D. R., & Jackson, R. J. (1997). The role of anxiety sensitivity in the pathogenesis of panic: Prospective evaluation of spontaneous panic attacks during acute stress. *Journal of Abnormal Psychology*, *106*, 355-364. doi:10.1037/0021-843X.106.3.355
- Schmidt, N. B., Lerew, D. R., & Jackson, R. J. (1999). Prospective evaluation of anxiety sensitivity in the pathogenesis of panic: Replication and extension. *Journal of Abnormal Psychology*, *108*, 532-537. doi:10.1037/0021-843X.108.3.532
- Schmidt, N. B., Lerew, D. R., & Trakowski, J. H. (1997). Body vigilance in panic disorder: Evaluating attention to bodily perturbations. *Journal of Consulting and Clinical Psychology*, *65*, 214-220. doi:10.1037/0022-006X.65.2.214



- Schmidt, N. B., & Telch, M. J. (1994). Role of fear of fear and safety information in moderating the effects of voluntary hyperventilation. *Behavior Therapy, 25*, 197-208. doi:10.1016/S0005-7894(05)80283-7
- Schmidt, N. B., & Woolaway-Bickel, K. (2006). Cognitive Vulnerability to Panic Disorder. In L. B. Alloy, J. H. Riskind (Eds.), *Cognitive vulnerability to emotional disorders* (pp. 207-234). Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.
- Schmidt, N. B., Zvolensky, M. J., & Maner, J. K. (2006). Anxiety sensitivity: Prospective prediction of panic attacks and Axis I pathology. *Journal of Psychiatric Research, 40*, 691-699. doi:10.1016/j.jpsychires.2006.07.009
- Shipherd, J. C., Beck, J. G., & Ohtake, P. G. (2001). Relationships between the anxiety sensitivity index, the suffocation fear scale, and responses to CO<sub>2</sub> inhalation. *Journal of Anxiety Disorders, 15*, 247-58. doi: 10.1016/S0887-6185(00)00050-5
- Smits, J. J., Berry, A. C., Rosenfield, D., Powers, M. B., Behar, E., & Otto, M. W. (2008). Reducing anxiety sensitivity with exercise. *Depression and Anxiety, 25*, 689-699. doi:10.1002/da.20411
- Smits, J. J., Julian, K., Rosenfield, D., & Powers, M. B. (2012). Threat reappraisal as a mediator of symptom change in cognitive-behavioral treatment of anxiety disorders: A systematic review. *Journal of Consulting and Clinical Psychology, 80*, 624-635. doi:10.1037/a0028957
- Smits, J. J., Powers, M. B., Cho, Y., & Telch, M. J. (2004). Mechanism of Change in Cognitive-Behavioral Treatment of Panic Disorder: Evidence for the Fear of Fear Mediation Hypothesis. *Journal of Consulting and Clinical Psychology, 72*, 646-652. doi:10.1037/0022-006X.72.4.646
- Smits, J. J., Tart, C. D., Presnell, K., Rosenfield, D., & Otto, M. W. (2010). Identifying potential barriers to physical activity adherence: Anxiety sensitivity and body mass as predictors of fear during exercise. *Cognitive Behaviour Therapy, 39*, 28-36. doi:10.1080/16506070902915261
- Statistics Canada. (2003). *Canadian Community Health Survey 1.2: Mental Health and Well-being, 2002*. Retrieved from: <http://www.statcan.gc.ca/pub/82-617-x/index-eng.htm>
- Stein, M. B., & Rapee, R. M. (1999). Biological aspects of anxiety sensitivity: Is it all in the head?. In S. Taylor (Ed.), *Anxiety sensitivity: Theory, research, and treatment of the fear of anxiety* (pp. 199-215). Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.
- Stein, M. B., Roy-Byrne, P. P., Craske, M. G., Bystritsky, A., Sullivan, G., Pyne, J. M., Katon, W., & Sherbourne, C. D. (2005). Functional impact and health utility of anxiety disorders in primary care outpatients. *Medical Care, 43*, 1164-1170. doi:10.1097/01.mlr.0000185750.18119.fd
- Story, T. J., & Craske, M. G. (2008). Responses to false physiological feedback in individuals with panic attacks and elevated anxiety sensitivity. *Behaviour Research and Therapy, 46*, 1001-1008. doi:10.1016/j.brat.2008.06.001
- Ströhle, A., Graetz, B., Scheel, M., Wittmann, A., Feller, C., Heinz, A., & Dimeo, F. (2009). The acute antipanic and anxiolytic activity of aerobic exercise in patients with panic disorder and healthy control subjects. *Journal of Psychiatric Research, 43*, 1013-1017. doi:10.1016/j.jpsychires.2009.02.004

- Struzik, L., Vermani, M., Duffin, J., & Katzman, M. A. (2004). Anxiety sensitivity as a predictor of panic attacks. *Psychiatry Research, 129*, 273-278. doi:10.1016/j.psychres.2004.04.007
- Tabachnick, B. G., & Fidell, L. S. (2012). *Using multivariate statistics (6th ed.)*. Boston, MA: Pearson.
- Taylor, S. (1999). *Anxiety sensitivity: Theory, research, and treatment of the fear of anxiety*. Mahwah, NJ: Erlbaum.
- Taylor, S., & Cox, B. J. (1998). An expanded Anxiety Sensitivity Index: Evidence for a hierarchic structure in a clinical sample. *Journal of Anxiety Disorders, 12*, 463-483. doi:10.1016/S0887-6185(98)00028-0
- Taylor, S., & Fedoroff, I. C. (1999). The expectancy theory of fear, anxiety, and panic: A conceptual and empirical analysis. In S. Taylor (Ed.), *Anxiety sensitivity: Theory, research, and treatment of the fear of anxiety* (pp. 17-33). Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.
- Taylor, S., Zvolensky, M., Cox, B., Deacon, B., Heimberg, R., Ledley, D., et al. (2007). Robust dimensions of anxiety sensitivity: Development and initial validation of the Anxiety Sensitivity Index-3. *Psychological Assessment, 19*, 176-188. doi:10.1037/1040-3590.19.2.176
- Telch, M. J., Harrington, P. J., Smits, J. A.J., Powers, M. B. (2011). Unexpected arousal, anxiety sensitivity, and their interaction on CO<sub>2</sub>-induced panic: Further evidence for the context-sensitivity vulnerability model. *Journal of Anxiety Disorders, 25*, 645-653. doi:10.1016/j.janxdis.2011.02.005
- Telch, M. J., & Lancaster, C. L. (2012). Is there room for safety behaviors in exposure therapy for anxiety disorders?. In P. Neudeck, & H. Wittchen (Eds.), *Exposure therapy: Rethinking the model – refining the method* (pp.313-334). New York, NY, US: Springer Science + Business Media. Doi: 10.1007/978-1-46143342-2\_18
- Telch, M. J., Silverman, A., & Schmidt, N. B. (1996). Effects of anxiety sensitivity and perceived control on emotional responding to caffeine challenge. *Journal of Anxiety Disorders, 10*, 21-35. doi:10.1016/0887-6185(95)00032-1
- Telch, M. J., Smits, J. A. J., Brown, M., Dement, M., Powers, M. B., Lee, H., & Pai, A. (2010). Effects of threat context and cardiac sensitivity on fear responding to a 35% CO<sub>2</sub> challenge: A test of the context-sensitivity panic vulnerability model. *Journal of Behavior Therapy and Experimental Psychiatry, 41*, 365-372. doi:10.1016/j.jbtep.2010.03.008
- Thomas, S., Reading, J., & Shephard, R. J. (1992). Revision of the Physical Activity Readiness Questionnaire (PAR-Q). *Canadian Journal of Sport Sciences, 17*, 338-345.
- Troy, A. S., Wilhelm, F. H., Shallcross, A. J., & Mauss, I. B. (2010). Seeing the silver lining: cognitive reappraisal ability moderates the relationship between stress and depressive symptoms. *Emotion, 10*, 783–795. doi:10.1037/a0020262.
- Tull, M. T. (2006). Extending an Anxiety Sensitivity Model of Uncued Panic Attack Frequency and Symptom Severity: The Role of Emotion Dysregulation. *Cognitive Therapy and Research, 30*, 177-184. doi:10.1007/s10608-006-9036-7
- Tull, M. T., Rodman, S. A., & Roemer, L. (2008). An examination of the fear of bodily sensations and body hypervigilance as predictors of emotion regulation

- difficulties among individuals with a recent history of uncued panic attacks. *Journal of Anxiety Disorders*, 22, 750-760. doi:10.1016/j.janxdis.2007.08.001
- Tull, M. T., & Roemer, L. (2007). Emotion regulation difficulties associated with the experience of uncued panic attacks: Evidence of experiential avoidance, emotional nonacceptance, and decreased emotional clarity. *Behavior Therapy*, 38, 378-391. doi:10.1016/j.beth.2006.10.006
- Tull, M. T., Stipelman, B. A., Salters-Pedneault, K., & Gratz, K. L. (2009). An examination of recent non-clinical panic attacks, panic disorder, anxiety sensitivity, and emotion regulation difficulties in the prediction of generalized anxiety disorder in an analogue sample. *Journal of Anxiety Disorders*, 23, 275-282. doi:10.1016/j.janxdis.2008.08.002
- University of Waterloo Office of Research Ethics. (2013). *Human participant research guidelines: Use of crowdsourcing services*. Retrieved from [https://uwaterloo.ca/research/sites/ca.research/files/uploads/files/crowdsourcing\\_guidelines\\_access\\_check\\_done.pdf](https://uwaterloo.ca/research/sites/ca.research/files/uploads/files/crowdsourcing_guidelines_access_check_done.pdf)
- Vujanovic, A. A., Arrindell, W. A., Bernstein, A., Norton, P. J., & Zvolensky, M. J. (2007). Sixteen-Item Anxiety Sensitivity Index: Confirmatory factor analytic evidence, internal consistency, and construct validity in a young adult sample from the Netherlands. *Assessment*, 14, 129-143. doi:10.1177/1073191106295053
- Vujanovic, A. A., Zvolensky, M. J., & Bernstein, A. (2008). The interactive effects of anxiety sensitivity and emotion dysregulation in predicting anxiety-related cognitive and affective symptoms. *Cognitive Therapy and Research*, 32, 803-817. doi:10.1007/s10608-007-9148-8
- Watt, M. C., & Stewart, S. H. (2008). *Overcoming the fear of fear: How to reduce anxiety sensitivity*. Oakland, CA: New Harbinger Publications.
- Webb, T. L., Miles, E., & Sheeran, P. (2012). Dealing with feeling: A meta-analysis of the effectiveness of strategies derived from the process model of emotion regulation. *Psychological Bulletin*, 138, 775-808. doi:10.1037/a0027600
- Weems, C. F., Hayward, C., Killen, J., & Taylor, C. (2002). A longitudinal investigation of anxiety sensitivity in adolescence. *Journal of Abnormal Psychology*, 111, 471-477. doi:10.1037/0021-843X.111.3.471
- Wells, A., & Papageorgiou, C. (2001). Social phobic interoception: Effects of bodily information on anxiety, beliefs and self-processing. *Behaviour Research and Therapy*, 39, 1-11. doi:10.1016/S0005-7967(99)00146-1
- Wheaton, M. G., Deacon, B. J., McGrath, P. B., Berman, N. C., & Abramowitz, J. S. (2012). Dimensions of anxiety sensitivity in the anxiety disorders: Evaluation of the ASI-3. *Journal of Anxiety Disorders*, 26, 401-408. doi:10.1016/j.janxdis.2012.01.002
- Wirtz, C. M., Hofmann, S. G., Riper, H. & Berking, M. (2014). Emotion regulation predicts anxiety over a five-year interval: a cross-lagged panel analysis. *Depression and Anxiety*, 31, 87-95. doi: 10.1002/da.22198
- Zinbarg, R. E., Brown, T. A., Barlow, D. H., & Rapee, R. M. (2001). Anxiety sensitivity, panic, and depressed mood: A reanalysis teasing apart the contributions of the two levels in the hierarchical structure of the Anxiety Sensitivity Index. *Journal of Abnormal Psychology*, 110, 372-377. doi:10.1037/0021-843X.110.3.372

- Zvolensky, M. J., Eifert, G. H., & Lejuez, C. W. (2001). Offset control during recurrent 20% carbon dioxide-enriched air induction: Relation to individual difference variables. *Emotion, 1*, 148-165. doi:10.1037/1528-3542.1.2.148.
- Zvolensky, M. J., Feldner, M. T., Eifert, G. H., & Stewart, S. H. (2001). Evaluating differential predictions of emotional reactivity during repeated 20% carbon dioxide-enriched air challenge. *Cognition and Emotion, 15*, 767-786. doi:10.1080/02699930143000284
- Zvolensky, M. J., Forsyth, J. P., Bernstein, A., & Leen-Feldner, E. W. (2007). A concurrent test of the Anxiety Sensitivity Taxon: Its relation to bodily vigilance and perceptions of control over anxiety-related events in a sample of young adults. *Journal of Cognitive Psychotherapy, 21*, 72-90. doi:10.1891/088983907780493322
- Zvolensky, M. J., Goodie, J. L., Ruggiero, K. J., Black, A. L., Larkin, K. T., & Taylor, B. K. (2002). Perceived stress and anxiety sensitivity in the prediction of anxiety-related responding: A multichallenge evaluation. *Anxiety, Stress & Coping: An International Journal, 15*, 211-229. doi:10.1080/1061580021000020699
- Zvolensky, M. J., Schmidt, N. B., Bernstein, A., & Keough, M. E. (2006). Risk-factor research and prevention programs for anxiety disorders: A translational research framework. *Behaviour Research and Therapy, 44*, 1219-1239. doi:10.1016/j.brat.2006.06.001

## List of Appendices

Appendix	Page
A. Recruitment Posting for Mechanical Turk.....	133
B. Threatening Cognitions Scale (TCS).....	134
C. Anxiety Sensitivity Index-3 (ASI-3) .....	135
D. Body Vigilance Scale (BVS) .....	136
E. Socially Desirable Response Set-5 (SDRS-5) .....	137
F. Body Sensations Questionnaire (BSQ).....	138
G. Anxiety Control Questionnaire (ACQ).....	139
H. Depression Anxiety and Stress Scale (DASS-21) .....	141
I. Hyperventilation Questionnaire (HQ).....	142
J. State Emotion Rating Scales .....	144
K. Eligibility Screening for Mechanical Turk Study.....	145
L. Consent Form for Mechanical Turk Study.....	146
M. Demographic Data – Mechanical Turk.....	148
N. Debriefing Form for Mechanical Turk Study.....	150
O. Physical Activity Readiness Questionnaire (PAR-Q) .....	151
P. Demographic Data .....	152
Q. Perceived Fitness Scale (PFS).....	154
R. Panic History Form (PHF) .....	155
S. Borg Rate of Perceived Exertion (RPE) Scale .....	156
T. Borg’s RPE Scale Instructions .....	157
U. Visual Analogue Scales (VASs) .....	158
V. Difficulties in Emotion Regulation Scale (DERS) Scale .....	160
W. Consent Form .....	161
X. Debriefing Form .....	163
Y. Post-Debrief Consent Form .....	164
Z. Hypotheses Testing with the ASI-3 Physical Concerns Subscale.....	165

## **Appendix A**

### **Recruitment Posting for Mechanical Turk**

#### **Recruitment for a study on the experience of physical sensations (30 min)**

We are based at the University of New Brunswick in Fredericton, Canada. We are studying psychological factors that influence responses to bodily sensations. To find out more please click on the link provided.

To participate you need to:

- Be a resident of Canada or the United States
- Be at least 19 years old
- Have no physical health issues that prevent participation in physical activity

**Appendix B**  
**Threatening Cognitions Scale**

**Instructions:** Whether engaged in physical activity or just sitting quietly, we are all aware of our physical state. Take notice of how you are feeling physically at this time. Below you will find statements that refer to specific physical or mental sensations.

**Using the scale below, rate the degree to which you were thinking anxiously about each sensation during the last few minutes:**

	<b>No Anxious Thinking</b>										<b>Thought Anxiously all the time</b>
1. Pounding/racing heart	0	1	2	3	4	5	6	7	8	9	
2. Breathlessness/ smothering	0	1	2	3	4	5	6	7	8	9	
3. Hot flushes/chills	0	1	2	3	4	5	6	7	8	9	
4. Nausea or stomach cramps	0	1	2	3	4	5	6	7	8	9	
5. Dizziness or faint	0	1	2	3	4	5	6	7	8	9	
6. Difficulty swallowing	0	1	2	3	4	5	6	7	8	9	
7. Numbness or tingling	0	1	2	3	4	5	6	7	8	9	
8. Feeling unreal or in a dream	0	1	2	3	4	5	6	7	8	9	
9. Mental loss of control	0	1	2	3	4	5	6	7	8	9	
10. Sweating	0	1	2	3	4	5	6	7	8	9	
11. Trembling or shaking	0	1	2	3	4	5	6	7	8	9	
12. Chest pain/tightness	0	1	2	3	4	5	6	7	8	9	

**Appendix C**  
**Anxiety Sensitivity Index-3 (ASI-3)**

**Instructions:** Please circle the number that best corresponds to how much you agree with each item. If any items concern something that you have never experienced (e.g., fainting in public), then answer on the basis of how you might feel *if you had* such an experience. Otherwise, answer all items on the basis of your own experience. Be careful to circle only one number for each item and please answer all items.

Questionnaire Items	Very little	A little	Some	Much	Very Much
1. It is important for me not to appear nervous.	0	1	2	3	4
2. When I cannot keep my mind on a task, I worry that I might be going crazy.	0	1	2	3	4
3. It scares me when my heart beats rapidly.	0	1	2	3	4
4. When my stomach is upset, I worry that I might be seriously ill.	0	1	2	3	4
5. It scares me when I am unable to keep my mind on a task.	0	1	2	3	4
6. When I tremble in the presence of others, I fear what people might think of me.	0	1	2	3	4
7. When my chest feels tight, I get scared that I won't be able to breathe properly.	0	1	2	3	4
8. When I feel pain in my chest, I worry that I'm going to have a heart attack.	0	1	2	3	4
9. I worry that other people will notice my anxiety.	0	1	2	3	4
10. When I feel "spacey" or spaced out I worry that I may be mentally ill.	0	1	2	3	4
11. It scares me when I blush in front of people.	0	1	2	3	4
12. When I notice my heart skipping a beat, I worry that there is something seriously wrong with me.	0	1	2	3	4
13. When I begin to sweat in a social situation, I fear people will think negatively of me.	0	1	2	3	4
14. When my thoughts seem to speed up, I worry that I might be going crazy.	0	1	2	3	4
15. When my throat feels tight, I worry that I could choke to death.	0	1	2	3	4
16. When I have trouble thinking clearly, I worry that there is something wrong with me.	0	1	2	3	4
17. I think it would be horrible for me to faint in public.	0	1	2	3	4
18. When my mind goes blank, I worry there is something terribly wrong with me.	0	1	2	3	4



## Appendix D Body Vigilance Scale (BVS)

**Instructions:** This measure is designed to index how sensitive you are to internal bodily sensations such as heart palpitations or dizziness. Fill it out according to how you have felt for the **past week**.

1. I am the kind of person who pays close attention to internal bodily sensations.

0	1	2	3	4	5	6	7	8	9	10	
Not at all like me				Moderately like me				Extremely like me			

2. I am very sensitive to changes in my internal bodily sensations.

0	1	2	3	4	5	6	7	8	9	10	
Not at all like me				Moderately like me				Extremely like me			

3. On average, **how much time** do you spend each day “scanning” your body for sensations (e.g., sweating, heart palpitations, dizziness)?

0	10	20	30	40	50	60	70	80	90	100	
No time				Half of the time				All of the time			

4. Rate how much attention you pay to each of the following sensations using this scale:

0	1	2	3	4	5	6	7	8	9	10
None		Slight		Moderate			Substantial		Extreme	

1. Heart palpitations \_\_\_\_\_
2. Chest pain/discomfort \_\_\_\_\_
3. Numbness \_\_\_\_\_
4. Tingling \_\_\_\_\_
5. Short of breath/smothering \_\_\_\_\_
6. Faintness \_\_\_\_\_
7. Vision changes \_\_\_\_\_
8. Feelings of unreality \_\_\_\_\_
9. Feeling detached from self \_\_\_\_\_
10. Dizziness \_\_\_\_\_
11. Hot flush \_\_\_\_\_
12. Sweating/clammy hands \_\_\_\_\_
13. Stomach upset \_\_\_\_\_
14. Nausea \_\_\_\_\_
15. Choking/throat closing \_\_\_\_\_

**Appendix E**  
**Socially Desirable Response Set-5 (SDRS-5)**

Instructions: Listed below are a few statements about your relationships with others. How much is *each* statement TRUE or FALSE for you?

	Definitely True	Mostly True	Don't know	Mostly False	Definitely False
1. I am always courteous even to people who are disagreeable.	1	2	3	4	5
2. There have been occasions when I took advantage of someone.	1	2	3	4	5
3. I sometimes try to get even rather than forgive and forget.	1	2	3	4	5
4. I sometimes feel resentful when I don't get my way.	1	2	3	4	5
5. No matter who I'm talking to, I'm always a good listener.	1	2	3	4	5

## Appendix F Body Sensations Questionnaire (BSQ)

**Instructions:** Below is a list of specific body sensations that may occur when you are nervous or in a feared situation. Please mark down how afraid you are of these feelings. Use the following five point scale:

1                      2                      3                      4                      5  
 not at all          somewhat          moderately          very                  extremely

..... frightened by this sensation.

1. heart palpitations.....	1	2	3	4	5
2. pressure or heavy feeling in chest.....	1	2	3	4	5
3. numbness in arms or legs.....	1	2	3	4	5
4. tingling in the fingertips .....	1	2	3	4	5
5. numbness in another part of your body.....	1	2	3	4	5
6. feeling short of breath.....	1	2	3	4	5
7. dizziness.....	1	2	3	4	5
8. blurred or distorted vision.....	1	2	3	4	5
9. nausea.....	1	2	3	4	5
10. having “butterflies” in your stomach.....	1	2	3	4	5
11. feeling a knot in your stomach.....	1	2	3	4	5
12. having a lump in your throat.....	1	2	3	4	5
13. wobbly or rubber legs.....	1	2	3	4	5
14. sweating.....	1	2	3	4	5
15. a dry throat.....	1	2	3	4	5
16. feeling disoriented and confused.....	1	2	3	4	5
17. feeling disconnected from your body: only partly present .....	1	2	3	4	5
18. other (please describe) _____	1	2	3	4	5
_____	1	2	3	4	5
_____	1	2	3	4	5

**Appendix G**  
**Anxiety Control Questionnaire (ACQ)**

**Instructions:** Listed below are a number of statements describing a set of beliefs. Please read each statement carefully and, on the 0-5 scale below, indicate how much you think each statement is typical of you.

0	1	2	3	4	5
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

- \_\_\_\_\_ 1. I am usually able to avoid threat quite easily.
- \_\_\_\_\_ 2. How well I cope with difficult situations depends on whether I have outside help.
- \_\_\_\_\_ 3. When I am put under stress, I am likely to lose control.
- \_\_\_\_\_ 4. I can usually stop my anxiety from showing.
- \_\_\_\_\_ 5. When I am frightened by something, there is generally nothing I can do.
- \_\_\_\_\_ 6. My emotions seem to have a life of their own.
- \_\_\_\_\_ 7. There is little I can do to influence people's judgments of me.
- \_\_\_\_\_ 8. Whether I can successfully escape a frightening situation is always a matter of chance with me.
- \_\_\_\_\_ 9. I often shake uncontrollably.
- \_\_\_\_\_ 10. I can usually put worrisome thoughts out of my mind easily.
- \_\_\_\_\_ 11. When I am in a stressful situation, I am able to stop myself from breathing too hard.
- \_\_\_\_\_ 12. I can usually influence the degree to which a situation is potentially threatening to me.
- \_\_\_\_\_ 13. I am able to control my level of anxiety.
- \_\_\_\_\_ 14. There is little I can do to change frightening events.
- \_\_\_\_\_ 15. The extent to which a difficult situation resolves itself has nothing to do with my actions.
- \_\_\_\_\_ 16. If something is going to hurt me, it will happen no matter what I do.
- \_\_\_\_\_ 17. I can usually relax when I want.
- \_\_\_\_\_ 18. When I am under stress, I am not always sure how I will react.

- \_\_\_\_\_ 19. I can usually make sure people like me if I work at it.
- \_\_\_\_\_ 20. Most events that make me anxious are outside my control.
- \_\_\_\_\_ 21. I always know exactly how I will react to difficult situations.
- \_\_\_\_\_ 22. I am unconcerned if I become anxious in a difficult situation, because I am confident in my ability to cope with my symptoms.
- \_\_\_\_\_ 23. What people think of me is largely outside of my control.
- \_\_\_\_\_ 24. I usually find it hard to deal with difficult problems.
- \_\_\_\_\_ 25. When I hear someone has a serious illness, I worry that I am next.
- \_\_\_\_\_ 26. When I am anxious, I find it hard to focus on anything other than my anxiety.
- \_\_\_\_\_ 27. I am able to cope as effectively with unexpected anxiety as I am with anxiety that I expect to occur.
- \_\_\_\_\_ 28. I sometimes think, "Why even bother to try coping with my anxiety when nothing I do seems to affect how frequently or intensely I experience it?"
- \_\_\_\_\_ 29. I often have the ability to get along with "difficult" people.
- \_\_\_\_\_ 30. I will avoid conflict due to my inability to successfully resolve it.

## Appendix H

### Depression Anxiety and Stress Scale-21 (DASS-21)

**Instructions:** Please read each statement and mark a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement.

*The rating scale is as follows:*

- 0 Did not apply to me at all
- 1 Applied to me to some degree, or some of the time
- 2 Applied to me to a considerable degree, or a good part of time
- 3 Applied to me very much, or most of the time

1. I found it hard to wind down	0	1	2	3
2. I was aware of dryness of my mouth	0	1	2	3
3. I couldn't seem to experience any positive feeling at all	0	1	2	3
4. I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5. I found it difficult to work up the initiative to do things	0	1	2	3
6. I tended to over-react to situations	0	1	2	3
7. I experienced trembling (eg, in the hands)	0	1	2	3
8. I felt that I was using a lot of nervous energy	0	1	2	3
9. I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10. I felt that I had nothing to look forward to	0	1	2	3
11. I found myself getting agitated	0	1	2	3
12. I found it difficult to relax	0	1	2	3
13. I felt down-hearted and blue	0	1	2	3
14. I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15. I felt I was close to panic	0	1	2	3
16. I was unable to become enthusiastic about anything	0	1	2	3
17. I felt I wasn't worth much as a person	0	1	2	3
18. I felt that I was rather touchy	0	1	2	3
19. I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
20. I felt scared without any good reason	0	1	2	3
21. I felt that life was meaningless	0	1	2	3

## Appendix I Hyperventilation Questionnaire

**Instructions:** Please rate the maximum degree to which you are experiencing the following feelings at the present time by marking the appropriate number.

<b><u>Feeling</u></b>	<b>Not at all</b>			<b>Markedly</b>
Numbness in extremities	0	1	2	2
Breathlessness	0	1	2	2
Buzzing in the head	0	1	2	2
Feeling distant	0	1	2	2
Feeling unreal	0	1	2	2
Fatigue	0	1	2	2
Fear	0	1	2	2
Pounding heart	0	1	2	2
Feeling trapped or helpless	0	1	2	2
Hot or flushed	0	1	2	2
Anxiety	0	1	2	2
Headache	0	1	2	2
Rising agitation	0	1	2	2
Feeling of suffocation	0	1	2	2
Dizziness	0	1	2	2
Feeling of losing control	0	1	2	2
Worrying that your actions are damaging to your health	0	1	2	2

<b><u>Feeling</u></b>	<b>Not at all</b>		<b>Markedly</b>
Tingling in the face	0	1	2
Light-headedness	0	1	2
Numbness in the face	0	1	2
Tight or stiff muscles	0	1	2
Blurred vision	0	1	2
Weakness	0	1	2
Relaxation	0	1	2
Nervousness	0	1	2
Racing heart	0	1	2
Feel like passing out	0	1	2
Nausea	0	1	2
Tingling in extremities	0	1	2
Fear of a heart attack	0	1	2
Band across head	0	1	2
Tension	0	1	2
Feel like panicking	0	1	2



## Appendix J State Emotion Rating Scales

**Instructions:** Please answer the following questions with how you are feeling AT THIS MOMENT. Select the number that best indicates how you feel.

How **anxious** do you feel right now?

0	1	2	3	4	5	6	7	8	9	10
NOT AT ALL										EXTREMELY
ANXIOUS										ANXIOUS

How **happy** do you feel right now?

0	1	2	3	4	5	6	7	8	9	10
NOT AT ALL										EXTREMELY
HAPPY										HAPPY

How **tired** do you feel right now?

0	1	2	3	4	5	6	7	8	9	10
NOT AT ALL										EXTREMELY
TIRED										TIRED

How **fearful** do you feel right now?

0	1	2	3	4	5	6	7	8	9	10
NOT AT ALL										EXTREMELY
AFRAID										AFRAID

How **energetic** do you feel right now?

0	1	2	3	4	5	6	7	8	9	10
NOT AT ALL										EXTREMELY
ENERGETIC										ENERGETIC

How **sad** do you feel right now?

0	1	2	3	4	5	6	7	8	9	10
NOT AT ALL										EXTREMELY
SAD										SAD

How **tense** do you feel right now?

0	1	2	3	4	5	6	7	8	9	10
NOT AT ALL										EXTREMELY
TENSE										TENSE

How **relaxed** do you feel right now?

0	1	2	3	4	5	6	7	8	9	10
NOT AT ALL										EXTREMELY
RELAXED										RELAXED

## Appendix K Eligibility Screening for Mechanical Turk Study

**Thank you for your interest in our study. To participate, you need to:**

- 1. Be a resident of Canada or the United States**
- 2. Be at least 19 years old**
- 3. Have no physical health issues that prevent participation in physical activity**

Please select one of the two following statements that best describes you.

- A. I confirm that I live in Canada or the United States and am at least 19 years old
- B. I DO NOT live in Canada or the United States and/or AM NOT at least 19 years old

[Participants who respond to respond to option B are ineligible for participation]

### **Physical Activity Readiness Questionnaire (PAR-Q)**

- 1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?**
- 2. Do you feel pain in your chest when you do physical activity?**
- 3. In the past month, have you had chest pain when you were not doing physical activity?**
- 4. Do you lose your balance because of dizziness or do you ever lose consciousness?**
- 5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
- 6. Is your doctor currently prescribing drugs (for example, water pills) for a blood pressure or heart condition?**
- 7. Do you have a respiratory problem?**
- 8. Are you prone to dizziness or anxiety attacks?**
- 9. Do you know of any other reason why you should not do physical activity?**

[Participants who respond “yes” to any of the PAR-Q questions are ineligible for participation]

### **Thank You Page for Ineligible Participants**

**Thank you for your interest in our research. Unfortunately you are not eligible to participate in the current study.**

If you have any questions or comments please feel free to contact the primary researcher, Catherine Hilchey, PhD candidate ([catherine.hilchey@unb.ca](mailto:catherine.hilchey@unb.ca)) or the researcher’s supervisor, Dr. David Clark ([clark@unb.ca](mailto:clark@unb.ca); 1+ (506) 452-6225). Any concerns about this study may be addressed to Dr. Carmen Poulin ([carmen@unb.ca](mailto:carmen@unb.ca); 1+ (506) 458-7800), Acting Chair of the Department of Psychology Ethics Committee at the University of New Brunswick, Canada.

## **Appendix L Informed Consent Form**

[If they meet eligibility criteria]

You are invited to participate in a study conducted by Catherine Hilchey, PhD candidate, and Dr. David Clark. We are researchers at the University of New Brunswick in Fredericton, Canada. This project is on file with the Research Ethics Board, University of New Brunswick (REB #2015-045).

### **Why is this research being done?**

We are conducting this study to learn more about people's experiences of bodily sensations with a specific focus on how different psychological factors influence the way people experience bodily sensations.

### **What do you want me to do?**

Your participation will consist of completing questionnaires about your background, mood, beliefs, thoughts, behaviours, health, and physical sensations. You will also be asked to engage in a deep breathing task for one minute. Following the breathing task you will be asked to complete additional questionnaires pertaining to your experience. Total participation will take approximately 30 minutes. There are also two easy questions included that let us know that you are a real person and not a spam bot. You must answer these questions correctly to be compensated for completing the study. Both of these questions are labeled to let you know which ones they are.

### **Are there any benefits to participating?**

You will receive \$0.50 via your Mechanical Turk account for completing the study. You can also choose to receive a summary of the findings of this research by providing your email at the end of the study.

### **Are there any risks?**

Deep breathing exercises are risk-free for most individuals. However, they may induce hyperventilation syndrome (HVS) in some individuals with a history of this disorder, or who are prone to feelings of anxiety or dizziness, or who have been diagnosed with respiratory disorders. Please perform our breathing exercise while seated. Participation in the study is completely voluntary and if you begin to feel uncomfortable or do not wish to participate for any reason, you can stop the study at any point.

### **Are my answers anonymous?**

Yes. Only your worker ID will be connected to your survey responses. We do not have access to any other identifying information (e.g., your name). If you choose to provide your email address it will not be connected with your survey responses.

### **Who will have access to my data?**

Only the researchers will have access to the information you give during the study. Amazon and Mechanical Turk will not have access to your answers. Only a summary of the overall results will be shared in possible future presentations or publications of the

survey data. The website that hosts the survey is on a secure server. All data will be securely stored on a password protected computer.

**How can I get more information about this research project?**

If you have questions before, during, or after the study, or if you would like to learn more about our research, please feel free to contact either Catherine Hilchey ([catherine.hilchey@unb.ca](mailto:catherine.hilchey@unb.ca)) or Dr. David Clark ([clark@unb.ca](mailto:clark@unb.ca); 1+ (506) 452-6225). If you have any concerns about the study you can contact the Acting Chair of the Psychology Ethics Committee at the University of New Brunswick, Canada (Dr. Carmen Poulin, [carmen@unb.ca](mailto:carmen@unb.ca), 1+ (506) 458-7800).

By clicking the “Next” button at the bottom of this page you are agreeing to the following statement: *I have read the above description and volunteer to participate in this study. I understand that I can decide to discontinue my participation or not to provide any personal information at any time without question and without penalty.*

[Next]

## Appendix M Demographic Data

Please enter your Mechanical Turk worker ID so we can confirm your compensation:

\_\_\_\_\_

1. How old are you (in years)? \_\_\_\_\_
2. What is your gender?  
 Male                       Female                       Other: \_\_\_\_\_
3. Where were you born?  
 Canada                       United States                       Other: \_\_\_\_\_
4. Where do you live now?  
 Canada                       United States
5. What is your current marital status? (check one)  
 Single  
 Dating but not exclusively  
 Dating exclusively  
 Married  
 Living together  
 Divorced/separated/widowed
6. What race or ethnic group do you identify with most closely?  
 Aboriginal (e.g., First Nations, Metis) or Native American  
 Asian/Pacific Islander  
 Black or African American/Canadian  
 Hispanic/Latino  
 Indian or Indo-American/Indo-Canadian  
 White/Caucasian  
 Other: \_\_\_\_\_
7. What language do you use most often at home?  
 English  
 French  
 Spanish  
 Other: \_\_\_\_\_
8. What is the highest level of education you have completed?  
 Grade school  
 Some high school  
 High school or equivalent  
 Some college/university  
 Completed college/university

- Post-graduate training/degree  
 Other: \_\_\_\_\_

9. How many times per week on average do you engage in at least 10 minutes of moderate to vigorous exercise (e.g., sweating, racing heart, etc.)? \_\_\_\_\_

10. Do you consider yourself to be in good physical health?  
 Yes       No

11. Have you ever suffered from or been treated for: (check all that apply)

- |   |  |
|---|--|
| <input type="checkbox"/> Arthritis              | <input type="checkbox"/> Emphysema                 |
| <input type="checkbox"/> Asthma                 | <input type="checkbox"/> Gastrointestinal problems |
| <input type="checkbox"/> Anemia                 | <input type="checkbox"/> Heart disease             |
| <input type="checkbox"/> Chest pain             | <input type="checkbox"/> Migraines                 |
| <input type="checkbox"/> Diabetes               | <input type="checkbox"/> Respiratory problems      |
| <input type="checkbox"/> Dizzy spells/ Fainting | <input type="checkbox"/> Sinus problems            |
| <input type="checkbox"/> Drug dependence        | <input type="checkbox"/> Thyroid problems          |
| <input type="checkbox"/> Epilepsy               | <input type="checkbox"/> TMD (jaw pain)            |
| <input type="checkbox"/> Earaches               |  |

12. Do you have other medical concerns or conditions not listed above?

- Yes       No

If yes, please  
list \_\_\_\_\_

13. Do you receive any treatments or take any medication for any medical issues?

- Yes       No

If yes, please  
list \_\_\_\_\_

14. Do you *currently* have a mental health problem that led you to obtain professional advice or help?

- Yes       No

If yes:

a) Please list current mental health  
problems \_\_\_\_\_

b) What treatment (e.g., medication, psychological treatment, counselling) have you received for this mental health problem?  
 \_\_\_\_\_

## Appendix N Debriefing Form

### **Thank you for taking time to complete the study on the experience of bodily sensations.**

How comfortable are you with your body? As it turns out this is a fairly complicated question. This question could mean “how comfortable are you with your physical appearance, or the size of your body?” In this study we are interested in a much more specific aspect of this question. How comfortable are you when you notice specific physical sensations like increased heart rate, chest pressure, and the like? Some people get very concerned when they experience physical sensations, and sometimes this can lead to unwanted states of anxiety. In this study we are investigating people’s anxiousness or comfort with physical sensations and whether they experience more anxiety when they are focused on their physical state, such as when you engaged in the breathing task. We are predicting that people who tend to be anxious about physical sensations will experience the greatest surge in anxious thinking after the breathing task. On the other hand, people who tend not to be anxious about their physical sensations are expected to find the breathing task relaxing. This research helps us understand the psychological factors that might lead to the development of clinical anxiety, such as panic disorder. Ultimately, if we can better understand people’s reactions to unexpected physical sensations we should be able to offer more effective psychological treatments for anxiety conditions such as panic disorder.

Research of this kind requires the participation of a large number of individuals. Thus, your participation is extremely important and very much appreciated. If you are interested in the topic of this study, below is a recommended reading:

Antony, M. M., Ledley, D. R., Liss, A., & Swinson, R. P. (2006). Responses to symptom induction exercises in panic disorder. *Behaviour Research And Therapy*, 44(1), 85-98. doi:10.1016/j.brat.2004.12.005

If you have any questions or concerns about this research project, you may contact Catherine Hilchey ([catherine.hilchey@unb.ca](mailto:catherine.hilchey@unb.ca)) or Dr. David Clark ([clark@unb.ca](mailto:clark@unb.ca); 1+ (506) 452-6225). For ethical concerns regarding your participation in this study you may contact the Acting Chair of the Psychology Ethics Committee, Dr. Carmen Poulin at 1+ (506) 458-7800 or [carmen@unb.ca](mailto:carmen@unb.ca).

If you would like to receive a summary of the findings from this study, please provide your email address: \_\_\_\_\_.

**Appendix O**  
**Physical Activity Readiness Questionnaire (PAR-Q)**

Now I will ask you about some questions from a form called the Physical Activity Readiness Questionnaire developed by Health Canada to determine if people should contact their doctor before engaging in physical exercise. If you respond “yes” to any question, you will not be able to participate in the study.

- 1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?**
- 2. Do you feel pain in your chest when you do physical activity?**
- 3. In the past month, have you had chest pain when you were not doing physical activity?**
- 4. Do you lose your balance because of dizziness or do you ever lose consciousness?**
- 5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
- 6. Is your doctor currently prescribing drugs (for example, water pills) for a blood pressure or heart condition?**
- 7. Do you know of any other reason why you should not do physical activity?**



## Appendix P Demographic Data

1. Current age (years): \_\_\_\_\_
2. What is your biological sex?
  - Male
  - Female
  - Other
3. What is your present relationship status? (check one)
  - Single
  - Dating but not exclusively
  - Dating exclusively
  - Married
  - Living together
  - Divorced/separated/widowed
4. What race or ethnic group do you identify with most closely?
  - Caucasian/European Canadian
  - Asian Canadian
  - Black/African Canadian
  - Aboriginal (e.g., First Nations, Metis)
  - Other: \_\_\_\_\_
5. What is your height? \_\_\_\_\_
6. What is your weight? \_\_\_\_\_
7. How many times per week on average do you engage in at least 10 minutes of moderate-vigorous exercise (e.g., sweating, racing heart, etc.)? \_\_\_\_\_
8. Do you consider yourself to be in good physical health?
  - Yes             No
9. Have you ever suffered from or been treated for:
 

<input type="checkbox"/> Arthritis	<input type="checkbox"/> Emphysema
<input type="checkbox"/> Asthma	<input type="checkbox"/> Gastrointestinal problems
<input type="checkbox"/> Anemia	<input type="checkbox"/> Heart disease
<input type="checkbox"/> Chest pain	<input type="checkbox"/> Migraines
<input type="checkbox"/> Diabetes	<input type="checkbox"/> Respiratory problems
<input type="checkbox"/> Dizzy spells/ Fainting	<input type="checkbox"/> Sinus problems
<input type="checkbox"/> Drug dependence	<input type="checkbox"/> Thyroid problems
<input type="checkbox"/> Epilepsy	<input type="checkbox"/> TMD (jaw pain)
<input type="checkbox"/> Earaches	<input type="checkbox"/> Ulcer

10. Do you have other medical concerns or conditions not listed above?

Yes       No

If yes, please

list \_\_\_\_\_

11. Do you receive any treatments or take any medication for any medical issues?

Yes       No

If yes, please

list \_\_\_\_\_

12. Do you *currently* have a mental health problem that led you to obtain professional advice or help?

Yes       No

If yes:

a) Please list current mental health

problems \_\_\_\_\_

b) What treatment (e.g., medication, psychological treatment, counselling) have you taken for this mental health problem?

\_\_\_\_\_

13. What year of university are you currently enrolled? \_\_\_\_\_

14. What is your faculty? (Arts, Science, Kinesiology, etc.) \_\_\_\_\_

**Appendix Q**  
**Perceived Fitness Scale (PFS)**

HOW FIT WOULD YOU DESCRIBE YOURSELF? Please circle a single number below.

0 = No activity

1-3 = Occasional activity

4-6 = Casual Sports

7-9 = Competitive Recreational Sports

10 = Olympic calibre fitness level

0    1    2    3    4    5    6    7    8    9    10

**Appendix R**  
**Panic History Form (PHF)**

1. Have you ever experienced a sudden and intense surge of fear or anxiety (e.g., a panic attack) in a situation *for no apparent reason*?  
YES      NO
  
2. Have you ever experienced four or more panic attacks in the period of one month?  
YES      NO
  
3. Have you ever had a panic attack and subsequently worried about having another for 1 month or more?  
YES      NO
  
4. Have you ever seen a psychologist, psychiatrist, or other mental health professional for treatment of anxiety or panic?  
YES      NO

**Appendix S**  
**Borg Rate of Perceived Exertion (RPE) Scale**

6	No exertion at all
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

## **Appendix T**

### **Borg's RPE Scale Instructions**

While exercising we want you to rate your perception of exertion, i.e., how heavy and strenuous the exercise feels to you. The perception of exertion depends mainly on the strain and fatigue in your muscles and on your feeling of breathlessness or aches in the chest.

Look at this rating scale; we want you to use this scale from 6 to 20, where 6 means "no exertion at all" and 20 means "maximal exertion".

- 9 corresponds to "very light" exercise. For a normal, healthy, person it is like walking slowly at his or her own pace for some minutes
- 13 on the scale is "somewhat hard" exercise, but it still feels OK to continue
- 17 "very hard" is very strenuous. A healthy person can still go on, but he or she really has to push him- or herself. It feels very heavy, and the person is very tired.
- 19 on the scale is an extremely strenuous exercise level. For most people this is the most strenuous exercise they have ever experiences.

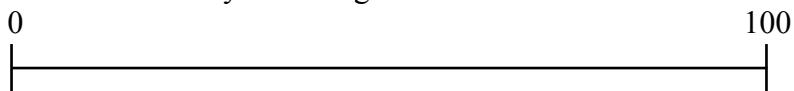
Try to appraise your feeling of exertion as honestly as possible, without thinking about what the actual physical load is. Don't underestimate it, but don't overestimate it either. It's your own feeling of effort and exertion that's important, not how it compares to other people's. What other people think is not important either. Look at the scale and the expressions and then give a number.

Any questions?

**Appendix U**  
**Visual Analogue Scales (VASs)**

**Instructions:** Please answer the following questions with how you are feeling AT THIS MOMENT. Place a **vertical mark** across the line at the point that best indicates how you feel.

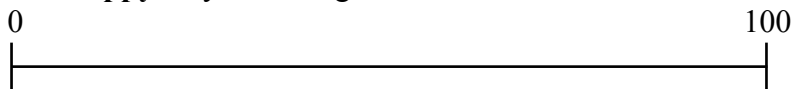
How **anxious** do you feel right now?



NOT AT ALL  
ANXIOUS

EXTREMELY  
ANXIOUS

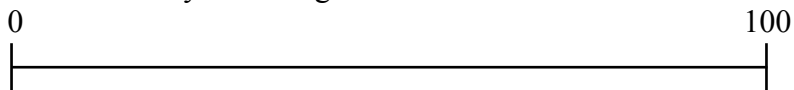
How **happy** do you feel right now?



NOT AT ALL  
HAPPY

EXTREMELY  
HAPPY

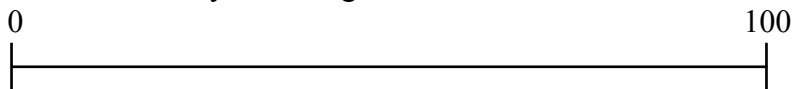
How **tired** do you feel right now?



NOT AT ALL  
TIRED

EXTREMELY  
TIRED

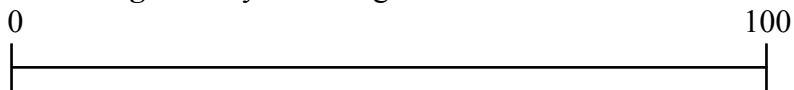
How **fearful** do you feel right now?



NOT AT ALL  
AFRAID

EXTREMELY  
AFRAID

How **energetic** do you feel right now?



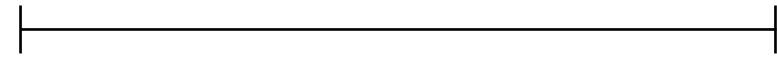
NOT AT ALL  
ENERGETIC

EXTREMELY  
ENERGETIC

How **sad** do you feel right now?

0

100



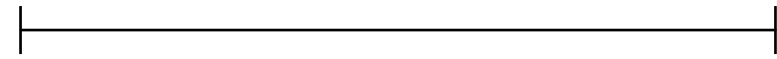
NOT AT ALL  
SAD

EXTREMELY  
SAD

How **tense** do you feel right now?

0

100



NOT AT ALL  
TENSE

EXTREMELY  
TENSE



**Appendix V**  
**Difficulties in Emotion Regulation Scale (DERS)**

Please indicate how often the following statements apply to you by writing the appropriate number from the scale below on the line beside each item.

1-----2-----3-----4-----5

almost never (0-10%)	sometimes (11-35%)	about half the time (36-65%)	most of the time (66-90%)	almost always (91-100%)
-------------------------	-----------------------	---------------------------------	------------------------------	----------------------------

- \_\_\_\_\_ 1) I am clear about my feelings.
- \_\_\_\_\_ 2) I pay attention to how I feel.
- \_\_\_\_\_ 3) I experience my emotions as overwhelming and out of control.
- \_\_\_\_\_ 4) I have no idea how I am feeling.
- \_\_\_\_\_ 5) I have difficulty making sense out of my feelings.
- \_\_\_\_\_ 6) I am attentive to my feelings.
- \_\_\_\_\_ 7) I know exactly how I am feeling.
- \_\_\_\_\_ 8) I care about what I am feeling.
- \_\_\_\_\_ 9) I am confused about how I feel.
- \_\_\_\_\_ 10) When I'm upset, I acknowledge my emotions.
- \_\_\_\_\_ 11) When I'm upset, I become angry with myself for feeling that way.
- \_\_\_\_\_ 12) When I'm upset, I become embarrassed for feeling that way.
- \_\_\_\_\_ 13) When I'm upset, I have difficulty getting work done.
- \_\_\_\_\_ 14) When I'm upset, I become out of control.
- \_\_\_\_\_ 15) When I'm upset, I believe that I will remain that way for a long time.
- \_\_\_\_\_ 16) When I'm upset, I believe that I will end up feeling very depressed.
- \_\_\_\_\_ 17) When I'm upset, I believe that my feelings are valid and important.
- \_\_\_\_\_ 18) When I'm upset, I have difficulty focusing on other things.
- \_\_\_\_\_ 19) When I'm upset, I feel out of control.
- \_\_\_\_\_ 20) When I'm upset, I can still get things done.
- \_\_\_\_\_ 21) When I'm upset, I feel ashamed at myself for feeling that way.
- \_\_\_\_\_ 22) When I'm upset, I know that I can find a way to eventually feel better.
- \_\_\_\_\_ 23) When I'm upset, I feel like I am weak.
- \_\_\_\_\_ 24) When I'm upset, I feel like I can remain in control of my behaviors.
- \_\_\_\_\_ 25) When I'm upset, I feel guilty for feeling that way.
- \_\_\_\_\_ 26) When I'm upset, I have difficulty concentrating.
- \_\_\_\_\_ 27) When I'm upset, I have difficulty controlling my behaviors.
- \_\_\_\_\_ 28) When I'm upset, I believe there is nothing I can do to make myself feel better.
- \_\_\_\_\_ 29) When I'm upset, I become irritated at myself for feeling that way.
- \_\_\_\_\_ 30) When I'm upset, I start to feel very bad about myself.
- \_\_\_\_\_ 31) When I'm upset, I believe that wallowing in it is all I can do.
- \_\_\_\_\_ 32) When I'm upset, I lose control over my behavior.
- \_\_\_\_\_ 33) When I'm upset, I have difficulty thinking about anything else.
- \_\_\_\_\_ 34) When I'm upset I take time to figure out what I'm really feeling.
- \_\_\_\_\_ 35) When I'm upset, it takes me a long time to feel better.
- \_\_\_\_\_ 36) When I'm upset, my emotions feel overwhelming.

## Appendix W Consent Form

**Title of Project:** The Psychology of Body Movement

**Principal Investigator:** Catherine Hilchey  
Department of Psychology, University of New Brunswick  
Email: [catherine.hilchey@unb.ca](mailto:catherine.hilchey@unb.ca)

**Faculty Supervisor:** Dr. David Clark  
Department of Psychology, University of New Brunswick  
Office Tel: 452-6225; Email: [clark@unb.ca](mailto:clark@unb.ca)

---

You have been invited to take part in a research study that investigates the relationship between psychological factors and the experience of body movement. Your participation will consist of completing questionnaires about your background, physical activity, mood, beliefs, and physical experiences. Then you will be asked to use a stationary bike for up to 20 minutes at moderate physical exertion. Following the bike task you will be asked to reflect on your experience.

This experiment will take about 60 minutes to complete. If you are an Introductory Psychology student you will receive 1 bonus mark for your participation. If you are not an Introductory Psychology student, you will receive \$10 to compensate for your participation. Please note that your participation is voluntary and you may withdraw at any time without penalty or loss of participation point. If you want to discontinue participation at any point you need only inform the investigator. You may decline to answer any question presented during the study. All the information you provide will be kept confidential and your name or student ID number will not appear on any research materials. Consent forms will be stored separately from the questionnaire and experimental data so your identity cannot be matched with your responses in the study. The raw data will be stored in a locked filing cabinet after completion of the study.

There are no major risks associated with this study. However, you may find the questions personal and some individuals may feel some anxiety in responding to them. In addition, while using the stationary bike you are likely to experience physical sensations that are expected but uncomfortable (e.g., sweating). You may decline to answer any question and/or participate in any aspect of the study. You will be given educational feedback that describes the purpose of the study upon study completion. This study has been reviewed by the Research Ethics Board of the University of New Brunswick (REB# 2015-055). You are free to contact Dr. David A. Clark (the principal investigator's supervisor; 459-8315 or [clark@unb.ca](mailto:clark@unb.ca)) if you have any questions or concerns about your participation in this study. You are also free to contact Dr. Carmen Poulin (Acting Chair of the Psychology Research Ethics Committee; 458-7800 or [carmen@unb.ca](mailto:carmen@unb.ca)).

If you are willing to participate in this study, please sign your name following the consent statement.

Thank you for your assistance in this research project.

*I agree to participate in a study conducted by Catherine Hilchey on the psychology of body movement. I have made this decision based on the information I have read in the Consent Form and have had all my questions about participating in this research study addressed by the investigator. I understand that I may withdraw this consent at any time by declaring this intention to the investigator. I realize that I will not incur any penalty or lose my participation point for withdrawing my consent. I also understand that this project has been reviewed by the Research Ethics Board at the University of New Brunswick and that I may contact this office ([ethics@unb.ca](mailto:ethics@unb.ca); 453-5189) if I have any concerns or questions about my involvement in the study.*

**If you are willing to participate in this study, please sign below.**

Participant's Name (please print): \_\_\_\_\_

Participant's Signature: \_\_\_\_\_

Date: \_\_\_\_\_

If you are interested in receiving information about the results of the research, please provide us with an email address where you can be contacted: \_\_\_\_\_

\_\_\_\_\_

## Appendix X Debriefing Form

### Psychological Factors and Exercise

This project was designed to study a personality trait called anxiety sensitivity. Individuals who have high levels of anxiety sensitivity tend to explain unwanted physical sensations, like a racing heartbeat, in the worst possible light. For example, individuals who have high anxiety sensitivity levels might think a racing heartbeat is an indicator they are going to have a heart attack, whereas people with low levels of anxiety sensitivity might attribute this sensation to being excited or nervous. Research has shown that individuals with high anxiety sensitivity levels are at greater risk for developing anxiety disorders, especially panic disorder. Therefore, research on anxiety sensitivity provides important information about how it may be related to the development of anxiety disorders as well as the possibility for prevention.

In this study we want to find out if individuals with high levels of anxiety sensitivity tend to explain information about physical sensations in a negative way. Specifically, do individuals with high anxiety sensitivity think more negatively and respond more fearfully in response to unexpected physical information? Our prediction is that individuals with high levels of anxiety sensitivity will have more negative thoughts and anxiety in response to physical information provided by the investigator. In addition, we want to look at how anxiety sensitivity relates to the ability to manage anxious emotions. We predict that individuals with high levels of anxiety sensitivity will have more difficulty managing anxious symptoms than individuals with low levels of anxiety sensitivity. If the predictions of the present study are supported, we will have a better understanding of how anxiety sensitivity makes individuals vulnerable to develop panic disorder. Such information will help inform treatment and prevention programs.

Psychological research of this kind requires the participation of a large number of individuals. Thus, your participation is extremely important and very much appreciated. If you are interested in the topic of this study, these are some recommended readings:

- Reiss, S. (1991). Expectancy model of fear, anxiety, and panic. *Clinical Psychology Review, 11*(2), 141-153.
- Vujanovic, A. A., Zvolensky, M. J., & Bernstein, A. (2008). The interactive effects of anxiety sensitivity and emotion dysregulation in predicting anxiety-related cognitive and affective symptoms. *Cognitive Therapy And Research, 32*(6), 803-817.
- Kashdan, T. B., Zvolensky, M. J., & McLeish, A. C. (2008). Anxiety sensitivity and affect regulatory strategies: Individual and interactive risk factors for anxiety-related symptoms. *Journal of Anxiety Disorders, 22*(3), 429-440.

If you have any questions or concerns about this research project, you may contact Catherine Hilchey ([catherine.hilchey@unb.ca](mailto:catherine.hilchey@unb.ca)) or Dr. David Clark at (506) 452-6225 or [clark@unb.ca](mailto:clark@unb.ca). For ethical concerns regarding your participation in this study you may contact the Chair of the Psychology Ethics Committee, Dr. Daniel Voyer at (506) 453-4974 or [voyer@unb.ca](mailto:voyer@unb.ca).

**Appendix Y**  
**Post-Debrief Consent Form**

**Title of Project:** The Psychology of Body Movement

**Principal Investigator:** Catherine Hilchey  
Department of Psychology, University of New Brunswick  
Email: [catherine.hilchey@unb.ca](mailto:catherine.hilchey@unb.ca)

**Faculty Supervisor:** Dr. David Clark  
Department of Psychology, University of New Brunswick  
Office Tel: 452-6225; Email: [clark@unb.ca](mailto:clark@unb.ca)

Thank you for your assistance in this research project. Due to the deception used in the present study, you now have the right to allow or refuse whether your data is used for this research project. Please indicate below whether you are willing to have your data used for this study.

*I agree that I have been informed of the deception used in the study conducted by Catherine Hilchey on the psychology of body movement. I was informed that deception of this kind is necessary in the present study to assess how individuals cope with unexpected and negative changes to their physical functioning. I have had all my questions about participating in this research study addressed by the investigator. I understand that I will not incur any penalty or lose my participation point for withdrawing my consent. I also understand that this project has been reviewed by the Research Ethics Board at the University of New Brunswick (REB# 2015-055) and that I may contact this office ([ethics@unb.ca](mailto:ethics@unb.ca); 453-5189) if I have any concerns or questions about my involvement in the study.*

\_\_\_ I give permission for my data to be used in the analysis for this experiment.

\_\_\_ I do NOT give my permission for my data to be used in the analysis for this experiment.

Participant's Name (please print): \_\_\_\_\_

Participant's Signature: \_\_\_\_\_

Date: \_\_\_\_\_

## Appendix Z

### Hypotheses Testing with the ASI-3 Physical Concerns Subscale

#### Hypothesis 1: Emotional Intensity

Hypothesis 1 predicts that heightened anxiety sensitivity physical concerns (AS-P) in the experimental group will be associated with a significant increase in anxiety, fear, and threatening cognitions at T2, whereas no change in anxiety, fear, or threatening cognitions is expected in the control group. General linear modelling (GLM) with categorical and continuous independent variables was used to test this hypothesis. Group (experimental, control) is a between-group factor, time (T1, T2) is a repeated measures factor, and AS-P (as measured by the ASI-3 physical concerns subscale score) is the continuous independent factor. The dependent variables are the VAS Fear score, VAS Anxiety score, and TCS total score. A significant Group x Time x AS-P interaction is predicted.

**Fear.** Hypothesis 1 was supported for fear because the Group x Time x AS-P interaction was significant,  $F(1,146)=6.52, p<.05, \eta_p^2=.04$ . Simple main effects showed a significant increase in fear from T1 to T2 for the experimental group,  $F(1,146)=38.55, p<.001, \eta_p^2=.21$ , but not the control group,  $F(1,146)=.03, p=.88, \eta_p^2=.00$ , suggesting the experimental manipulation was effective in inducing a fear response in participants. To disentangle the three-way interaction, the time factor was transformed into a T2-T1 difference score for the VAS Fear rating. With this difference score as a dependent variable, the ASI-3 physical concerns score was positively correlated with the change in VAS Fear in the experimental group ( $r=.32, p<.001$ ). This finding supports Hypothesis 1, indicating that heightened AS-P was associated with increased fear after false physiological feedback. In contrast, a negative correlation was found between the ASI-3

physical concerns score and the change in VAS Fear for the control group ( $r=-.19$ ,  $p=.36$ ; lack of significance due to low power). Heightened AS-P was associated with a reduction in fear in response to benign feedback. The only other significant findings were a Group x AS-P interaction,  $F(1, 146)=7.86$ ,  $p<.01$ ,  $\eta_p^2=.05$ , and a significant main effect of AS-P,  $F(1, 146)=6.28$ ,  $p<.05$ ,  $\eta_p^2=.04$ .

**Anxiety.** Hypothesis 1 was not supported for anxiety because the three-way interaction of Group x Time x AS-P was not significant,  $F(1, 146)=1.97$ ,  $p=.16$ ,  $\eta_p^2=.01$ . There was a significant main effect of AS-P,  $F(1, 146)=12.00$ ,  $p<.01$ ,  $\eta_p^2=.08$ . Pearson correlations revealed a significant correlation between the ASI-3 physical concerns subscale score and VAS Anxiety at T1 ( $r=.41$ ,  $p<.001$ ) and T2 ( $r=.20$ ,  $p<.05$ ) for the total sample. There was also a significant AS-P x Time interaction,  $F(1, 146)=3.93$ ,  $p<.05$ ,  $\eta_p^2=.03$ . Although the correlation between ASI-3 physical concerns and anxiety was stronger at T1 than T2, the correlation between ASI-3 physical concerns score and VAS Anxiety difference score (T2-T1) was not statistically significant ( $r=-.12$ ,  $p=.13$ ).

**Threatening cognitions.** Hypothesis 1 was not supported for threatening cognitions because the predicted Group x Time x AS-P interaction was not significant,  $F(1, 147)<1$ ,  $p=.61$ ,  $\eta_p^2=.00$ . There was a significant main effect of time,  $F(1, 147)=16.14$ ,  $p<.001$ ,  $\eta_p^2=.10$ , showing that participants reported an increase in threatening cognitions from T1 to T2, regardless of group. In addition, there was a significant main effect of AS-P,  $F(1, 147)=17.23$ ,  $p<.001$ ,  $\eta_p^2=.12$ . The ASI-3 physical concerns subscale score and the TCS total score were significantly correlated at both T1 ( $r=.36$ ,  $p<.001$ ) and T2 ( $r=.39$ ,  $p<.001$ ), suggesting that individuals with high AS-P levels tended to endorse more threatening cognitions for their current physical sensations. All other effects were non-significant.

**Hypothesis 1 summary.** Overall, the pattern of results using the ASI-3 physical concerns subscale score was consistent with findings using the ASI-3 total score. Hypothesis 1 was partially supported. As predicted, a greater increase in fear was observed across time in the experimental group (false physiological feedback) than the control group (benign feedback). In contrast, group assignment did not influence self-reported anxiety or threatening cognitions, indicating that the experimental manipulation was effective for fear responses only. As predicted, heightened AS-P was associated with fearful responding in the experimental group. AS-P significantly predicted fear, anxiety, and threatening cognitions regardless of time or group.

### **Hypothesis 2: Emotion Regulation**

Hypothesis 2 predicts that heightened anxiety sensitivity physical concerns (AS-P) will be associated with a significant increase in anxiety, fear, and threatening cognitions in the catastrophizing condition, whereas low AS-P will be associated with a significant decrease in anxiety, fear, and threatening cognitions in the cognitive reappraisal condition. GLM with categorical and continuous independent variables was used to test this hypothesis. Emotion regulation condition (catastrophizing vs. cognitive reappraisal) is a between-group independent factor, time (T2, T3) is a repeated measures factor, and AS-P (as measured by the ASI-3 physical concerns subscale score) is the continuous independent factor. The dependent variables are VAS Fear score, VAS Anxiety score, and TCS total score. A significant Condition x Time x AS-P interaction was predicted.

**Fear.** Hypothesis 2 was not supported for fear because the Condition x Time x AS-P interaction was not significant,  $F(1, 121) < 1, p = .33, \eta_p^2 = .01$ . The only significant finding was a main effect of AS-P,  $F(1, 121) = 26.90, p < .001, \eta_p^2 = .18$ . Correlations



revealed that the ASI-3 physical concerns subscale score was significantly and positively correlated with VAS Fear both at T2 ( $r=.43, p<.001$ ) and T3 ( $r=.36, p<.001$ ).

**Anxiety.** Hypothesis 2 was not supported for anxiety, because the Condition x Time x AS-P interaction was not significant,  $F(1, 121)<1, p=.71, \eta_p^2=.00$ . There was a main effect of time,  $F(1, 121)=10.73, p<.01, \eta_p^2=.08$ , with anxiety scores decreasing from T2 to T3. There was also a significant main effect of AS-P,  $F(1, 121)=19.54, p<.001, \eta_p^2=.14$ ; the ASI-3 physical concerns subscale score was significantly and positively correlated with anxiety at both T2 ( $r=.26, p<.01$ ) and T3 ( $r=.42, p<.001$ ). The AS x Time interaction was significant,  $F(1, 121)=5.34, p<.05, \eta_p^2=.04$ . Further examination of this significant two-way interaction revealed a significant but small correlation between the ASI-3 physical concerns score and the VAS Anxiety difference score (T3-T2),  $r=.20, p<.05$ . These results suggest that overall, heightened AS-P was significantly correlated with an increase in anxiety from T2 to T3.

**Threatening cognitions.** The Condition x Time x AS-P interaction was again not significant,  $F(1, 122)=1.25, p=.27, \eta_p^2=.01$ ; Hypothesis 2 was not supported for threatening cognitions. There was a main effect of time,  $F(1, 122)=29.52, p<.001, \eta_p^2=.20$ , with threatening cognitions higher at T2 than T3 for the entire sample. There was also a main effect of AS-P,  $F(1, 122)=36.94, p<.001, \eta_p^2=.23$ . The ASI-3 physical concerns subscale score was significantly and positively correlated with the TCS total score at both T2 ( $r=.43, p<.001$ ) and T3 ( $r=.47, p<.001$ ). All other effects were non-significant.

**Hypothesis 2 summary.** Hypothesis 2 was not supported in any of the analyses. These results are consistent with findings using the ASI-3 total score. Cognitive reappraisal and catastrophizing had no effect on subjective VAS Fear or Anxiety scores,

or endorsement of threatening cognitions on the TCS. However, AS physical concerns was robust in showing a positive correlation with fear, anxiety, and threatening cognitions, which is consistent with the fear amplification interpretation of anxiety sensitivity.

## CURRICULUM VITAE

Catherine A. Fraser (née Hilchey)

### Universities Attended

- 2010-2018                      Ph.D., Clinical Psychology, University of New Brunswick
- 2006-2010                      B.Sc. (Honours), Psychology, Dalhousie University

### Publications

- Clark, D. A., & Hilchey, C. A. (2017). Repugnant obsessions: Phenomenology, etiology, and treatment. In J. S. Abramowitz, D. McKay, & E. S. Storch (Eds.), *The Wiley handbook of obsessive-compulsive disorders, volume 1*. (pp. 421-440). New York: Wiley-Blackwell.
- Clark, D. A., & Hilchey, C. A. (2014). Depressive personality disorder. In A. T. Beck, D. D. Davis, & A. Freeman (Eds.), *Cognitive therapy of personality disorders* (3<sup>rd</sup> ed.) (pp. 223-243). New York: Guilford Press.
- Hilchey, C. A., & Clark, D. A. (2014). Context in anxiety sensitivity: The role of expectancy, catastrophic misinterpretations and diminished reappraisal in response to hypothetical physical arousal scenarios. *Cognitive Therapy and Research*, 38, 343-348.
- Sabourin, B. C., Hilchey, C. A., Lefaiivre, M-J., Watt, M. C., & Stewart, S. H. (2011). Why do they exercise less? Barriers to exercise in high anxiety sensitive women. *Cognitive Behaviour Therapy*, 40, 206-215.
- Price, S. R., Hilchey, C. A., Darredeau, C., Fulton, H. G., & Barrett, S. P. (2010). Energy drink co-administration is associated with increased reported alcohol ingestion. *Drug and Alcohol Review*, 29, 331-333.

### Conference Presentations

- Hilchey, C. A., Watt, M. C., & Gallagher, C. E. (2015, June). *Self-reported fears: Relation to prevalence of DSM-5 phobia and anxiety sensitivity*. Poster presentation at the Canadian Psychological Association's Annual Convention, Ottawa, ON.
- Hilchey, C. A., & Clark, D. A. (2013, November). *High anxiety sensitivity: The role of expectedness in catastrophic misinterpretations of physical sensations*. Poster presentation at the Annual Meeting of the Association for Behavioral and Cognitive Therapies, Nashville, TN.

- Hilchey, C. A., & Clark, D. A. (2012, June). *Anxiety sensitivity and the emotional processing of fear: Does expectedness matter?* Poster presentation at the Canadian Psychological Association's Annual Convention, Halifax, NS.
- Hilchey, C. A., Clark, D. A., & del Palacio-González, A. (2011, November). *Anxiety sensitivity and unwanted intrusive thoughts*. Poster presentation at the New Brunswick Health Research Foundation's 3<sup>rd</sup> Annual Health Research Conference, Moncton, NB.
- Inozu, M., del Palacio-González, A., Hilchey, C. A., & Clark, D. A. (2011, May). *International Intrusive Thoughts Interview Schedule (IITIS) in Turkish and Canadian Samples*. Research Consortium on Intrusive Fear, International Research Meeting, Cordoba, Spain.
- Sabourin, B. C., Hilchey, C. A., Lefavre, M. J., Watt, M. C., & Stewart, S. H. (2010, November). *They know it's good for them, so why won't they exercise? Internal barriers as a mediator of exercise avoidance in high anxiety sensitive women*. In A. C. McLeish (Chair), *The role of anxiety sensitivity and chronic health conditions*. Symposium presented at the Annual Meeting of the Association for Behavioral and Cognitive Therapies, San Francisco, CA.
- Hilchey, C. A., Sabourin, B. C., Lefavre, M. J., Stewart, S. H., & Watt, M. C. (2010, August). *Perceived exercise barriers as a mediator of exercise avoidance in high anxiety sensitive women*. Poster presentation at the Rising Stars of Research Poster Competition, University of British Columbia, Vancouver, BC.