AN INVESTIGATION OF THE EFFICACY AND COGNITIVE MECHANISMS OF TWO BRIEF INTERVENTIONS FOR ANXIETY SENSITIVITY

by

Emma M. MacDonald

Master of Arts, Ryerson University, 2011

Bachelor of Science, First Class Honours, St. Francis Xavier University, 2009

A dissertation

presented to Ryerson University

in partial fulfillment of the

requirements for the degree of

Doctor of Philosophy

in the Program of

Psychology

Toronto, Ontario, Canada, 2016

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Abstract

An Investigation of the Efficacy and Cognitive Mechanisms of Two Brief Interventions for Anxiety Sensitivity

Doctor of Philosophy, 2016

Emma M. MacDonald

Psychology, Ryerson University

Anxiety Sensitivity (AS) is the fear of normal, arousal-related bodily sensations due to the belief that they have negative consequences. AS is a transdiagnostic construct, and high AS is associated with psychopathology, including panic disorder, social anxiety disorder, generalized anxiety disorder, depression, and alcohol-use disorders. There is research and clinical interest in developing brief and transdiagnostic interventions to streamline treatment. Targeting AS through brief interventions may be one way to accomplish this goal. Therefore, the purpose of this dissertation was to advance the literature on AS by examining the efficacy and transdiagnosticity of two brief interventions for AS. Cognitive mediators of change in AS were also examined. Target variables were psychopathology symptoms and cognitive processes, including interpretation biases, attentional biases, and perceived control. Study 1 investigated the immediate and short-term efficacy of a brief intervention that included a single session of psychoeducation and daily interoceptive exposure practices. Participants with high AS were randomly assigned to the intervention (n = 19) or health education control condition (n = 16). Participants in the intervention condition appeared to demonstrate reductions in AS, one facet of interpretation bias, social anxiety symptoms, and motivation to consume alcohol. Methodological issues, however, limited conclusions about the efficacy of the intervention. Finally, the three potential cognitive mediators did not mediate change in AS. Study 2

investigated the efficacy of a computerized cognitive bias modification (CBM) program. Participants with high AS were randomly assigned to 4 sessions of CBM (*n*= 24) or 4 sessions of sham training (*n*= 24). Sessions occurred over a 2-week period. At the end of the intervention period, the CBM condition appeared to show reductions in AS, interpretive biases, and almost all facets of psychopathology. However, similar changes were found in the control condition. Again, the three potential cognitive mediators did not mediate change in AS. Taken together, these findings provide limited support for the efficacy of psychoeducation and CBM as brief, transdiagnostic interventions. However, both studies must be interpreted in light of major limitations, which include limited homework completion in Study 1 and a control training task that induced training effects in Study 2.

Acknowledgements

First, I would like to thank my mentor Dr. Naomi Koerner. I cannot fully express my appreciation for your constant guidance and support. Thank you for always believing in me and pushing me to be a better scientist, researcher and writer. I am grateful for having had the opportunity to work with, and learn from, you over the past seven years.

Thank you also to my supervisory committee, Dr. Marty Antony and Dr. Kristin Vickers. I appreciated your support, insight and feedback throughout this process. Thank you for your commitment to helping me grow as a researcher. Thank you to Dr. Janice Kuo for all of your assistance with my analyses. Also, thank you to Dr. Patrizia Albanese and Dr. Nick Carleton for being a part of my examining committee and participating in my defense.

Thank you to my labmates. It was a pleasure going to the lab everyday because I was working alongside amazing, brilliant, supportive people. A special thank you to Tessie Mastorakos, as I could not have completed this project without you. Thank you for being my right-hand woman! You are a superb researcher, and I know that you are going to do amazing things in the future. Also, thank you to Kathleen Tallon, Melina Ovanessian and Elvira Prusaczyk. I am so grateful for your willingness to help with data collection. I cannot express how much of a relief it was to leave my project in such capable hands. Thank you for commitment to seeing this project through.

Thank you to my cohort, whom I now call my friends. We've been through so much together, and our friendships have never wavered. Thank you for being such an important and positive part of my life. I am grateful for the memories that we have made and cannot wait to make more in the future.

Thank you to my co-interns at Montefiore Medical Center. You kept me going during the tough times this past year, and your encouragement, friendship, and Thursday treats were greatly appreciated.

A very special thank you to my family. This has been a long journey, and it would not have been possible without your love, understanding, encouragement and patience.

Thank you to everyone who contributed to my dissertation research in some way, from Dr. Meghan Keough, who provided study materials, to Jennifer Khoury and Erin Strauts, who each consulted with me regarding statistical analyses, and everyone else in between. I am grateful for your assistance and support that allowed me to successfully complete these studies.

Finally, thank you to the Ontario Graduate Scholarship Program and the Social Sciences and Humanities Research Council for financial support during graduate school, and to Ryerson University for financial support for this dissertation.

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Chapter 1: General Introduction

Anxiety sensitivity (AS) reflects beliefs about the negative physical, social or cognitive consequences of arousal-related physical sensations (Reiss & McNally, 1985). Individuals with high levels of AS catastrophize when experiencing benign physiological sensations, such as increased heart rate, sweating or trembling, due to their inaccurate beliefs about the ramifications of these sensations. AS is considered a stable, trait-like set of beliefs (McNally, 1994). AS was introduced as part of the expectancy theory, a theory proposed to account for one's motivation to avoid feared stimuli (Reiss, 1991; Reiss & McNally, 1985). According to this theory, motivation to avoid a feared stimulus is determined by the relationship between expectancies and sensitivities. An *expectancy* is what one believes will happen when one encounters the feared stimulus, and a *sensitivity* is the reason that one is fearful of the stimulus (i.e., the consequences of encountering the feared stimulus; Reiss & McNally, 1985). There are three types of expectancies (i.e., social disaster expectancy, illness/injury expectancy, anxiety expectancy), and each has a corresponding sensitivity (i.e., criticism sensitivity, illness/injury sensitivity, anxiety sensitivity). The relationship between a set of expectancies and sensitivities is interactive (Reiss, 1991). For example, in the case of anxiety, one's belief that one will become anxious in social situations interacts with one's fear of the consequences of changes in physical sensations to predict motivation to avoid social situations. As part of the expectancy theory, AS beliefs are integral to the level of fear of, and avoidance of, a stimulus.

AS and Psychopathology. According to current conceptualizations, AS is a transdiagnostic construct and is related to varied psychopathology. Early research on AS, however, did not adopt a transdiagnostic perspective and was conducted almost exclusively in the context of panic disorder. AS is a known cognitive vulnerability factor for panic, as high AS

is associated with increased risk of developing panic symptoms and panic disorder (McNally, 2002; Schmidt, Zvolensky & Maner, 2006). Conceptualizations have since shifted, and AS is now considered transdiagnostic. People with social anxiety disorder (SAD; e.g., Weeks et al., 2005), generalized anxiety disorder (GAD; e.g., Carleton, Abrams, Asmundson, Antony, & McCabe, 2009), obsessive-compulsive disorder (OCD; e.g., Calamari, Rector, Woodard, Cohen, & Chik, 2008), posttraumatic stress disorder (PTSD; e.g., Taylor, Koch, & McNally, 1992), depression (e.g., Simon et al., 2005), bipolar disorder (e.g., Simon et al., 2005), and alcohol-use disorders (e.g., Gillihan, Farris, & Foa, 2011) have also demonstrated elevations in AS compared to the published norms of nonclinical samples (Peterson & Reiss, 1992). AS elevations are relatively comparable across disorders, as assessed via the *Anxiety Sensitivity Index* (ASI; Reiss, Peterson, Gursky & McNally, 1986), with the notable exception of panic disorder, which is associated with higher AS than other types of psychopathology (e.g., Taylor et al., 1992). Mean AS levels in the aforementioned disorders range from 25.10 to 35.33 (*SD*= 12.80 to 14.60; Calamari et al., 2008; Carleton et al., 2009; Simon et al., 2005; Taylor et al., 1992; Weeks et al., 2005), with the exception of alcohol-use disorders (*M*=21.40, *SD*= 15.70; Gillihan et al., 2011). Although this is lower than the ASI scores associated with other disorders, it is, nonetheless, elevated compared to a nonclinical sample (Gillihan et al., 2011). Therefore, high AS is a transdiagnostic factor.

Brief Interventions to Reduce AS. Given the relationship between AS and psychopathology, it is not surprising that interventions to reduce AS have been of interest in the treatment literature. Research has examined how AS levels change in response to interventions for specific disorders (e.g., treatment for panic disorder) and interventions that target AS. These treatments are based on the principles of cognitive behavioural therapy (CBT). CBT is generally

effective at reducing AS. Smits and colleagues (2008) conducted a meta-analysis to examine AS reductions in response to CBT for panic disorder, claustrophobia, social anxiety and tinnitus. The researchers also examined the effects of CBT for AS in people who are at risk of developing psychopathology by virtue of having high AS. They reported that CBT for a specific problem (i.e., panic disorder, claustrophobia, etc.) resulted in large AS reductions from baseline (Hedges' g= 1.40), whereas CBT for AS resulted in moderate-to-large AS reductions from baseline (Hedges' g= 0.74; Smits, Berry, Tart, & Powers, 2008). The results of this meta-analysis suggest that, although AS is associated with stable beliefs, high AS can be modified through CBT interventions.

In light of the solid empirical support for CBT, research interests have shifted to refining and streamlining treatment practices. In particular, there is interest in developing brief treatments that have similar efficacy and effectiveness as longer term CBT. Brief treatments have several advantages over full-length CBT (which can range from 10 to 20 1-hour sessions; Beck, 2011). Brief treatments may be more feasible to implement in community settings where factors like therapist availability and client commitment may influence decisions to begin or terminate treatment. More specifically, therapists who use brief treatments may be able to treat *more* clients, which could reduce waitlists, especially for government-funded clinics (Crawley et al., 2013). Furthermore, brief treatments may be more appealing to clients because of reduced burden, as fewer treatment sessions may involve less time, less effort, and lower financial cost (e.g., private treatment costs, transportation, time off work, child care; Otto et al., 2012). Taken together, developing brief treatments could be beneficial for both clients and clinicians.

In addition to developing brief treatments, researchers are also interested in developing transdiagnostic treatments. A transdiagnostic treatment applies the same treatment approach to a

variety of psychological disorders (McEvoy, Nathan, & Norton, 2009). This type of treatment is of particular relevance for people with comorbid diagnoses, as symptoms are treated concurrently instead of consecutively, which is the case with disorder-specific treatments. Because high AS is associated with varied psychopathology, brief treatments for high AS indirectly target multiple sets of symptoms through a single treatment protocol. Therefore, brief interventions for high AS may also be transdiagnostic.

Mechanisms of Interventions to Reduce AS. Understanding treatment mechanisms is an important part of psychotherapy research for several reasons (Kazdin, 2007). First and foremost, mediator research can be used to optimize existing treatments. By understanding the elements of a treatment that contribute to clinical change, treatments can be refined and improved upon. Second, information on mediators is crucial to translating research findings into clinical practice (Kazdin, 2007). Treatments that are effective in randomized controlled trials are not always efficacious when administered in clinical settings, and understanding the pathways through which change occurs is important to the successful implementation of psychological treatments in real-world settings. Finally, elucidating treatment mediators is the first step to identifying treatment *moderators*. Comprehensive understanding of treatment mediators can generate testable hypotheses about moderators, which can help determine client suitability for specific treatments and influence the overall effectiveness of treatments (Kazdin, 2007).

Knowledge of factors that mediate the effects of brief, transdiagnostic treatments is particularly important. By design, these interventions aim to maximize treatment effects with the least amount of intervention possible. Therefore, knowledge about mediators could be applied to increase the efficacy of these treatments. AS is a known cognitive mediator of the effect of psychological treatments on psychopathology symptoms, including panic symptoms, excessive

worry, depression and suicidality (Norr, Allan, Macatee, Keough, & Schmidt, 2014; Olthuis, Watt, Mackinnon, Stewart, 2014; Schmidt, Capron, Raines, & Allan, 2014; Smits, Powers, Cho, & Telch, 2004). Therefore, AS is a treatment target in psychological interventions for several disorders. However, there is no known research on the pathways through which brief interventions for AS reduce AS. This is an important area of research, as understanding exactly how interventions for AS target AS could lead to the refinement of existing treatments, or the development of more efficacious treatments, for AS.

The Present Dissertation. The present dissertation sought to advance the literature on brief, transdiagnostic treatments for AS by examining the efficacy and transdiagnosticity of two brief interventions for AS. This was accomplished through two studies that investigated two different interventions: psychoeducation for high AS and cognitive bias modification for high AS, respectively. Each study investigated the *short-term* efficacy of the intervention for reducing AS and symptoms of disorders associated with elevated AS. Moreover, each study also set out to elucidate the cognitive mediators of change in AS in response to the intervention. Specifically, negative interpretive bias, perceived control and attentional biases were tested as mediators of the relationship between treatment and change in AS. Study 1 (Chapter 2) examined the effects of a brief intervention that included a single session of psychoeducation and daily interoceptive exposure practices for one month. Study 2 (Chapter 3) investigated the efficacy of a four session computerized cognitive bias modification (CBM) intervention. These studies are discussed in detail in the forthcoming chapters. Finally, a general discussion (Chapter 4) integrates the findings of the present studies and discusses future directions for the field of brief, transdiagnostic treatments.

Chapter 2: An Investigation of the Immediate and Short-term Efficacy and Cognitive Mechanisms of a Brief Psychoeducation Intervention for High Anxiety Sensitivity

Introduction

Anxiety sensitivity (AS) is described as a set of beliefs about the negative consequences of arousal-related physical sensations (Reiss & McNally, 1985). Individuals high in AS catastrophize when experiencing benign physiological sensations, such as racing heart or trembling, because they believe that these sensations will have negative social, physical or cognitive consequences. AS is a stable, trait-like set of beliefs (McNally, 1994), and is a known cognitive risk factor for panic disorder (e.g., McNally, 1994). Although it was first conceptualized as a panic-specific factor, AS is now considered transdiagnostic. Elevated AS has been reported in individuals with anxiety, mood, and alcohol-use disorders (e.g., Carleton et al., 2009, Gillihan et al., 2011; Simon et al., 2005; Weeks et al., 2005). With regards to alcohol-use, high AS is specifically associated with higher motivation to consume alcohol and more problems as a result of alcohol-use (Chavarria et al., 2015; Howell, Leyro, Hogan, Buckner, & Zvolensky, 2010).

The transdiagnosticity of AS makes it particularly interesting as a treatment target. Research efforts have focused on developing interventions that specifically target AS, with the goal of reducing symptoms of disorders associated with high AS (e.g., Olthuis, 2013). Treatment research is investigating transdiagnostic interventions as a way of streamlining treatments, as these types of treatments target symptoms of multiple disorders through a single intervention (see McManus, Shafran & Cooper, 2010 for a review). Relatedly, efforts to streamline treatments have also focused on developing brief treatments, which have several advantages over full-length psychological treatments, including reduced time commitment on the part of both clients and

therapists. With shorter treatments, clients may be more likely to commit to and complete treatment, and clinicians may be able to see more clients, thereby reducing waitlists and increasing overall access to treatment (Crawley et al., 2013; Otto et al., 2012).

Psychoeducation

Psychoeducation is one intervention that has been examined as a treatment for AS. This involves the provision of accurate information about the nature of psychopathology symptoms and discussion of how empirically-supported treatments modify those symptoms (Dannon, Iancu, & Grunhaus, 2002). Psychoeducation can include information about theoretical models of psychopathology, including the role of maladaptive beliefs, behaviours, physical sensations, and the environment in the development and maintenance of psychopathology symptoms (Beck, 2011).

In isolation, psychoeducation interventions designed to target mood and anxiety symptoms is effective at alleviating those types of symptoms. Meta-analytic results suggest that psychoeducation (versus attention control or waitlist control conditions) consistently results in significant reductions in depressive symptoms. Although the pooled between-group effects of psychoeducation are small (Cohen's d= 0.20), the magnitude of the clinical change in individual interventions varies from small (between-group Cohen's d=0.07) to moderate (between-group Cohen's d= 0.61; Donker, Griffiths, Cuijpers, & Christensen, 2009). Psychoeducation is also effective at reducing anxiety symptoms. Dannon et al. (2002) found that participants with panic disorder who received psychoeducation reported significantly lower levels of anxiety and panic symptoms compared to participants in a waitlist condition 3 weeks after treatment. The magnitude of this effect, however, is not known because effect sizes and information required to compute effect sizes were not reported (Dannon, et al. 2002). Furthermore, psychoeducation has

also been used to correct maladaptive beliefs about the causes of fatigue. Harris and Carney (2012) randomly assigned undergraduate students to one of two groups. The first group received information about causes of fatigue (e.g., physical inactivity, changes in body temperature, boredom). The second group received sleep information unrelated to fatigue (e.g., descriptions of sleep stages). Immediately after the 1-hour intervention, participants in the fatigue information group reported fewer sleep-related attributions for their own fatigue compared to participants in the sleep information group (between-group Cohen's d= 0.24; Harris & Carney, 2012). Taken together, psychoeducation is effective at changing symptoms of and beliefs associated with psychological disorders.

Psychoeducation in CBT for AS

Psychoeducation is also a component of CBT for AS. Abplanalp (2001) developed a brief CBT intervention for AS based on a validated treatment for panic disorder (Telch et al., 1993) that included psychoeducation, breathing retraining and interoceptive exposure. Breathing retraining involves teaching diaphragmatic breathing to reduce panic-like symptoms associated with hyperventilation, while interoceptive exposures are repeated exposures to physical sensations that mimic those experienced during a panic attack (Craske, Rowe, Lewin, & Noriega-Dimitri, 1997). The treatment was composed of three 50-minute sessions, the first of which included psychoeducation. The psychoeducation component consisted of information about AS, the biological effects of anxiety, and a CBT model of panic. The CBT intervention was compared to a control intervention that consisted of information about ethical issues in psychology and was designed to account for the nonspecific effects of therapy, such as amount of time spent interacting with the therapist (Abplanalp, 2001). Participants were undergraduate students enrolled in an introductory psychology course who scored one standard deviation above

the mean score on the *Anxiety Sensitivity Index* (ASI; Reiss, et al., 1986) and were not assessed for psychological disorders. Immediately following treatment there were small to moderate between group differences in AS, as participants in the CBT group reported significantly lower AS (between-group Cohen's $d = 0.37$). Furthermore, participants in the CBT group continued to report significantly lower levels of AS compared to those in the control group 1 year after treatment (between-group Cohen's $d = 0.47$; Abplanalp, 2001), which supports the long-term efficacy of a brief CBT for AS that includes a psychoeducation component.

Gardenswartz and Craske (2001) developed their own CBT intervention for AS that was delivered in groups via a single 5-hour workshop. Participants were assigned to either a treatment condition or a waitlist control condition. In addition to psychoeducation about the etiology of panic and agoraphobia, the treatment included cognitive restructuring and interoceptive exposures. Homework assignments were encouraged as part of the treatment, but homework completion was not assessed. Participants were undergraduate students, graduate students, and community members who scored at least 16 on the ASI (Reiss et al., 1986), which is indicative of low to moderate AS, and had experienced at least one unexpected panic attack in the past year. Although participants in both conditions reported reductions in AS, the magnitude of the AS reductions in the treatment condition (within-group Cohen's $d = 0.78$) were significantly larger than the reduction observed in the waitlist condition (within-group Cohen's $d = 0.49$; Gardenswartz & Craske, 2001). Furthermore, participants in the treatment condition reported lower AS 6 months after treatment (between-group Cohen's $d = 0.33$) compared to those in the waitlist condition (Gardenswartz & Craske, 2001), which provides further support for CBT for high AS.

Olthuis (2013) tested the efficacy of CBT for AS delivered exclusively on the telephone.

The intervention was adapted from a three-session group treatment that led to reductions in AS, pain-related anxiety and motivation to drink alcohol (Watt, Stewart, Birch, & Bernier, 2006; Watt, Stewart, Lefaivre, & Uman, 2006). The telephone treatment was eight sessions and included psychoeducation, and descriptions of cognitive restructuring and interoceptive exposure, which were completed for homework between sessions. Homework compliance was not assessed. The psychoeducation component covered information about AS, the cycle of anxiety, and the relationship between AS and mental health. Participants were recruited from the community on the basis of having high AS (i.e., scored at least 23 on the *Anxiety Sensitivity Index-3* [ASI-3]; Taylor et al., 2007). Compared to participants in the waitlist control condition, those who received CBT reported lower levels of AS immediately following treatment (between-group Cohen's d= 0.57) and at the follow-up assessment 4 weeks later (between-group Cohen's d= 0.29; Olthuis, 2013). When considered with the results of Abplanalp (2001) and Gardenswartz and Craske (2001), AS-targeted CBT that includes a psychoeducation component is efficacious at reducing AS.

Psychoeducation for AS

None of the aforementioned studies examined the *isolated* effects of psychoeducation for AS on AS levels and psychopathology symptoms. This is of particular interest, as psychoeducation for AS has the potential to be a brief intervention when delivered alone. Moreover, given that elevated AS is associated with anxiety, mood, and substance-use disorders, brief treatments for high AS may target symptoms of multiple disorders through a single intervention. Taken together, psychoeducation for high AS has the potential to be a brief, transdiagnostic intervention.

Several researchers have conducted psychoeducation intervention studies in high AS

samples to isolate the therapeutic effects of psychoeducation for AS. Maltby (2001) investigated the efficacy of psychoeducation for AS in a sample of undergraduate students who scored at least 22 on ASI (Reiss et al., 1986) and who had experienced at least one unexpected panic attack in the past year. Participants were randomly assigned to one of three conditions. In the exposure condition, participants were instructed on how to carry out interoceptive exposures, practiced this with the experimenter and were asked to complete the exposures for homework. In the education condition, the experimenter delivered psychoeducation and distributed a handout for participants to read for homework. The exposure and psychoeducation interventions were each delivered in a single, 15-minute session. The third condition was a waitlist control condition. Participants in all three groups reported large reductions in AS at all assessment points compared to their baseline AS scores (exposure, within-group Cohen's *d*= 1.17 to 1.71; psychoeducation, within-group Cohen's *d*= 1.23 to 1.64; waitlist, within-group Cohen's *d*= .81 to 1.65). Whereas 10% of the exposure participants and 23% of the waitlist participants endorsed symptoms meeting criteria for panic disorder at 1-year follow-up, the same could be said for only 5% of the psychoeducation participants (Maltby, 2001). Homework compliance was assessed over the 2 weeks following the initial appointment and was based on the number of exposures completed (in the exposure condition) or pages read (in the education condition). Participants in the exposure condition completed a mean of 7.3 interoceptive exposures, and practiced exposures for a mean of 4.9 days. Participants in the education condition read an average of 9.7 pages of their 14-page manual, and read from the manual on 2.3 days. There were no significant between-group differences in the amount of homework completed. Although it appears that all participants reported reductions in AS, psychoeducation was associated with the lowest incidence of panic disorder (Maltby, 2001), and this research demonstrates the short- and long-

term efficacy of psychoeducation for AS.

Schmidt and colleagues (2007) also investigated the effects of psychoeducation on AS and psychopathology symptoms. Participants were recruited from public schools, universities and an urban community on the basis of having high AS (i.e., scored at least 1.5 standard deviations above the mean of a nonclinical community sample [Schmidt & Joiner, 2002] on the ASI; Reiss et al., 1986). Participants were randomly assigned to one of two conditions. The psychoeducation condition was called *Anxiety Sensitivity Amelioration Training* (ASAT) and was delivered in a single session via an experimenter-led, 30-minute audiovisual computer presentation that contained information about anxiety symptoms and their effects. Participants then had a 10-minute discussion with the experimenter. Participants learned about interoceptive exposures during the presentation and were encouraged to practice them at home, although homework completion was neither monitored nor reported. Participants in the control condition received general health and nutrition information, also via audiovisual computer presentation, and discussed the information with the experimenter. Participants received readings related to the presentation material and were encouraged to read it after the session, although compliance was not assessed at subsequent sessions. Immediately following treatment, participants in the ASAT condition displayed significantly lower levels of AS compared to those in the control condition, and this difference was of a medium magnitude (between-group partial $\varepsilon^2 = 0.05$[1]). Although the ASAT group continued to report lower levels of AS compared to the control group at 1- and 2-year follow-up, these differences were of a small magnitude (between-group Cohen's $d = 0.10$ and 0.24, respectively) and were not significant. The effects of ASAT appeared to generalize beyond AS. When assessed at 2 years posttreatment, the incidence of DSM-IV Axis I diagnoses was significantly lower in the ASAT group compared to the control group, which suggests that

[1] Partial ε^2 is an unbiased effect size similar to partial η^2 (Jaccard, 1998).

ASAT was associated with decreased risk of developing psychopathology (Schmidt et al., 2007).

Following from the work of Schmidt et al. (2007), Keough and Schmidt (2012) refined the ASAT treatment through the addition of interoceptive exposures, which were added to the treatment for several reasons. First, interoceptive exposures are hypothesized to be an integral component of AS treatment (Keough & Schmidt, 2012), and are included in many full-length CBT treatments for AS (e.g., Olthuis, 2013). Interoceptive exposures, however, had not yet been systematically examined in an investigation of psychoeducation for AS. Maltby (2001) included this type of exposure as part of the exposure treatment, not the psychoeducation treatment. Schmidt et al. (2007) discussed the concept during the ASAT training, but did not give participants a chance to practice the exposures; nor did they assess whether participants engaged in exposures following the intervention session. Furthermore, neither Maltby (2001) nor Schmidt et al. (2007) tailored the interoceptive exposures to participants' individual AS-related fears (Keough & Schmidt, 2012). Therefore, Keough and Schmidt (2012) investigated the effect of systematically adding interoceptive exposure to psychoeducation for AS on changes in AS by adding them to an established psychoeducation protocol. Exposure completion was explicitly monitored throughout the study. Known as *Anxiety Sensitivity Education and Reduction Training* (ASERT), participants in the psychoeducation treatment condition received corrective information about stress and anxiety. After the presentation, participants completed several interoceptive exposures (e.g., breath holding, spinning), and the activity that resulted in the most fear was repeated until the fear diminished. Participants were then asked to complete interoceptive exposures every day for the next month (Keough & Schmidt, 2012). Participants in the control condition, termed Physical Health Education Training (PHET) received general health and nutrition information and were asked to monitor daily health habits over the next

month. In both conditions, the training sessions lasted 50 minutes and the experimenter presented the information using a PowerPoint presentation. The results showed that there was an effect of ASERT immediately after training, as participants in the ASERT condition reported significantly lower AS compared to participants in the PHET condition at posttest (between-group Cohen's *d*= 0.60). Participants in the ASERT group continued to report significantly lower AS 1 week posttreatment (between-group Cohen's *d*= 0.87) and 1 month posttreatment (between-group Cohen's *d*= 1.20) compared to participants in the PHET condition (Keough & Schmidt, 2012).

Schmidt and colleagues have continued to refine their psychoeducation intervention, and have focused on targeting specific AS beliefs (Schmidt et al., 2014). The cognitive domain of AS consists of beliefs that physical sensations will have negative cognitive outcomes (e.g., going crazy, losing control; Reiss et al., 1986), and is uniquely associated with suicidality (Capron, Norr, Macatee, & Schmidt, 2013). *Cognitive Anxiety Sensitivity Treatment* (CAST) was designed to target beliefs in the cognitive AS domain, and was adapted from the ASAT and ASERT interventions (Keough & Schmidt, 2012; Schmidt et al., 2007). Similar to ASERT, the CAST training presented participants with information about stress, the relationship between stress and sensations, and descriptions of interoceptive exposures. Of note, CAST was presented exclusively via an interactive computer program and it included several quizzes and videos to increase engagement and consolidate information (Schmidt et al., 2014). Participants were also directed to complete a hyperventilation interoceptive exposure and encouraged, but not required, to practice other interoceptive exposures on their own after the training session. The effects of CAST were compared to a *Physical Health Education Training* (PHET), a control condition that presented information similar to the PHET condition in Keough and Schmidt (2012). Like CAST, PHET was presented exclusively via computer program. CAST and PHET were each

delivered in one, 45-minute session. Participants with high AS (i.e., scoring at or above community sample mean on ASI-3 [Taylor et al., 2007]) were randomly assigned to the CAST or PHET training conditions, and returned for follow-up assessments 1 month after training. The results demonstrated that CAST was effective at reducing AS, with participants in the CAST condition reporting significantly lower total AS compared to those in the PHET condition immediately following training (between-group Cohen's *d*= .57). Participants in the CAST condition also reported significantly lower scores on all three AS subscales compared to participants in the PHET condition immediately following training (cognitive, between-group Cohen's *d*= .41; physical, between-group Cohen's *d*= .64; social, between-group Cohen's *d*= cc.38). The effects of CAST were maintained at 1-month follow-up (Schmidt et al., 2014). Therefore, it appears that psychoeducation, even in the absence of clinician intervention, is effective at reducing AS.

Although it is difficult to directly compare the ASAT (Schmidt et al., 2007), ASERT (Keough & Schmidt, 2012) and CAST (Schmidt et al., 2014) interventions because of different follow-up points and delivery methods, adding repeated interoceptive exposures to psychoeducation appears to increase the efficacy of psychoeducation. Whereas as the between-group effect sizes for AS changes at posttest were of a small to moderate magnitude in all studies (partial ε^2= 0.05, Schmidt et al., 2007; Cohen's *d*= 0.60, Keough & Schmidt, 2012; Cohen's *d*= .57, Schmidt et al., 2014), ASERT treatment effects were large 1 week after treatment (Cohen's *d*= 0.87) and 1 month after treatment (Cohen's *d*= 1.20). The ASAT between-group effects were small for the duration of the 2-year follow-up period (Cohen's *d*= 0.10 to 0.24; Schmidt et al., 2007) and the moderate between-group effects of CAST were maintained, but did not increase, in the month following the intervention (Schmidt et al., 2014). Based on the limited information

available, ASERT training results in a greater magnitude of change in AS compared to ASAT and CAST training, thereby suggesting that repeated interoceptive exposures may increase the efficacy of a brief psychoeducation intervention for high AS.

Limitations of the psychoeducation for AS literature. Taken together, there is evidence that psychoeducation is effective at reducing AS immediately after treatment and over longer periods of time. AS is a transdiagnostic risk factor, as high AS confers risk for a variety of psychological disorders (e.g., Reardon & Williams, 2007). While psychoeducation has been shown to reduce future incidence of DSM-IV Axis I disorders over 2 years (Schmidt et al., 2007), there is limited and inconsistent research on the more immediate impact of psychoeducation interventions on symptoms of psychopathology. Given that AS levels change immediately in response to psychoeducation (Keough & Schmidt, 2012; Schmidt et al., 2014), it is possible that symptoms of the disorders for which AS confers risk may also change in response to psychoeducation.

High AS is most closely associated with the presence of symptoms of panic disorder (Schmidt et al., 2006), SAD (Weeks et al., 2005), GAD (Carleton et al., 2009), depression (Simon et al., 2006), and alcohol-use disorders (Gillihan et al., 2011). Aside from panic disorder and panic symptoms, there is little research on how AS-specific interventions influence symptoms of the aforementioned disorders. When examining the effects of a three-session group CBT protocol, Abplanalp (2001) found that, compared to participants in the ethical information (control) condition, those in the CBT condition reported lower levels of depression (as assessed via the *Beck Depression Inventory* [BDI]; Beck, Ward, Mendelson, & Erbaugh, 1961) immediately following treatment, although the magnitude of the difference was small (between-group Cohen's d= 0.13). Conversely, Gardenswartz and Craske (2001) found that participants

who received brief CBT for AS reported similar levels of depression compared to participants in the waitlist condition (between-group Cohen's *d*= -0.08), as assessed via the *Beck Depression Inventory-II* (BDI-II; Beck, Steer, & Garbin, 1988).

Olthuis (2013) conducted the most comprehensive study to date on the effects of CBT for AS on symptoms of psychopathology. CBT, delivered via telephone, resulted in small-to-medium changes in symptoms of SAD (between-group Cohen's *d*= 0.50; assessed via the *Liebowitz Social Anxiety Scale* [LSAS]; Liebowitz, 1987), worry (between-group Cohen's *d*= 0.36; assessed via the *Penn State Worry Questionnaire* [PSWQ]; Meyer, Miller, Metzger, & Borkovec, 1990), and depression (between-group Cohen's *d*= 0.24; *Depression Anxiety Stress Scales 21-Item Version, Depression subscale* [DASS-21 Dep]; Lovibond & Lovibond, 1995). Olthuis (2013) also examined the effect of CBT for AS on changes in motives to consume alcohol (assessed via the *Modified Drinking Motives Questionnaire- Revised* [MDMQ-R]; Grant, Stewart, O'Connor, Blackwell, & Conrod, 2007) and problems associated with alcohol consumption (assessed via the *Short Inventory of Problems- Revised* [SIP-R]; Miller, Tonigan, & Longabaugh, 1995), both of which are associated with high AS (Chandley, Luebbe, Messman-Moore, & Ward, 2013), and found that CBT for AS had different effects of these constructs. Participants in the CBT group reported lower desire to use alcohol to cope with anxiety compared to participants in the waitlist condition following the final treatment session (between-group Cohen's *d*= 0.27). However, participants in the CBT condition (versus those in the waitlist condition) reported more problems associated with alcohol use across life domains (between-group Cohen's *d*= -0.15 to -0.38), which was not consistent with hypotheses (Olthuis, 2013) or other research (e.g., Chandley et al., 2013).

Maltby (2001) also examined the unique effects of psychoeducation for AS on

psychopathology symptoms. Compared to participants in the waitlist control condition, those in the psychoeducation condition reported lower levels of problems associated with alcohol (between-group Cohen's *d*= 0.54; assessed via the Problems Caused by Alcohol subscale of the *Alcohol Use Disorders Identification Test* [AUDIT]; Babor, De La Fuente, Saunders, & Grant, 1992) and slightly lower depressive symptoms (between-group Cohen's *d*= 0.13; assessed via BDI-II). In contrast to Olthuis' (2013) results, Maltby (2001) reported that psychoeducation for AS resulted in similar levels of social anxiety symptoms 2 weeks after treatment, compared to the waitlist condition (between-group Cohen's *d*= -0.09; assessed via the Social Phobia subscale of the *Fear Questionnaire* [FQ]; Marks & Mathews, 1979). Finally, in the only other study to examine the effects of psychoeducation for AS on symptoms of depression, Schmidt et al. (2007) reported that, 1 year posttreatment, participants who completed one session of psychoeducation for AS reported slightly lower levels of depressive symptoms compared to participants who received general health information (between-group Cohen's *d*= 0.15; assessed via BDI-II; Beck et al., 1988).

Taken together, the current understanding of the effect of AS-specific psychoeducation on psychopathology symptoms is incomplete. Very few studies have directly examined symptom changes, and the limited research is inconsistent in the direction and size of treatment effects. Maltby (2001) and Schmidt et al. (2007) are the only known researchers to have examined the efficacy of brief, single-session, psychoeducation treatment, which further limits the ability to make conclusions about the effect of psychoeducation for high AS on psychopathology symptoms.

Additionally, no known research has yet to investigate the effect of psychoeducation for high AS on *changes* to reactions to *in vivo* (i.e., intentionally induced) physical sensations.

Carbon dioxide (CO_2) challenges are a common way of inducing physical sensations that mimic those of a panic attack in a safe and controlled manner (Perna, Cochi, Allevi, Bussi, & Bellodi, 1999). Schmidt et al. (2007) administered a CO_2 challenge to participants that used a 20% CO_2 solution (i.e., 20% CO_2 and 80% oxygen). However, the CO_2 challenge was only administered immediately after completing the psychoeducation training (i.e., ASERT or PHET). Given this design, only between-group comparisons were possible. There is no known study that has administered the CO_2 challenge before and after a psychoeducation intervention for high AS, which would allow for both within- and between-group comparisons.

Furthermore, the cognitive mechanisms of psychoeducation have yet to be elucidated, as there are no known studies investigating mediators of change in psychoeducation for AS. By understanding how psychoeducation leads to changes in AS, brief treatments for AS can be refined and their efficacy increased. Theories and existing research were used to guide predictions about mediators of change, as reviewed in the following section.

Potential Cognitive Mechanisms of Change of Psychoeducation for AS

Interpretation bias. Interpretation biases may play an important role in the relationship between psychoeducation and change in AS. An interpretive bias occurs when a system of beliefs results in ambiguous information being perceived as consistent with pre-existing schemas (Beard & Amir, 2008). People with elevated AS display negative interpretive biases in response to ambiguous physical sensations presented in brief vignettes (Van Cleef & Peters, 2008). AS level reliably predicts the strength of negative interpretive biases toward ambiguous arousal-related physical sensations in people with panic disorder or panic attacks and those without a history of panic experiences (Richards, Austin & Alvarenga, 2001).

CBT reduces the strength of negative interpretive biases associated with anxiety disorders. For example, Voncken and Bögels (2006) reported that CBT for SAD resulted in large reductions in negative interpretive biases in response to ambiguous social situations (within-group Cohen's *d*=1.11), as assessed via idiographic sets of ambiguous social situations that described each participant's most feared social experience. Furthermore, interpretive biases in response to ambiguous physical sensations change following CBT for panic disorder (within-group Cohen's *d*= 1.33 to 1.50; Clark et al., 1997), assessed via the *Brief Bodily Sensations Interpretation Questionnaire* (BBSIQ; Clark et al., 1997). When considered together, negative interpretive biases are responsive to treatment.

Research suggests that change in negative interpretive biases towards ambiguous physical sensations may be one of the primary cognitive mechanisms of change in AS in response to CBT. First, changes in these biases predict changes in panic symptoms following CBT for panic disorder, as demonstrated through analysis of latent difference score models (Gloster et al., 2014; Teachman, Marker, & Clerkin, 2010). Casey et al. (2005) reported that change in negative interpretations (as assessed via the BBSIQ; Clark et al., 1997) following CBT for panic disorder was a partial mediator of treatment outcome, as analysed via Baron and Kenny's (1986) mediation procedure (β= 0.26; Casey et al., 2005). Hofmann and colleagues (2007) found similar results when examining changes in interpretive biases as a result of CBT for panic disorder. Using a moderated mediation model (analyzed via hierarchical linear modeling), three types of negative appraisals (i.e., appraisals of physical, social and cognitive catastrophes) were found to mediate the effect of CBT on panic disorder symptoms (Cohen's *d*=0.33 to 0.56 for three types of appraisals; Hofmann et al., 2007). Although the aforementioned studies did not directly examine the relationship between negative interpretive biases and AS, high AS is directly related

to panic symptoms and panic disorder (e.g., Gallagher et al., 2013). Therefore, it can be inferred that changes in negative interpretive biases may also be a cognitive mechanism of change in AS.

More evidence for negative interpretive biases as a possible mediator of change in AS comes from research that shows that targeting specific interpretive biases results in changes in symptom-related schemas. This research has employed Cognitive Bias Modification (CBM) training procedures, which are designed to modify information-processing biases, such as interpretation biases. CBM training can be used to induce a specific interpretation bias, or to modify the strength of a pre-existing bias (Beard, 2011). Hirsch, Mathews, and Clark (2007) used computerized CBM training to train female undergraduate students to adopt a personally-relevant positive or negative interpretation bias regarding behaviour in social situations. Participants then completed a self-imagery task, during which they were asked to imagine themselves in a certain social situation, and describe the image to the experimenter. Participants in the negative training group produced images that were rated as significantly more negative compared to those produced by participants in the positive training condition (between-group Cohen's *d*= 1.79; Hirsch et al., 2007), thereby suggesting that they had adopted a negative self-view. Similar results have been reported in response to a CBM protocol for depression. Adolescents and young adults with depressive symptoms were assigned to either a positive CBM training condition, in which they were trained to make positive interpretations of ambiguous situations, or a neutral CBM training condition, that was not designed to alter interpretive biases associated with depression (Micco, Henin, & Hirschfeld-Becker, 2014). Immediately after the fourth and final CBM training session, participants in the positive training condition reported significantly lower levels of maladaptive depressive attitudes (assessed via the *Dysfunctional Attitude Scale- Form A* [DAS; Weissman & Beck, 1978]), compared to participants in the neutral

training condition (between-group Cohen's *d*= 0.60; Micco et al., 2014). Furthermore, participants in positive training condition continued to develop more positive attitudes after treatment ended, as the magnitude of the between-group difference increased to Cohen's *d*= 1.02 at 2-week follow-up (Micco et al., 2014). Therefore, directly targeting interpretive biases results in changes in broad schemas and beliefs, which suggests that changes in negative interpretive biases may lead to changes in AS beliefs.

Collectively, research suggests that negative interpretive biases in response to physical sensations may be a cognitive mediator of the effect of CBT on AS. Although this research was conducted almost exclusively in panic disorder, negative interpretive biases in response to changes in physical sensations are associated with high AS, irrespective of panic symptoms. Given that high AS is associated with the same beliefs and negative interpretive biases across psychological disorders (Rosmarin, Bourque, Antony, & McCabe, 2009), research suggests that the results of these studies should generalize to disorders other than panic disorder. Therefore, there is strong evidence to suggest that changes in negative interpretive biases will mediate the effects of psychoeducation on AS.

Perceived control. Control may be another cognitive mechanism of psychoeducation for AS. Control is defined as having the ability or the perceived ability to influence one's emotional experiences, external threats, and stressful experiences (Barlow, 2002). *Perceptions* of control are known to be broadly related to psychopathology (Chorpita & Barlow, 1998), as deficits in perceived control are associated with elevated symptoms of SAD (e.g., Hofmann, 2005), GAD (e.g., Stapinski, Abbott, & Rapee, 2010), and depressive disorders (e.g., Brown & Siegel, 1988).

Lack of control, either actual or perceived, may be particularly important in reactions to physical sensations. Fear of losing control is a panic attack symptom (American Psychiatric

Association [APA], 2013), which suggests that perceptions of low control can occur when experiencing arousal-related physical sensations. Accordingly, lower perceptions of control are associated with higher levels of AS in undergraduate students with high AS (Viana & Gratz, 2012). Perceived control was assessed via the *Anxiety Control Questionnaire* (ACQ; Rapee, Craske, Brown, & Barlow, 1996), which is a measure of perceptions of general control over emotional states, threatening (external) life events, and when experiencing stress. Similar results have been found in adults with panic disorder (Bentley et al., 2013; White, Brown, Somers & Barlow, 2006) using the *Anxiety Control Questionnaire-Revised* (ACQ-R; Brown, White, Forsyth, & Barlow, 2004), a brief version of the original ACQ. Furthermore, lower perceptions of control predict the severity of panic disorder symptoms in adults with panic disorder (Bentley et al., 2013; White et al., 2006), even after accounting for the effects of AS-related negative interpretative biases (Casey, Oei, Newcombe, & Kenardy, 2004), or when using a different measure of perceived control (i.e., *Self-Efficacy to Control a Panic Attack*; Bouchard, Pelletier, Gauthier, Coté & Laberge, 1997). Taken together, low perceptions of control are strongly related to the presence of some psychopathology symptoms.

Perceptions of control change in response to CBT. Gallagher, Naragon-Gainey and Brown (2014) used structural equation modeling to demonstrate that perceived control (as assessed via the ACQ-R) increased during CBT for anxiety disorders. Furthermore, whereas changes in anxiety symptoms were small-to-moderate (within-group Cohen's d=0.39 to 0.47) over the following 2 years, changes in perceived control were large (within-group Cohen's d= 0.74; Gallagher et al., 2014), which suggests that the effect of CBT on control-related beliefs is particularly strong.

Perceived control is also predictive of treatment efficacy. Change in perceived control

(assessed via the ACQ-R) predicted change in anxiety disorder symptoms in adults over the 2 years following CBT, as demonstrated through bootstrapped mediation analyses (standardized mediation effects of perceived control= -0.20 to -0.26; Gallagher et al., 2014). Meuret and colleagues (2010) found similar results when examining mediators of change in panic symptoms in response to CBT. Using the same measure of perceived control and multilevel modeling, perceived control mediated change in symptoms, and accounted for 17% of the overall effect of CBT (Meuret, Rosenfield, Seidel, Bhaskara, & Hofmann, 2010). Vögele and colleagues (2010) had comparable results in a study of the efficacy of exposure therapy for agoraphobia (with or without panic disorder) and SAD. Perceived control was assessed via the "loss of control" subscale of the *Agoraphobic Cognitions Questionnaire* (Chambless, Caputo, Bright & Gallagher, 1984). This subscale assesses the frequency of catastrophic thoughts about cognitive or social consequences (e.g., I am going to go crazy). Using Baron and Kenny's (1986) moderated mediation analysis, frequency of catastrophic control-related thoughts significantly meditated treatment effects, and accounted for 16% and 45% of the total effect of treatment for agoraphobia and SAD, respectively (Vögele et al., 2010). Moreover, similar results have been found in children. Change in perceived control (assessed via the *Anxiety Control Questionnaire for Children*; Weems, Silverman, Rapee, & Pina, 2003) significantly predicted change in social anxiety symptoms in children in response to CBT (β= -0.31; Muris, Mayer, den Adel, Roos & van Wamelen, 2009).

When considered together, perceptions of control may mediate change in AS in response to psychoeducation. Like research on negative interpretive biases, the majority of this research has been conducted with participants with panic disorder. Nonetheless, low perceived control is transdiagnostic and is associated with AS, regardless of diagnoses, and is therefore worthy of

further investigation as a mediator of change in AS in response to psychoeducation.

Attentional bias. Attentional bias is another information-processing bias that may contribute to the relationship between psychoeducation and change in symptoms. A negative attentional bias is the tendency to attend to threatening (versus nonthreatening) stimuli (Van Bockstaele et al., 2013). There are several different processes involved in attending to a stimulus, including orienting attention to, and disengaging attention from, the stimulus (Cisler, Bacon, & Williams, 2009). People with depression and anxiety display biases in both parts of the attention process (see Cisler et al., 2009 for a detailed review). Meta-analytic results suggest that people with anxiety disorders and people with high levels of state or trait anxiety report significantly stronger threat-related attentional biases compared to nonanxious control participants (between-group Cohen's *d*= 0.41; Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van Ijzendoorn, 2007). Furthermore, participants with anxiety disorders display significantly stronger attentional biases for threatening information compared to nonanxious controls (between-group Cohen's *d*= 0.46 to 0.55; Bar-Haim et al., 2007).

Research shows that there are AS-specific attentional biases. Hunt and colleagues (2006) found that people with elevated (versus low or moderate) concerns about the physical consequences of bodily sensations had significantly stronger attentional biases for threatening information about anxiety symptoms (e.g., confuse, faint, sting; between-group partial η^2= .09). There were, however, no differences in attentional biases for social threat cues (e.g., alone, exclude, shy) or positive words (e.g., brave, fun, peaceful) between participants with high versus low physical AS concerns (Hunt, Keogh, & French, 2006), which suggests the presence of AS-specific attentional biases towards information about anxiety symptoms.

Although there is very limited research examining change in attentional biases as a

cognitive mechanism of psychological treatment, research suggests that this may be the case. Attentional biases normalize in response to CBT (Tobon, Ouimet, & Dozois, 2011). Mathews and colleagues (1995) compared the attentional biases of participants who had completed CBT for GAD to participants without psychological diagnoses (Mathews, Mogg, Kentish, & Eysenck, 1995). Although participants in the CBT condition displayed stronger attentional biases for threat prior to treatment (between-group Cohen's *d*= 0.66), there was no between-group difference after CBT (between-group Cohen's *d*= 0.07; Mathews et al., 1995). Pishyar, Harris and Menzies (2008) found similar results in participants with SAD. While there were no significant differences in attentional biases at baseline, participants in the CBT condition displayed significantly weaker attentional biases for social threat words (between-group Cohen's *d*= 1.18) and threatening faces (between-group Cohen's *d*= 1.77) compared to participants in the waitlist condition after treatment (Pishyar, et al., 2008). Therefore, there is evidence that attentional biases change in response to treatment.

Additional evidence that attentional biases may mediate the effect of treatment come from the finding that attentional and interpretive biases are intrinsically related. According to the *combined cognitive biases hypothesis*, information-processing biases have an interactive effect, and the combined effect of these biases is stronger than their isolated effects (Hirsch et al., 2006). Information-processing is an interactive process between attentional and interpretation processes. For example, attentional biases may determine the stimuli to which one attends, but an interpretive bias determines how the information is perceived (Hirsch et al., 2006). Therefore, biases in one cognitive process are exacerbated by biases in another cognitive process. Although limited in scope, research supports the combined cognitive biases hypothesis. Everaert, Duyck, and Koster (2014) examined the interaction of attentional and interpretive biases in relationship

to depressive symptoms in undergraduate students. Using structural equation modeling, the researchers found that the best fitting models were those that predicted *interdependent* relationships between attentional and interpretive biases (Everaert et al., 2014), thereby supporting the combined cognitive biases hypothesis. When considered with the research on the relationship between negative interpretive biases and high AS, attentional biases may mediate the relationship between treatment and changes in AS.

The aforementioned research highlights the roles of negative interpretive biases, perceptions of control and attentional biases in changes in response to CBT. Given the relationships between these constructs and AS, these three factors could be cognitive mechanisms of change of AS in response to psychoeducation for AS.

The Present Study

The purpose of the present study was two-fold. First, the immediate and short-term effects of psychoeducation plus interoceptive exposures for AS on AS and related constructs were investigated. ASERT was the psychoeducation intervention under investigation and has previously been found to be effective at reducing AS (Keough & Schmidt, 2012). The effects of ASERT were compared to that of a control condition in which participants were presented with general health information. No known research had examined the effects of ASERT on cognitive processes associated with AS (e.g., negative interpretive biases, perceived control and attentional biases) or psychopathology symptoms over a brief follow-up period. In the present study, assessments occurred 2- and 4-weeks after the administration of the psychoeducation sessions. Moreover, no known research had examined the effect of the ASERT intervention on reactions to physical sensations. Therefore, a CO_2 challenge was administered as a behavioural measure of reactions to physical sensations. The second goal of the present study was to investigate the

cognitive mechanisms of psychoeducation for AS, as there is no known research on the pathways through which this intervention results in changes in AS. It was hypothesized that:

1a. Averaged across the 2- and 4-week follow-ups, participants in the ASERT condition would report lower AS, lower negative interpretive biases in response to physical sensations, lower attentional biases for threatening information and higher perceived control compared to participants in the control condition.

1b. Compared to participants in the control condition, participants in the ASERT condition would report greater reductions from baseline in AS, negative interpretive biases in response to physical sensations, attentional biases in response to threatening information, and greater increases in perceived control at the 2- and 4-week follow-ups.

2a. Averaged across the 2- and 4-week follow-ups, participants in the ASERT condition would report significantly less severe symptoms of panic disorder, SAD, GAD, and depression; lower motivation to consume alcohol; fewer problems as a result of alcohol consumption and; lower general symptoms of distress, compared to participants in the control condition.

2b. Compared to participants in the control condition, participants in the ASERT condition would report greater reductions from baseline in symptoms of panic disorder, SAD, GAD, problems as a result of alcohol consumption, motivation to consume alcohol and, general symptoms of distress at the 2- and 4-week follow-ups.

3a. At the 4-week follow-up, participants in the ASERT condition would report significant decreases in fear and anxiety during the CO_2 challenge, compared to their pretest scores.

3b. At the 4-week follow-up, participants in the ASERT condition would report

significantly lower levels of fear and anxiety during the CO_2 challenge compared to participants in the control condition.

4. Changes in negative interpretive biases, perceptions of control and attentional biases would each mediate the relation between intervention assignment and changes in AS.

Method

Participants

Participants between the ages of 18 and 65 years were recruited from the community via newspaper advertisements, online advertisements (i.e., *Craigslist*, *Kijiji*, *Cognition and Psychopathology Lab* website) and flyers (see Appendix A for advertisements). The advertisements and flyers were designed to attract people with high AS by stating that this study was recruiting people who experience specific bodily sensations (i.e., arousal-related physical sensations, such as racing heart, shortness of breath, etc.), pay attention to these sensations, feel afraid when they notice these sensations, worry that other people will notice these sensations, and worry that these sensations are harmful to their health. Everyone who responded to the advertisements was invited to complete a brief telephone screen to determine eligibility for participation. The telephone screen consisted of the ASI-3 (Taylor et al., 2007) and specific sections of the *Mini International Neuropsychiatric Interview-7* (MINI 7.0; Sheehan, 2014) to assess symptoms of *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5; APA, 2013) disorders. High AS was defined as scoring 23 or higher on the ASI-3, which is one standard deviation above the mean AS level in a nonclinical population, as per the ASI-3 manual (M= 12.8, SD= 10.6; Reiss, Peterson, Taylor, Schmidt, & Weems, 2008).

Exclusion criteria were as follows: (1) current/past psychotic episode, current/past manic/hypomanic episode, criteria for (any) substance use disorder met in the past 3 months; (2)

currently receiving CBT treatment, or initiation/completion of CBT that included psychoeducation about, or exposure to, arousal-related physical sensations within the past 6 months; (3) clinically significant suicidal intent; (4) medical conditions or medication use that would prohibit participation in assessments of reactions to physical sensations (see Appendix B for full list of medical exclusions). These exclusion criteria were included to protect against adverse reactions to the CO_2 challenge. Of note, the final exclusion criterion (i.e., medical conditions and medication use) was modified during recruitment to facilitate recruitment Specifically, participants were invited to participate in the study if they endorsed one or more of the medical and medication exclusions, provided that they did not endorse any other exclusion criteria. These participants *did not* complete the CO_2 challenge (see *Measures* section for further discussion of CO_2 challenge).

In total, 107 potential participants completed the telephone screen during the recruitment phase, 66 of whom were invited to the lab to complete the present study. Participants were excluded specifically for endorsing low AS, substance use, manic symptoms, medical conditions, medication use, or current CBT. Additionally, participants were excluded for not having completed an annual physical in the past year that deemed them healthy, although, as previously mentioned, this criterion was modified (see *Results* section). Fifteen participants did not attend the first session (i.e., lost contact; no-showed for the first session; withdrew participation), and one participant withdrew during the first session. Of the 50 participants who completed the study, 15 participants were excluded from data analysis due to low ASI-3 scores at the baseline assessment (range of ASI-3 total scores= 1 to 20). Therefore, the final sample included 35 participants (ASERT condition, n=19; control condition, n=16). Randomization will be discussed in detail in the Procedure section (pp. 48).

Sample characteristics of the final study sample separated by condition are presented in Table 1. The majority of participants reported: being female/identifying as a woman, identifying their ethnicity as Caucasian, not working, being married/common-law, and being enrolled in an educational program. With regards to DSM-5 diagnoses, the most common disorder diagnosed was GAD (42.9% of the total sample), followed by panic disorder (40.0%) and social anxiety disorder (28.6%). Table 1 summarizes the DSM-5 diagnoses, separated by condition. There were no significant between-condition differences in demographic characteristics with the exception of sex/gender. There were significantly more men/males in the ASERT condition versus the control condition, sex, $\chi^2(1)= 6.11$, $p< .05$; gender, $\chi^2(1)= 5.64$, $p< .05$. The control condition did not include any males, six participants reported their sex as male in the ASERT condition, and five participants reported their gender as man. Of note, the discrepancy between the proportion of males and men is believed to be the result of incomplete items (i.e., all participants completed the sex item while one participant did not complete the gender item).

Table 1

Study 1- Sample Characteristics Separated by Study Condition

	ASERT (*n* = 19)	PHET (*n* = 16)
Age in years - *M* (*SD*)	30.27 (12.11)	25.36 (8.45)
Sex – Frequency (%) [a]		
Female	12 (63.20%)	15 (93.80%)
Male[a]	6 (31.60%)	0 (0%)
Gender - Frequency (%) [b]		
Women	10 (52.60%)	14 (87.50%)
Men	5 (26.30%)	2 (12.50%)
Race/Ethnicity - Frequency (%)		
Caucasian	5 (26.30%)	7 (43.80%)
South Asian	5 (26.30%)	0 (0%)
Mixed Race	4 (21.10%)	2 (12.50%)
Arab/ West Asian	2 (10.50%)	0 (0%)
Latin American	1 (5.30%)	1 (6.30%)
East Asian	1 (5.30%)	2 (12.50%)
Other Ethnicity	1 (5.30%)	1 (6.30%)
Black	0 (0%)	3 (18.80%)
Employment Status - Frequency (%)		
Not working	12 (63.20%)	9 (56.30%)
Employed part-time	4 (21.10%)	5 (31.30%)
Employed full-time	3 (15.80%)	2 (12.50%)

	ASERT (*n* = 19)	PHET (*n* = 16)
Marital Status - Frequency (%)		
Married/Common-law	10 (52.60%)	12 (75.00%)
Single	9 (47.40%)	4 (25.00%)
Enrolled in Educational Program- Frequency (%)		
Yes	10 (52.60%)	11 (68.80%)
No	9 (47.40%)	6 (31.30%)
Highest Education - Frequency (%)		
High School Diploma	1 (5.30%)	0 (0%)
College Diploma	3 (15.80%)	1 (6.30%)
Undergraduate Degree	2 (10.50%)	2 (12.50%)
Master's Degree	3 (15.80%)	3 (18.80%)
Doctoral Degree	1 (5.30%)	0 (0%)
Diagnoses - Frequency (%)		
Generalized Anxiety Disorder	10 (52.60%)	5 (31.30%)
Panic Disorder	7 (36.80%)	7 (43.80%)
Social Anxiety Disorder	5 (26.30%)	5 (31.30%)
Panic Attack Specifier	5 (26.30%)	3 (18.80%)
Major Depressive Disorder	3 (15.80%)	2 (12.50%)
Obsessive-Compulsive Disorder	3 (15.80%)	0 (0%)
Anorexia Nervosa	2 (10.50%)	0 (0%)
Bulimia Nervosa	1 (5.30%)	0 (0%)
Binge Eating Disorder	1 (5.30%)	0 (0%)

	ASERT (n = 19)	PHET (n = 16)
Agoraphobia	1 (5.30%)	3 (18.80%)
Days between Study Visits - *M* (*SD*)		
Baseline to 2 weeks	14.80 (2.54)	14.55 (2.16)
2 weeks to 4 weeks	18.33 (6.96)	16.18 (4.73)
Total Intervention Time - *M* (*SD*) [c]	64.26 (10.36)	43.88 (3.01)
Psychoeducation Time - *M* (*SD*)	36.86 (9.39)	37.86 (2.91)

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. Percentage totals may not add up to 100% due to missing responses for some variables. Intervention and Psychoeducation time are both reported in minutes.

[a] There were significantly more males in the ASERT condition versus the PHET condition, χ^2 (1)= 6.11, p< .05.

[b] There were significantly more men in the ASERT condition than the PHET condition, χ^2 (1)= 5.64, p< .05.

[c] The mean length of the ASERT intervention (i.e., psychoeducation and interoceptive exposures) was significantly longer than the mean length of the PHET intervention, t(33)= 7.59, p< .01.

Materials

Telephone Screening measures.

Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007). The ASI-3 is an 18-item self-report measure that assesses fear of and beliefs about the experience of anxiety-related physical sensations. Items are rated on a 5-point Likert scale, and total scores range from 0-72. The ASI-3 is based on the original ASI (Reiss et al., 1986) and has retained the three lower-order factors from the original ASI (i.e., Physical Concerns, Social Concerns, and Cognitive Concerns). The ASI-3 was developed as a more psychometrically-sound, multidimensional AS assessment, as the original ASI does not adequately assess the lower-order factors of AS (Carter, Sbrocco, & Ayati, 2009; Wheaton, Deacon, McGrath, Berman & Abramowitz, 2012). The ASI-3 was subject to comprehensive construction and validation procedures in North American and European clinical and nonclinical samples. The ASI-3 has excellent psychometric properties, with internal consistencies of α=.73 to .90 for the subscales (Taylor et al., 2007; Wheaton et al., 2012) and α=.93 for the total score (Wheaton et al., 2012). Scores from the ASI-3 telephone administration were used only for the purpose of determining eligibility, and were not included in the analyses of the present study. This decision was made to standardize the amount of time between the baseline ASI-3 assessment and the intervention, as participants completed the telephone screen up to 33 days before attending the first session.

Mini International Neuropsychiatric Interview 7.0 (MINI 7.0; Sheehan, 2014). The MINI 7.0 is a brief, semistructured clinical interview that assesses for symptoms of several DSM-5 disorders (APA, 2013). *Select sections* of the MINI 7.0 were administered to assess for current suicidal intent or current/past diagnosis of a psychotic episode, substance dependence, or manic/hypomanic episode, all of which were exclusion criteria for the present study.

Testing measures.

MINI 7.0 (Sheehan, 2014). The MINI 7.0 was administered in its entirety to assess for the presence of psychopathology.

Medical History Questionnaire (MHQ; Appendix C). The MHQ was created by Dr. Kristin Vickers of Ryerson University and was originally adapted from other measures used by CO_2 researchers. The MHQ is designed to inquire about the presence of medical conditions that would preclude participation in the behavioural measure of reactions to physical sensations (i.e., CO_2 challenge; See *Behavioural Measure* section). It was administered during the first visit. Although participants were asked about medical conditions during the telephone screen, the MHQ was used to confirm that participants did not have conditions that could result in adverse outcomes during a CO_2 challenge. Any response of *yes* or *not sure* on the MHQ deemed participants ineligible to complete the CO_2 challenge. These participants, however, were eligible to complete the rest of the study if they did not report medical conditions that would preclude them from completing the interoceptive exposures as part of the ASERT treatment.

Demographics Questionnaire. A general demographics measure was administered to collect information on participants' sex, gender, age, race, marital status, education level, and employment type and status. This measure was adapted from a general demographic questionnaire that is frequently used in the *Cognition and Psychopathology Lab*.

Process Measures.

Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007). In addition to being used as a screening measure, the ASI-3 was the primary measure of AS.

Brief Bodily Sensations Interpretation Questionnaire (BBSIQ; Clark et al., 1997). The BBSIQ assesses negative interpretive biases about physical sensations and was adapted from an

earlier measure of negative interpretations (McNally & Foa, 1987). The BBSIQ is a 14-item questionnaire that presents participants with descriptions of ambiguous situations (internal sensations and external events) and explanations that disambiguate the scenario. Of the three explanations, one resolves the situation in a negative way, and the other two resolve the situation in a positive/neutral way. The BBSIQ has two separate scales. The Belief scale assesses belief in the likelihood of each explanation occurring and asks participants to rate the plausibility of each explanation. Belief scores are calculated by determining the mean rating of the negative explanations and the mean of the positive/neutral explanations. This results in four scores: Internal Negative (negative interpretations of physical sensations), Internal Neutral (neutral interpretations of physical sensations), External Negative (negative interpretations of external situations) and External Neutral (neutral interpretations of external situations). The second BBSIQ subscale, the Ranking scale, assesses specific interpretations of physical sensations and external situations. Participants are asked to rank the order in which each explanation would come to mind (i.e., 1^{st}, 2^{nd}, 3^{rd}) given each scenario. This scale is reverse-scored and scores of 3, 2, or 1 are assigned for providing rankings of 1, 2, or 3, respectively. The two Ranking scores are the mean rankings of the negative explanations for situations describing physical sensations (Internal Ranking) and external events (External Ranking). The BBSIQ has been found to have adequate internal consistency for each subscale (α= .74 to .90; Clark et al., 1997). Test-retest reliability has been reported as satisfactory for the Ranking subscale (r = .73 to .75) and for the Beliefs subscales (r = .41 to.81; Clark et al., 1997).

Anxiety Control Questionnaire-Revised (ACQ-R; Brown et al., 2004). The ACQ-R is a 15-item self-report measure of perceptions of control of aversive experiences and emotional states. Questions are rated on a 6-point Likert scale. The ACQ-R total score assesses general

perceptions of control. The three lower-order factors assess perceptions of control over emotional states, threatening events, and when experiencing stress (Brown et al., 2004). High scores represent high perceived control. The internal consistency of the scales is moderate (α= .71 to .73) for the subscales and high for the total score (α= .85; Brown et al., 2004). The reliability of the subscales were moderate to high (ρ= .65 -.74) and high for the total score (ρ= .85; Brown et al., 2004).

Visual Dot-Probe Task. Attentional biases were assessed via a visual dot-probe task (MacLeod, Mathews, & Tata, 1986), which was adapted for use in the present study. Participants were first presented with a fixation point in the middle of the computer screen for 500ms. A pair of words replaced the fixation point, one on either side of the screen. One word was a threatening/emotional word (e.g., dizzy), whereas the other word was neutral (e.g., whisk). After 500ms, the words disappeared and one word was replaced by a dot. Participants were asked to indicate as quickly as possible if the dot-probe appeared on the left (by pressing the "A" key) or the right (by pressing the "L" key). After the participants responded, the dot was erased and the next trial began 500ms later. Faster reaction times when the dot replaced a threat (versus neutral) word are indicative of strong negative attentional biases. All of the word pairs included a threat word (e.g., choking; panicky) and a neutral word (e.g., radiator; mirror) and the word list was adapted from studies that have assessed attentional biases associated with high AS (e.g., Hunt et al., 2006; Keogh, Dillon, Georgiou, & Hunt, 2001; Taake, Jaspers-Fayer, & Liotti, 2009). Word frequency and word length were matched (see Hunt et al., 2001, Keogh et al., 2001, Taake et al., 2001 for description of development of word lists). These three studies yielded a total of 54 word pairs. Two pairs were removed because the threat word was included on multiple lists. Therefore, there are 52 word pairs. Each pair was presented four times per administration (with

the threat word appearing on the left and right side of the computer screen twice each), for a total of 208 trials. The same stimuli were used during all attentional bias assessments and were presented in random order.

Trials that met at least one of the following criteria were removed prior to data analysis: incorrect response (i.e., indicated that the dot was on the other side of the screen); reaction time less than 150ms; reaction time greater than 2000ms; or *z* score greater than |2.5| (i.e., absolute value of 2.5; e.g., Maoz, Abend, Fox, Pine & Bar-Haim, 2013). The number of trials retained for each visit ranged between 91.60% and 93.80% of total trials, which is consistent with other research (Maoz et al., 2013). There were no between-group differences in the number of trials retained for analyses at any time point (*p*s ranged from .26 to .95). Attention bias scores were calculated by subtracting the mean reaction time when the dot was paired with a threat word from the mean reaction time when the dot was paired with a benign word. Positive attention bias scores represent a bias *towards benign words*.

Symptom measures. All symptom measures in the present study were modified to inquire about symptoms over the past 2 weeks (See *Procedure* for description of assessment points).

Panic Disorder Severity Scale- Self-Report (PDSS-SR; Houck, Spiegel, Shear, & Rucci, 2002). The PDSS-SR is a 7-item measure of the severity of panic disorder symptoms. It was adapted from the *Panic Disorder Severity Scale* (PDSS; Shear et al., 1997), a clinician-administered interview. The PDSS-SR has good internal consistency (α= .92; Houck et al., 2002), and good convergent validity with the PDSS (Wuyek, Antony & McCabe, 2011). The PDSS-SR has good test-retest reliability over 1 day (*r*= .94; Lee, Kim, & Yu, 2009) and 2 days (intraclass correlation coefficient [ICC]= .83; Houck et al., 2002). A 5-item version of the PDSS-

SR was inadvertently administered throughout the present study. This version was adapted from Wuyek et al. (2011). In that study, the last two PDSS-SR items (i.e., distress and impairment questions) were accidentally omitted from the final questionnaire. This error was carried over to the present study. The 5-item PDSS-SR, as administered in this study, assessed panic symptoms only.

Social Phobia Inventory (SPIN; Connor et al., 2000). The SPIN is a 17-item measure of severity of SAD symptoms. Items are rated on a 5-point Likert scale. The SPIN assesses three sets of symptoms: fear, avoidance, and physiological arousal. The SPIN has excellent internal consistency and convergent validity (Antony, Coons, McCabe, Ashbaugh, & Swinson, 2006; Connor et al., 2000). The test-retest reliability is excellent over 1 to 3 weeks (r= .78 to .89; Antony et al., 2006; Connor et al., 2000).

Generalized Anxiety Disorder Questionnaire-IV (GAD-Q-IV; Newman et al., 2002). The GAD-Q-IV is a 14-item self-report measure that assesses the presence of GAD symptoms, as outlined by the *Diagnostic and Statistical Manual of Mental Disorders, 4th edition, Text revision* (DSM-IV-TR; American Psychiatric Association [APA], 2000). Given that the diagnostic criteria for GAD that are assessed by the GAD-Q-IV have not changed in the DSM-5 (APA, 2013), the GAD-Q-IV is still a useful measure of GAD symptoms. The total score on the GAD-Q-IV ranges from 0 to 13, and scores equal to or greater than 7.67 are suggestive of a diagnosis of GAD. The GAD-Q-IV has good convergent validity with a clinical interview that assesses symptoms of GAD (i.e., *Anxiety Disorders Interview Schedule for DSM-IV*; κ= .67; Di Nardo, Brown, & Barlow, 1994) and self-report measures of pathological worry (i.e., *Penn State Worry Questionnaire*; r = .66; Meyer et al., 1990). The test-retest reliability of the GAD-Q-IV is stable over 2 weeks (κ= .64; Newman et al., 2002).

Centre for Epidemiological Studies-Depression Scale-Revised (CESD-R; Eaton, Smith, Ybarra, Muntaner, & Tien, 2004). The CESD-R is a 20-item measure of the frequency and severity of symptoms of a DSM-IV-TR major depressive episode (APA, 2000). The CESD-R is based on the original CES-D (Radloff, 1977) and was adapted to more precisely assess the symptoms of a DSM-IV-TR major depressive episode. Items are rated on a 4-point Likert scale, with higher scores indicating a greater severity of depressive symptomatology. The CESD-R has high internal consistency (α= .93; Van Dam & Earleywine, 2011). Although there is no known information on the test-retest reliability of the CESD-R, the CES-D has acceptable test-retest reliability over 2 weeks (*r*= .51), considering normal fluctuations in depressive symptoms (Radloff, 1977) and is strongly correlated with the CESD-R (Eaton et al., 2004).

Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994). The DMQ-R is a 20-item measure that assesses motives for consuming alcohol. Questions are rated on a five-point Likert scale, with higher scores indicating greater coping motives. The DMQ-R has 5 subscales that reflect social, coping, enhancement, and conformity motives, respectfully. Whereas the DMQ-R was originally developed to assess drinking motives in adolescents, it is a valid assessment of motives in other populations, including undergraduate students (MacLean & Lecci, 2000) and adults (Piasecki et al., 2014). The DMQ-R has good internal consistency (α= .89; Chandley et al., 2013) and good criterion-related validity (Cooper, 1994).

Short Inventory of Problems-Recent (SIP-R; Miller et al., 1995). The SIP-R is a 15-item measure of the frequency of alcohol-related problems. It is an abbreviated version of the 50-item *Drinker Inventory of Consequences* (DrInC; Miller et al., 1995). Items are rated on a 4-point Likert scale, with higher scores indicating greater frequency of negative consequences of consuming alcohol. The SIP-R has five subscales that assess the frequency of different types of

consequences: physical, interpersonal, intrapersonal, impulse control, social responsibility. The SIP-R total and subscale scores are strongly correlated to the corresponding subscale of the DrInC (*r*= .80 to .96; Forcehimes, Tonigan, Miller, Kenna, & Baer, 2007). Furthermore, the SIP-R total score has good internal consistency (α= .89; Miller et al., 1995), good convergent validity (*r*= .68 with the *Addiction Severity Index-6*; Alterman, Cacciola, Habing, Ivey, & Lynch, 2009) and excellent test-retest reliability (*r*= .94; Miller et al., 1995).

Depression Anxiety Stress Scales-21 item version (DASS-21; Lovibond & Lovibond, 1995). The DASS-21 is a 21-item measure of three emotional states, depression, anxiety and stress, each assessed on via a 7-item subscale. The Depression scale assesses symptoms of dysphoric mood (e.g., feeling worthless). The Anxiety scale assesses symptoms of autonomic arousal and panic (e.g., trembling), and the Stress scale assesses symptoms of distress and negative affect (e.g., overreacting to situations). The DASS-21 is an abridged version of the DASS-42 (Lovibond & Lovibond, 1995). DASS-21 subscale scores are multiplied by two, and are therefore comparable to DASS-42 scores. The DASS-21 has excellent psychometric properties. The internal consistency of the total score is α= 0.88 (Henry & Crawford, 2005), and α= .82 to .94 for the three scales (Antony, Bieling, Cox, Enns, & Swinson, 1998; Henry & Crawford, 2005). Antony et al. (1998) reported that all the scales demonstrate high convergent validity, as the Depression scale is correlated with the BDI-II (*r*= .79), and the Anxiety scale is correlated with the *Beck Anxiety Inventory* (BAI; Beck & Steer, 1990) (*r*= .85). The Stress scale is correlated with the BDI-II (*r*= .69), BAI (*r*= .70) and the *State-Trait Anxiety Inventory- Trait* (STAI-T; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) (*r*= .68). The 3-month test-retest reliability for the scales is *r*= .59 for the Depression scale, *r*= .65 for the Anxiety scale, and *r*= .77 for the Stress scale (Gomez, Summers, Summers, Wolf, & Summers, 2007). Of note, the

CESD-R, not the DASS-21 depression subscale, was the primary depression measure. The DASS-21 assesses the presence of symptoms associated with depressed *mood*, whereas the CESD-R is a measure of the frequency and severity of symptoms of *major depressive episode*, as defined by the DSM-IV-TR (APA, 2000), and the latter was of interest in the present study.

Treatment Credibility and Change Expectancy Measure.

Credibility/Expectancy Questionnaire (CEQ; Borkovec & Nau, 1972). The CEQ is a 6-item measure that assesses perceptions of treatment credibility and expectations of change in response to the treatment being offered. Credibility and expectancy are assessed on separate, 3-item subscales. All items on the credibility subscale are rated on a 9-point (i.e., 1-9) Likert scale. Of the items on the expectancy subscale, one item is rated on the 9-point scale, and the other two items are rated on an 11-point (i.e., 0% to 100%, in increments of 10%) Likert scale. Therefore, items 4 and 6 were standardized via linear transformations to create distributions with a minimum of 1 and a maximum of 9 (Devilly & Borkovec, 2000; Smeets, 2006). Total scores were calculated by finding the mean score of the items on each subscale. The CEQ has excellent internal consistency for the credibility and expectancy subscales (α= .86 and .90, respectively; Devilly & Borkovec, 2000). The test-retest reliability is good to excellent over 1 week (r= .75 for the credibility subscale, r= .82 for the expectancy subscale; Devilly & Borkovec, 2000). The CEQ was administered immediately after the psychoeducation session in Visit 1.

CEQ results were compared to benchmarks adapted from previous studies. Given that there is no known single-session, psychoeducation/interoceptive exposure intervention study that administered the CEQ, benchmarks were adapted from previous research on an AS-specific intervention (i.e., Smits, Berry, et al., 2008) and a full CBT treatment (Borkovec & Costello, 1993). These studies were chosen as the best representations of the range of acceptable

credibility and expectancy scores. Credibility and expectancy scores from the two studies were averaged to create benchmarks of ≥ 6.25 on the credibility subscale and ≥ 6.13 on the expectancy subscale.

Behavioural measure. Reactions to physical sensations were assessed via a CO_2 challenge, which involved a single breath inhalation of CO_2 enriched air (35% CO_2; 65% O_2). Participants began the CO_2 challenge by being connected to a breathing circuit. The breathing circuit consisted of a disposable 30mm inner diameter, mouthpiece (single-participant use) fixed to a bacterial/viral filter (single-participant use) and connected to plastic tubing. The tubing was connected to the gas-mixing chamber, which was connected to a respiratory flowhead (i.e., pneumotach). The pneumotach was connected to a two-way nonrebreathing valve, one side of which was exclusively used for expiration and the other side for inspiration. The inspiratory port was connected to a manual stopcock with two connections: one to feed room air (to be used for the baseline and placebo inhalations), and the second to feed the CO_2-enriched air (35% CO_2; 65% O_2) from a gasbag.

Prior to the participants' arrival to the lab, the experimenter prepared the breathing circuit by disconnecting the gasbag (Hans Rudolph, nondiffusing gas collection bag [15L] and a 4-way stopcock, 2500 series) from the breathing circuit and filling it with CO_2-enriched air from the gas tank. The gasbag was then reconnected the circuit, and a new Pulmoguard filter was attached to the tubing connected to the gas mixing chamber. A new mouthpiece was then attached to the other end of the Pulmoguard filter.

To begin the CO_2 challenge, participants were asked to sit in a comfortable chair and were connected to a clinical vital signs monitor (Criticare Systems Inc., Model 5060DXNT, USA). The monitor's blood pressure cuff was attached to the participants' nondominant arm, and

the oxygen saturation finger clip sensor was connected to a finger on his/her nondominant hand. Participants were asked to put on a new (single-participant use) nose clip, and place the mouthpiece in his/her mouth. To establish baseline measures, participants were asked to breathe normally on the breathing circuit (which was feeding room air) for 3 minutes. During this time, their vital capacity was measured by asking him/her to exhale as big a breath of as possible, inhale, hold this breath for 4 seconds, and then exhale fully (recorded by AD Instruments, PowerLab System 8/30, with Chart Pro Modules). The CO_2 administration then occurred via the breathing circuit, with the stopcock turned to deliver CO_2-enriched air. As the participants exhaled, the stopcock was immediately adjusted back to room air. A recovery period followed, during which participants breathed normal room air off the breathing circuit. The CO_2 challenge ended following the final recovery period. Of note, only CO_2 inhalations that were of at least 80% of vital capacity were included in statistical analyses.

Participants were asked to record their reactions to physical sensations immediately following the baseline and CO_2 inhalations via two measures. First, participants were asked to complete the Visual Analogue Scale (VAS) and rate their current anxiety by placing a mark on the 10cm long line. The change in VAS score from baseline to post CO_2 challenge provided a measure of reactivity to CO_2. Second, participants completed the *Acute Panic Inventory* (API; Liebowitz, Gorman, Fyer, Dillon, & Klein, 1984), a 17-item measure of physiological and cognitive arousal symptoms. Participants were asked to rate the severity of each symptom on a 4-point Likert scale. Total symptom scores (TSS) were calculated for each administration. The change in TSS from baseline to post-CO_2 challenge provided a second measure of reactivity to CO_2.

Psychoeducation intervention

The *Anxiety Sensitivity Education and Reduction Training* (ASERT; Keough & Schmidt, 2012) was administered in the present study. The ASERT training was developed based on the ASAT training (Schmidt et al., 2007). The ASERT protocol presented information about stress, AS, and physiological arousal. The experimenter presented this information with the aid of a PowerPoint presentation, which, along with all psychoeducation materials, was provided by the authors of the original study. The intervention lasted approximately 50 minutes and was delivered individually to each participant. At the end of the presentation, participants were asked to engage in a number of brief activities designed to induce physical sensations to determine which exercise produced the most fear. For each activity, participants were asked to report: 1) the sensations they experienced; 2) the intensity of the sensations, from 0 to 10; and 3) the intensity of their distress as a result of the sensations, from 0 to 10. The three BATs that induced the most distress were recorded for each participant. Participants were then asked to complete a set of interoceptive exposure of the activity that produced the most distress. They were asked to repeatedly complete trials until they reported minimal distress (0-1) or had completed at least 10 trials. Participants were taught how to record their progress on the homework monitoring forms, and had the opportunity to ask the experimenter questions. Participants were then asked to complete the three most fear-inducing interoceptive exposures for homework every day for the duration of the study.

Participants in the control condition received information about general health and nutrition topics. Termed *Physical Health Education Training* (PHET; Keough & Schmidt, 2012), participants received information about diet, exercise, sleep habits, and alcohol and water consumption. The PHET intervention was designed to last approximately 50 minutes and was delivered individually to each participant. This control condition attempted to account for the

nonspecific effects of treatment (e.g., time spent interacting with the experimenter, opportunity to ask questions), while not providing information that directly targets AS. For the purpose of the present study, the PHET protocol was modified slightly to include information from Canadian (versus American) sources (i.e., use of nutritional recommendations from Health Canada, rather than the United States Department of Agriculture). At the end of the presentation, the health behaviour monitoring form was introduced. Participants practiced completing the form with the experimenter by recording their sleep, exercise level, and food/water/alcohol intake for the previous day, and had the opportunity to ask the experimenter questions. Participants were asked to record this information daily for the duration of the study and received several copies of the record forms.

Homework quantity and quality was assessed using Keough and Schmidt's (2012) indices of quantity and quality. For participants in the ASERT condition, homework *quantity* was determined by the number of days the homework was completed (i.e., any information was recorded on the monitoring form). Homework *quality* was based on the proportion of trials for which each of the following were recorded: 1) the interoceptive exposure exercise that was attempted; 2) sensations experienced; and 3) thoughts experienced. Of note, Keough and Schmidt (2012) did not report the specific indices of homework quality and quantity for participants in the PHET condition. Therefore, homework quality and quantity measures for the PHET condition were devised based on the PHET record form that was administered to participants in the PHET condition by Keough and Schmidt (2012) and were designed to be similar to the ASERT homework indices. For participants in the PHET condition, homework *quantity* was based on the number of days the homework was completed (i.e., any information was recorded on the monitoring form). Homework *quality* was assessed based on the proportion

of trials for which each of the following sections of the monitoring form were completed in their entirety: 1) sleep time; 2) food consumed; 3) water consumed; 4) alcohol consumed; and 5) amount of exercise. Homework quantity and quality were examined as measures of treatment adherence. Therefore, there were no specific hypotheses about the effect of homework completion on change in AS or symptoms.

Procedure

The study procedure is depicted in Figure 1. Potential participants first completed a telephone screen to determine eligibility. This involved oral administration of the ASI-3 (Taylor et al., 2007), select sections of the MINI 7.0 and the MHQ. People who met the eligibility criteria were invited to the Psychology Research and Training Centre (PRTC) at Ryerson University.

Visit 1. Upon their arrival to the PRTC, participants were asked to provide written informed consent (see Appendix D for consent form). The MINI 7.0 was then administered in its entirety. Participants were asked to complete the Demographics Questionnaire (Appendix E), the self-report measures, visual dot-probe task, and the CO_2 challenge. Participants were then randomly assigned to either the ASERT condition or the PHET condition and received the assigned training. Immediately after completing the training, participants were asked to complete the measures of AS, negative interpretation bias, perceived control, attentional bias (i.e., the visual dot probe task) and the CEQ. Prior to the end of the session, participants received the monitoring forms.

Visit 2. Approximately 2 weeks later, participants returned to the PRTC. Participants were asked to complete the self-report measures and the visual dot-probe task. Participants were also asked to submit their monitoring forms and received new ones.

Visit 3. Participants returned to the PRTC 2 weeks after Visit 2. Participants were asked to complete the MHQ, self-report measures, the visual dot-probe task, the CO_2 challenge, and to submit their monitoring forms.

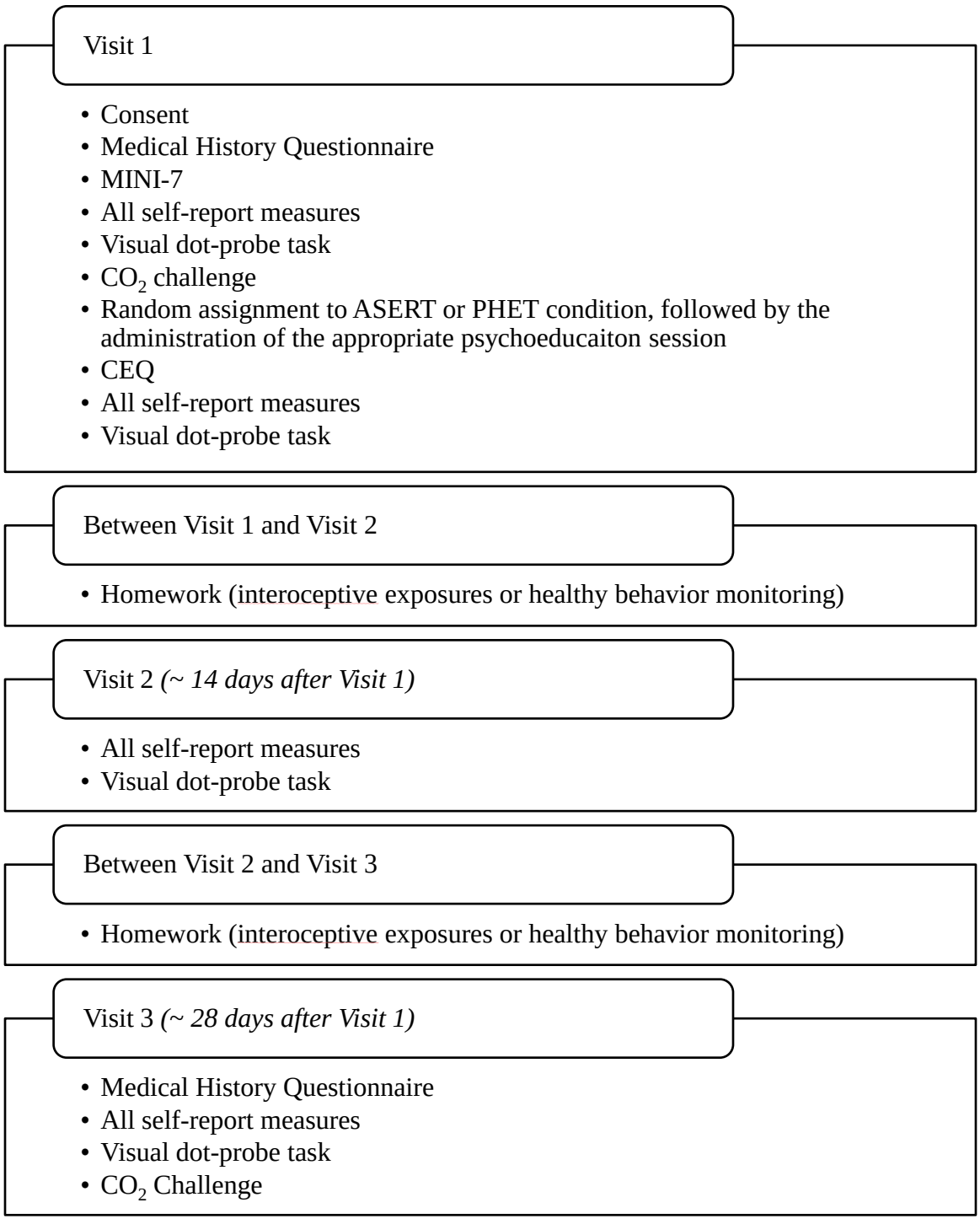

Figure 1. Outline of Study 1 Procedure. MINI 7.0= *Mini International Neuropsychiatric Interview 7.0* (Sheehan, 2014); CO_2 Challenge= carbon dioxide challenge. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*.

Results

Data Screening

The data were screened for outliers, which were data points with *z*-scores greater than |3.29| (Tabachnick & Fidell, 2007). Using this criterion, four outliers were identified and were replaced by the second most extreme value in the distribution. Additionally, independent *t*-tests were used to assess between-group differences on outcome measures at pretest. There were significant baseline between-group differences in ASI-3 scores. Participants in the ASERT condition (M= 40.83, SD= 10.94) scored significantly higher on the ASI-3, $t(33)= 2.58$, $p< .05$, Cohen's d= 0.89, compared to participants in the PHET condition (M= 32.63, SD= 7.08). There were no other significant baseline differences. Subsequent analyses controlled for baseline ASI-3 total scores.

Analytic Plan

Hypotheses 1 to 3 were tested using Hierarchical Linear Modeling (HLM; Raudenbush, Bryk, Cheong, Congdon, & du Toit, 2004). HLM has several advantages over traditional analyses that compare means, such as *t*-tests or Analyses of Variance (ANOVAs). HLM is robust to violations of the assumption of normality (Maas & Hox, 2004) and HLM allows for the inclusion of all participants, regardless of missing data (e.g., due to dropout or missed assessments; Raudenbush & Bryk, 2002), which is particularly important in a longitudinal study. Finally, HLM analyses provide more precise estimates of means by accounting for the reliability of within-group scores, between-group scores and the number of observations, (Nelzek, 2008).

Data were transformed using grand mean centering prior to HLM analyses. Grand mean centering increases the precision of estimates of main effects and interactions in multilevel data. This is accomplished by dictating the location of the intercept in each analysis (Wu &

Wooldridge, 2005). Grand mean centering is advantageous over other types of transformations because it reduces covariance between intercepts and slopes, and therefore reduces multicollinearity (Hofmann & Gavin, 1998).

To fully investigate the effects of the ASERT intervention (Hypotheses 1 to 3), HLM analyses were applied to the total model to examine the effects of ASERT over the whole study. Main effects of time and condition, and an interaction of Time x Condition were produced by the HLM analyses. Planned contrasts were applied to examine within-condition changes in the ASERT and PHET conditions, respectively, and to test between-group differences. Bonferonni corrections were applied to all analyses. To control for baseline ASI-3 scores, ASI-3 was included as a covariate in all analyses excluding those involving the ASI-3 as the independent variable, as HLM analyses are designed to account for differences at the first assessment point.

Mediation analyses were conducted via *Mplus* 7.0 (Muthén & Muthén, 2015) to test Hypothesis 4. Mplus uses Structural Equation Modeling (SEM) to examine the direct and indirect pathways of change and to determine whether the hypothesized model provides a good fit to the data. Several indices are used to examine model fit. Adequate model fit is characterized by: comparative fit index (CFI) and Tucker-Lewis Index (TLI) ≥ 0.95; and root-mean-square error of approximation (RMSEA) ≤ 0.06 (Byrne, 2011).

Treatment Delivery

There were no significant between-group differences in the number of days between study visits for the ASERT and PHET conditions. There were, however, significant differences in the length of the intervention between the two conditions. Length of the intervention included both the time the experimenter spent delivering the psychoeducation materials (i.e., PowerPoint presentation), and the activities after the psychoeducation portion that were specific to each

condition (i.e., completing activities to induce physical sensations and interoceptive exposures in ASERT condition; reviewing and completing health monitoring form in PHET condition). The average length (in minutes) of the ASERT intervention (*M*= 64.26, *SD*= 10.36) was significantly longer, $t(33) = 7.59$, $p < .01$, than that of the PHET condition (*M*= 43.88, *SD*= 3.01). There were no significant between-group differences in the amount of time spent delivering the psychoeducation presentation, $t(31) = -0.59$, $p = .56$ (ASERT, *M*= 36.32, *SD*= 9.39; PHET, *M*= 37.86, *SD*= 2.91). However, the experimenter spent significantly longer discussing homework and practicing interoceptive exposures with the ASERT condition (*M*= 27.95, *SD*= 6.96) than was spent discussing homework with the PHET condition, $t(31) = 11.09$, $p < .01$ (*M*= 6.57, *SD*= 2.06).

Treatment Adherence

Homework quantity and quality were examined as measures of treatment adherence. Homework quantity was defined as the number of days that participants in the ASERT and PHET condition recorded *any* information on their respective monitoring forms. For the ASERT condition, homework quality was the proportion of trials for which each participants recorded the interoceptive exposure attempted, the sensations experienced and the thoughts experienced (Keough & Schmidt, 2012). For the PHET condition, homework quality was based on the proportion of trials for which information was recorded in all sections of the monitoring form. In general, homework completion was poor for participants in the ASERT condition, as 36.80% of participants (*n*= 7) had quantity scores of 0 and 47.40% of participants (*n*= 9) had quality scores of 0. In contrast, 6.30% of participants in the PHET condition (*n*= 1) had quantity scores of 0, and 6.30% of PHET participants (*n*= 1) had quality scores of 0. There were significant differences in both homework quantity and quality ratings between the ASERT and PHET

conditions. Participants in the PHET condition (*M*= 24.75, *SD*= 10.00) completed homework on significantly more days than participants in the ASERT condition, *t*(30)= -5.19, *p*< .01 (*M*= 15.79, *SD*= 13.21). Moreover, homework completed by participants in the PHET condition (*M*= 0.92, *SD*= 0.19) was of a significantly higher quality than that completed by participants in the ASERT condition, *t*(33)= -2.26, *p*< .05 (*M*= 0.28, *SD*= 0.41). Of note, ASI-3 baseline scores correlated neither with homework quality nor quantity, *r*= .03-.11, *p*= .53-.87.

Treatment expectancy and credibility

The CEQ was administered to all participants immediately after the psychoeducation intervention. Scores on the credibility subscale ranged from 3.33 to 9 in the ASERT condition and 3 to 9 in the PHET condition. Scores on the expectancy scale ranged from 3.27 to 8.67 in the ASERT condition to 1.33 to 7.60 in the PHET condition. Independent sample *t*-tests were used to examine potential differences in credibility and/or expectancy beliefs between conditions. There were no significant differences in credibility beliefs, *t*(31)= -0.46, *p*= .65, between the ASERT (*M*= 6.38, *SD*= 1.70) and PHET conditions (*M*= 6.67, *SD*= 1.73). There were also no significant differences in expectancy beliefs, *t*(30)= 1.40, *p*= .17, between the ASERT (*M*= 5.61, *SD*= 1.57) and PHET conditions (*M*= 4.76, *SD*= 1.86).

CEQ subscale scores were compared to previously discussed benchmarks of ≥ 6.25 for the credibility subscale and ≥ 6.13 for the expectancy subscale. Using these benchmarks, participants in both conditions viewed the intervention as credible, although participants in both conditions did not expect that the intervention would change their symptoms.

Scores on the CEQ were correlated with change scores on the other study measures to determine the relationship between credibility beliefs, expectancy beliefs and constructs under investigation in the present study. Change scores were calculated by subtracting scores at Visit 3

from baseline scores. Credibility and expectancy scores were not significantly correlated with any process or symptom variable. Correlations ranged from *r*= -.24 to .40 for the credibility subscale, and *r*= -.19 to .29 for the expectancy subscale.

Posthoc Power Analysis

A *posthoc* power analysis was conducted to determine the statistical power of the present analyses. The power analysis focused specifically on the effect of the interaction of Time x Condition on ASI-3 scores, as AS was one of the primary dependent variables in the present study. Power analyses were conducted with *G*Power 3.1* (Faul, Erdfelder, Bychner & Lang, 2009). Given that G*Power is not designed to compute power of HLM analyses, the power of the interaction of Time x Condition in a repeated measures ANOVA was used to estimate power. Independent variables were Time (four time points) and Condition (ASERT versus PHET). ASI-3 score was the dependent variable. Repeated measures ANOVA was chosen as the substitute analysis because of its similarity to HLM and ability to compute a Time x Condition interaction. Although this approach was not ideal, it was considered vital to have an estimate of *posthoc* power. The results provided a power estimate of .64, which is lower than the .80 power level recommended by Cohen (1988). Analyses also revealed that 50 participants would be required for an 80% chance of this effect being detected at the α= .05 level.

Hypothesis 1: Process Measures

ASI-3. Mean scores and standard deviations for the ASI-3 separated by condition are reported in Table 2. The results of the HLM analyses for the ASI-3 are displayed in Table 3. There was a main effect of condition, indicating that there was a significant difference in ASI-3 scores between the ASERT and PHET conditions, with participants in the ASERT condition reporting significantly higher ASI-3 scores. There was no main effect of time, nor was there an

interaction of Time x Condition. There were no significant changes in ASI-3 score in either condition, nor were there significant between-group differences.

BBSIQ. Mean scores and standard deviations for all three BBSIQ subscales, separated by condition, are presented in Table 2. The results of the HLM analyses are presented in Tables 4 to 6. The Panic-Negative Beliefs (Panic-Neg) subscale assesses the extent to which participants believe that a hypothetical situation involving ambiguous physical sensations would be resolved in a negative manner, and the Panic-Neutral Beliefs (Panic-Neu) subscale assesses the degree to which participants believed that a hypothetical situation involving ambiguous physical sensations would be resolved in a neutral or positive manner. There were no main effects or interactions, nor were there significant changes or differences between the ASERT and PHET conditions for both the Panic-Neg and Panic-Neu subscale.

The Ranking subscale represents participants' rankings of the negative explanations for the ambiguous physical sensations in each hypothetical scenario. Because the Ranking subscale is reverse coded, *lower* scores represent *weaker* negative interpretive biases regarding ambiguous physical sensations. There were no main effects or interactions. There was, however, a significant reduction in Ranking scores in only the ASERT condition, b= -0.10, SE= 0.03.

ACQ-R. The ACQ-R assessed participants' perceptions of control over aversive experiences and emotional states. Mean scores and standard deviations for the ACQ-R, separated by condition are reported in Table 2, and the results of the HLM analyses for the ACQ-R are displayed in Table 7. There were no significant main effects, interactions or contrast analyses for the ACQ-R.

Visual Dot-Probe Task. Positive attention bias scores represent a bias *towards* benign interpretations, with larger scores representing *stronger* biases. Mean scores and standard

deviations, separated by condition are reported in Table 2, and the results of the HLM analyses are displayed in Table 8. There were no significant main effects, interactions or contrast analyses for the attentional bias score.

Table 2

Study 1- Means and Standard Deviations of All Process Variables Separated by Condition

	ASERT	Within Cohen's *d*	PHET	Within Cohen's *d*	Between Cohen's *d*
ASI-3 Total					
Baseline [a]	40.83 (10.94)	--	32.63 (7.10)	--	-0.89
Posttest	36.72 (15.21)	0.27	33.13 (8.47)	-0.07	-0.29
2 weeks	39.47 (13.09)	0.13	33.02 (8.80)	-0.05	-0.58
4 weeks	33.67 (16.28)	0.54	33.33 (11.94)	0.14	-0.02
BBSIQ Beliefs Panic Negative					
Baseline	3.80 (1.80)	--	2.79 (1.84)	--	-0.55
Posttest	3.51 (1.79)	0.64	2.68 (1.89)	0.42	-0.45
2 weeks	3.64 (1.64)	0.22	2.94 (1.71)	-0.16	-0.42
4 weeks	3.18 (1.83)	0.46	3.38 (1.90)	-0.02	0.11
BBSIQ Beliefs Panic Neutral [b]					
Baseline	5.30 (0.91)	--	5.59 (1.18)	--	0.06
Posttest	5.49 (1.08)	-0.28	5.79 (1.05)	-0.46	0.28
2 weeks	5.41 (1.11)	-0.18	5.66 (1.06)	-0.09	0.23
4 weeks	5.49 (1.08)	-0.37	5.48 (0.96)	-0.41	-0.01
BBSIQ Panic Ranking					
Baseline	1.81 (0.51)	--	1.58 (0.53)	--	-0.44
Posttest	1.54 (0.55)	0.86	1.52 (0.55)	0.16	-0.04
2 weeks	1.62 (0.57)	0.63	1.45 (0.49)	0.44	-0.32

		ASERT	Within Cohen's *d*	PHET	Within Cohen's *d*
4 weeks	1.58 (0.59)	0.63	1.59 (0.51)	0.34	0.01
ACQ-R					
Baseline	39.68 (7.08)	--	36.14 (5.06)	--	-0.58
Posttest	43.06 (10.12)	-0.53	36.00 (8.17)	0.02	-0.77
2 weeks	41.20 (8.44)	-0.07	38.44 (6.62)	-0.34	-0.36
4 weeks	41.33 (10.13)	-0.08	37.00 (6.14)	-0.24	-0.52
Attention Bias Score					
Baseline	-2.73 (9.90)	--	-0.50 (9.15)	--	-0.23
Posttest	2.06 (9.53)	0.46	5.45 (12.12)	0.36	-0.31
2 weeks	3.28 (15.47)	0.44	-0.96 (8.43)	-0.03	0.34
4 weeks	-2.41 (16.65)	0.10	-1.07 (9.99)	-0.13	-0.10

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). BBSIQ = *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997); BBSIQ Beliefs Panic Negative= rating of the probability of negative explanations of ambiguous physical sensations. BBSIQ Beliefs Panic Neutral= ratings of the probability of neutral explanations of ambiguous physical sensations. BBSIQ Ranking = rankings of the negative explanations of ambiguous physical sensations. BBSIQ Ranking is reverse scored; lower scores represent weaker negative interpretive biases in response to ambiguous physical sensations. ACQ-R= *Anxiety Control Questionnaire- Revised* (Brown et al., 2004). Attention Bias scores calculated by subtracting the mean reaction time when the dot is paired with a threat word from the mean reaction time when the dot is paired with a benign word. Positive attention bias scores represent a bias *towards* benign interpretations. Within Cohen's *d*= within-group Cohen's *d* value representing the magnitude of the change in scores from Baseline to each timepoint. Between Cohen's *d*= between-group Cohen's *d* value representing the magnitude of the difference in scores between the ASERT and PHET conditions.

[a] Participants in the ASERT condition produced significantly higher baseline ASI-3 scores, $t(33)= 2.58$, $p< .05$, Cohen's $d= 0.89$ compared to participants in the PHET condition.

[b] Higher scores on the BBSIQ Panic-Neu subscale represent weaker negative interpretive biases.

Table 3

Study 1- Multilevel Models for ASI-3 as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	-0.42	2.37	-0.18
Time	-0.68	1.26	-0.54
Condition	8.92	3.23	2.76**
Time x Condition	-1.56	1.75	-0.89
Contrasts			
ASERT	-2.23	1.21	-1.84
PHET	-0.68	1.26	-0.54
Difference	-1.56	1.75	-0.89

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 4

Study 1- Multilevel Models for BBSIQ Beliefs Panic-Negative as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	-0.53	0.56	-0.95
Time	0.08	0.15	0.56
Condition	1.36	0.76	1.78
Time x Condition	-0.32	0.21	-1.52
Contrasts			
ASERT	-0.24	0.15	-1.61
PHET	0.08	0.15	0.56
Difference	-0.32	0.21	-1.52

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. BBSIQ Beliefs Panic Negative= Beliefs Panic subscale of the *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997). This scale represents the rating of the probability of *negative* explanations of ambiguous physical sensations. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 5

Study 1- Multilevel Models for BBSIQ Beliefs Panic-Neutral as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	0.15	0.27	0.55
Time	0.03	0.06	0.46
Condition	-0.39	0.37	-1.04
Time x Condition	0.08	0.09	0.90
Contrasts			
ASERT	0.11	0.06	1.77
PHET	0.03	0.06	0.46
Difference	0.08	0.09	0.90

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. BBSIQ Beliefs Panic Neutral= Beliefs Panic subscale of the *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997). This scale represents the rating of the probability of *neutral* explanations of ambiguous physical sensations. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*p< .05; **p< .01

Table 6

Study 1- Multilevel Models for BBSIQ Ranking as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	-0.05	0.14	-0.38
Time	-0.04	0.04	-1.10
Condition	0.23	0.19	1.22
Time x Condition	-0.06	0.05	-1.15
Contrasts			
ASERT	-0.10	0.03	-2.86**
PHET	-0.04	0.04	-1.10
Difference	-0.06	0.05	-1.15

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. BBSIQ Ranking= Ranking subscale of the *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997). This scale represents the rankings of the negative explanations of ambiguous physical sensations. BBSIQ Ranking is reverse scored; lower scores represent weaker negative interpretive biases in response to ambiguous physical sensations. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 7

Study 1- Multilevel Models for ACQ-R as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	-1.42	2.08	-0.68
Time	0.58	0.63	0.92
Condition	5.17	2.83	1.83
Time x Condition	-0.44	0.87	-0.51
Contrasts			
ASERT	0.14	0.60	0.24
PHET	0.58	0.63	0.92
Difference	-0.44	0.87	-0.51

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. ACQ-R= *Anxiety Control Questionnaire- Revised* (Brown et al., 2004). The ACQ-R assesses perceptions of control over aversive experiences and emotional states. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 8

Study 1- Multilevel Models for Attention Bias Scores as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	6.09	3.31	1.84
Time	-0.71	1.36	-0.53
Condition	-3.32	4.49	-0.74
Time x Condition	0.99	1.86	0.53
Contrasts			
ASERT	0.22	1.27	0.21
PHET	-0.71	1.36	-0.53
Difference	0.99	1.86	0.53

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. Attention Bias score was calculated by subtracting the mean reaction time when the dot is paired with a threat word from the mean reaction time when the dot is paired with a benign word. Positive attention bias scores represent a bias *towards* benign interpretations. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*p< .05; **p< .01

Hypothesis 2: Symptom measures

The means and standard deviations of all the symptom measures, separated by condition, are reported in Table 9. The results of the HLM analyses are presented in Tables 10 to 17. There were no significant main effects, interactions or contrast analyses for the PDSS-SR, GAD-Q-IV, CESD-R, SIP-R, DASS-21 anxiety or DASS-21 stress. With regards to the SPIN, although there were no main effects or interactions, contrast analyses revealed a significant reduction in SPIN scores in only the ASERT condition, *b*= -3.02, SE= 1.15. As for the DMQ-R, there were also no main effects or interactions. There was, however, a significant reduction in DMQ-R scores in only the ASERT condition, *b*= -3.18, SE= 1.44.

Table 9

Study 1- Means and Standard Deviations of Symptom Variables Separated by Condition

	ASERT	Within Cohen's *d*	PHET	Within Cohen's *d*	Between Cohen's *d*
PDSS-SR					
Baseline	6.16 (4.86)	--	4.31 (2.68)	--	-0.47
2 weeks	5.00 (3.64)	0.55	3.67 (2.75)	0.26	-0.41
4 weeks	5.93 (4.22)	0.20	3.85 (5.21)	0.03	-0.44
SPIN					
Baseline	35.53 (15.99)	--	35.31 (12.30)	--	-0.02
2 weeks	32.07 (16.46)	0.31	33.92 (11.25)	0.14	0.13
4 weeks	28.20 (17.16)	0.70	29.67 (15.08)	0.44	0.10
GAD-Q-IV					
Baseline	9.73 (1.49)	--	10.26 (0.74)	--	0.45
2 weeks	9.90 (1.92)	-0.02	10.48 (1.07)	-0.05	0.37
4 weeks	10.30 (1.61)	-0.08	10.28 (1.03)	0.20	-0.01
CESD-R					
Baseline	35.62 (20.78)	--	27.25 (22.55)	--	-0.39
2 weeks	27.60 (15.79)	0.69	21.88 (18.09)	0.35	-0.34
4 weeks	28.67 (17.63)	0.60	24.09 (24.33)	-0.14	-0.22
DMQ-R					
Baseline	41.53 (19.37)	--	43.80 (21.65)	--	0.11
2 weeks	34.27 (16.23)	0.52	37.88 (18.72)	0.43	0.21

	ASERT	Within Cohen's *d*	PHET	Within Cohen's *d*	Between Cohen's *d*
4 weeks	34.40 (16.48)	0.46	35.19 (20.32)	0.32	0.04
SIP-R					
Baseline	1.21 (2.32)	--	0.75 (1.88)	--	-0.22
2 weeks	0.80 (2.15)	0.21	0.81 (2.76)	-0.03	< 0.01
4 weeks	2.67 (4.58)	-0.46	0.25 (0.62)	0.35	-0.74
DASS- Anxiety					
Baseline	17.37 (10.33)	--	12.63 (6.36)	--	0.55
2 weeks	15.47 (10.91)	0.29	11.38 (9.87)	0.16	0.39
4 weeks	14.27 (8.71)	0.39	14.31 (11.86)	-0.13	-0.01
DASS-Stress					
Baseline	21.26 (8.44)	--	19.63 (8.98)	--	-0.19
2 weeks	21.47 (10.70)	0.10	15.88 (8.41)	0.39	-0.59
4 weeks	21.33 (12.11)	0.07	17.38 (12.50)	0.10	-0.32

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. PDSS-SR= *Panic Disorder Severity Scale- Self-Report* (Houck et al., 2002). SPIN= *Social Phobia Inventory* (Connor et al., 2000). GAD-Q-IV= *Generalized Anxiety Disorder Questionnaire* (Newman et al., 2002). CESD-R= *Centre for Epidemiological Studies-Depression Scale-Revised* (Eaton et al., 2004). DMQ-R= *Drinking Motives Questionnaire-Revised* (Cooper, 1994). SIP-R= *Short Inventory of Problems-Recent* (Miller et al., 1995). DASS-21 Anxiety= the Anxiety subscale of the *Depression Anxiety Stress Scales-21* (Lovibond & Lovibond 1995). DASS-21 Stress= the Stress subscale of the *Depression Anxiety Stress Scales-21* (Lovibond & Lovibond 1995). Within Cohen's *d*= within-group Cohen's *d* value representing the magnitude of the change in scores from Baseline to each timepoint. Between Cohen's *d*= between-group Cohen's *d* value representing the magnitude of the difference in scores between the ASERT and PHET conditions.

Table 10

Study 1- Multilevel Models for PDSS-SR as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	< -0.01	1.19	< 0.01
Time	-0.56	0.51	-1.12
Condition	1.33	1.61	0.83
Time x Condition	0.21	0.69	0.30
Contrasts			
ASERT	-0.36	0.47	-0.76
PHET	-0.56	0.51	-1.12
Difference	0.21	0.69	0.30

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. PDSS-SR= *Panic Disorder Severity Scale- Self-Report* (Houck et al., 2002). The PDSS-SR assesses the severity of panic disorder symptoms. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. **p*< .05; ***p*< .01

Table 11

Study 1- Multilevel Models for SPIN as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	3.97	3.95	1.01
Time	-2.14	1.24	-1.73
Condition	1.06	5.35	0.20
Time x Condition	-0.88	1.69	-0.52
Contrasts			
ASERT	-3.02	1.15	-2.62*
PHET	-2.14	1.24	-1.73
Difference	-0.88	1.69	-0.52

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. SPIN= *Social Phobia Inventory* (Connor et al., 2000). SPIN assesses the severity of social anxiety disorder symptoms. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 12

Study 1- Multilevel Models and for GAD-Q-IV as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	0.74	0.44	1.69
Time	-0.25	0.27	-0.92
Condition	-0.94	0.55	-1.70
Time x Condition	0.23	0.35	0.67
Contrasts			
ASERT	-0.01	0.22	-0.07
PHET	-0.25	0.27	-0.92
Difference	0.23	0.35	0.67

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. GAD-Q-IV= *Generalized Anxiety Disorder Questionnaire* (Newman et al., 2002). This measure assesses the presence of symptoms of GAD. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. **p*< .05; ***p*< .01

Table 13

Study 1- Multilevel Models for CESD-R as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	-5.35	6.14	-0.87
Time	-0.12	2.30	-0.05
Condition	12.80	8.31	1.54
Time x Condition	-4.06	3.12	-1.30
Contrasts			
ASERT	-4.18	2.12	-1.98
PHET	-0.12	2.30	-0.05
Difference	-4.06	3.12	-1.30

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. CESD-R= *Centre for Epidemiological Studies-Depression Scale-Revised* (Eaton et al., 2004). This measure assesses the severity of symptoms of a major depressive episode. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 14

Study 1- Multilevel Models for DMQ-R as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	0.98	5.27	0.19
Time	-1.12	1.52	-0.74
Condition	-0.23	7.18	-0.03
Time x Condition	-2.06	2.10	-0.98
Contrasts			
ASERT	-3.18	1.44	-2.20*
PHET	-1.12	1.52	-0.74
Difference	-2.06	2.10	-0.98

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. DMQ-R= *Drinking Motives Questionnaire- Revised* (Cooper, 1994). This measure assesses the motives for consuming alcohol. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 15

Study 1- Multilevel Models for SIP-R as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	0.29	0.77	0.37
Time	-0.30	0.41	-0.74
Condition	-1.00	1.06	-0.94
Time x Condition	1.04	0.56	1.87
Contrasts			
ASERT	0.73	0.38	1.94
PHET	-0.30	0.41	-0.74
Difference	1.04	0.56	1.87

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. SIP-R= *Short Inventory of Problems-Recent* (Miller et al., 1995). The SIP-R assesses the frequency of alcohol-related problems. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 16

Study 1- Multilevel Models for DASS-21 Anxiety as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	-0.94	2.96	-0.32
Time	-0.35	1.26	-0.28
Condition	6.39	4.01	1.59
Time x Condition	-1.51	1.71	-0.89
Contrasts			
ASERT	-1.86	1.15	-1.61
PHET	-0.35	1.26	-0.28
Difference	-1.51	1.71	-0.89

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. DASS-21 Anxiety= the Anxiety subscale of the *Depression Anxiety Stress Scales-21* (Lovibond & Lovibond 1995). This subscale assesses the autonomic arousal and panic symptoms. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 17

Study 1- Multilevel Models for DASS-21 Stress as Associated with Time and Condition

	b	*SE*	*t*
Model Analyses			
Intercept	1.89	2.84	0.66
Time	-2.27	1.55	-1.46
Condition	0.08	3.85	0.02
Time x Condition	2.06	2.12	0.97
Contrasts			
ASERT	-0.04	1.48	-0.03
PHET	-2.27	1.55	-1.46
Difference	2.06	2.12	0.97

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. DASS-21 Stress= the Stress subscale of the *Depression Anxiety Stress Scales-21* (Lovibond & Lovibond 1995). This subscale assesses symptoms of negative affect and general distress. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Hypothesis 3: Behavioural Measures

Participants completed a CO_2 challenge as an *in vivo* measure of reactions to physical sensations. The study was designed so that every participant would complete CO_2 challenge. However, due to recruitment challenges, exclusion criteria were adjusted. Participants were invited to complete the study if they endorsed one or more medical exclusions, provided that they did not endorse any other any exclusion criteria and these medical conditions would not exclude them from completing the ASERT intervention. These participants were asked to complete all study tasks *except* the CO_2 challenge, and therefore, only a subset of the participants completed the CO_2 challenge. Of the 27 participants who were not asked to complete the CO_2 challenge: 8 participants had not had a physical exam that deemed them healthy in the past 12 months (i.e., either had not had a physical exam, or had a physical exam that deemed them not healthy); 7 endorsed symptoms or diagnoses of medical conditions; 7 endorsed multiple exclusion criteria (e.g., no physical exam *and* history of fainting); 2 were taking medications (i.e., antibiotics, antihistamines; and 3 were excluded for unrecorded reasons.

Therefore, 8 participants were eligible to complete the CO_2 challenge. Of those participants, two were unable to complete the task during at least one visit due to scheduling and/or equipment issues. Two participants discontinued the task because their diastolic blood pressure increased over 110, one participant was unable to complete the task because of taking antibiotics and one participant discontinued the task because their oxygen saturation level dropped below 90%. Therefore, six participants (ASERT n= 5; PHET n=1) completed the CO_2 challenge during at least one visit.

Valid trials were considered those in which the CO_2 inhalations were at least 80% of vital capacity. There were two valid trials during baseline (i.e., Visit 1) administration of the CO_2

challenge. There was one valid trial during the final (i.e., Visit 3) administration. Given the extremely small sample size, the CO_2 challenge was removed from the study. Therefore, there was no behavioural measure of reactions to physical sensations included it the final study. Implications will be discussed in forthcoming sections.

Hypothesis 4: Mediation analyses

It was hypothesized that change in negative interpretation bias, perceived control and negative attentional bias would each uniquely predict changes in AS. Therefore, three separate mediation analyses were conducted. In each analysis, Condition was the independent variable, ASI-3 total score was the dependent variable, and negative interpretation bias, perceived control and attentional bias were the mediator variables, respectively. Although the results of three interpretation bias subscales were previously reported, only the BBSIQ Ranking subscale was used in the mediation analyses, as this was the only measure of interpretation bias in which there were significant effects of the intervention (i.e., there was a significant reduction in interpretation biases in the ASERT condition only).

Of note, mediation analyses were conducted regardless of the presence of treatment effects (i.e., direct effects). Indirect effects can be observed in the absence of direct effects (Rucker, Preacher, Tormala, & Petty, 2011). Given that many factors, including precision of variable measurement, strength of relationships between the variables, suppression effects, and size of the total effect, could affect the ability to detect both direct and indirect effects, it is appropriate to test for indirect effects in the absence of a direct effect (Rucker et al., 2011). Therefore, mediation analyses were conducted for all three hypothesized mediators, as it was considered prudent to investigate the effects of the proposed mediators.

The first mediation analysis examined the effects of change in negative interpretation bias on change in AS level, and is depicted in Figure 2. The fit indices indicated excellent fit, $\chi^2(0)$= 0.00, *p*= 1.00; CFI= 1.00; TLI= 1.00; RMSEA= 0.00. Change in BBSIQ Ranking scores predicted change in ASI-3 scores, *b*= 13.51, *p* <.01, 95% CI [8.66, 18.53]. Condition did not predict Ranking scores, *a*= -0.11, *p*= .48, 95% CI [-0.37, 0.15], nor did it predict change in ASI-3 scores, *c*= -3.65, *p*= .15, 95% CI [-7.79, 0.50]. Moreover, the indirect effect was nonsignificant, *c'* = -1.51, *p*= .50, 95% CI [-5.22, 2.21]. Therefore, change in Ranking scores did not mediate the effect of training on change in ASI-3 scores.

The second mediation analysis examined the effects of change in perceived control on change in AS level, and is depicted in Figure 3. The fit indices indicated excellent fit, $\chi^2(0)$= 0.00, *p*= 1.00; CFI= 1.00; TLI=1.00; RMSEA= 0.00. Change in ACQ-R scores did not predict change in ASI-3 total scores, *b*= 0.50, *p*= .11, 95% CI [-0.01, 1.01]. Condition also did not predict ACQ-R scores, *a*= -4.15, *p*= .05, 95% CI [-7.70, -0.60], and also did not predict change in ASI-3 total scores, *c*= -3.20, *p*= .35, 95% CI [-8.86, 2.46]. Again, the indirect effect was not significant, *c'*= -2.07, *p*= .18, 95% CI [-4.60, 0.46]. Therefore, change in ACQ-R did not mediate the effect of training on change in ASI-3 scores.

The third mediation analysis examined the effects of change in negative attentional bias on change in AS level, and is depicted in Figure 4. The fit indices indicated excellent fit, $\chi^2(0)$= 0.00, *p*= 1.00; CFI= 1.00; TLI= 1.00; RMSEA= 0.00. Change in attention bias scores did not predict change in ASI-3 total scores, *b*= -1.06, *p*= .15, 95% CI [-2.27, 0.16], nor did Condition, *a*= 1.04, *p*= .67, 95% CI [-3.00, 5.08]. Also, Condition did not predict change in attention bias scores, *c*=-4.24, *p*= .18, 95% CI [-9.43, 0.95]. The indirect effect was nonsignificant, *c'*= -1.10,

p= .64, 95% CI [-5.04, 2.83]. Therefore, change in attention bias scores did not mediate the effect of training on change in ASI-3 scores.

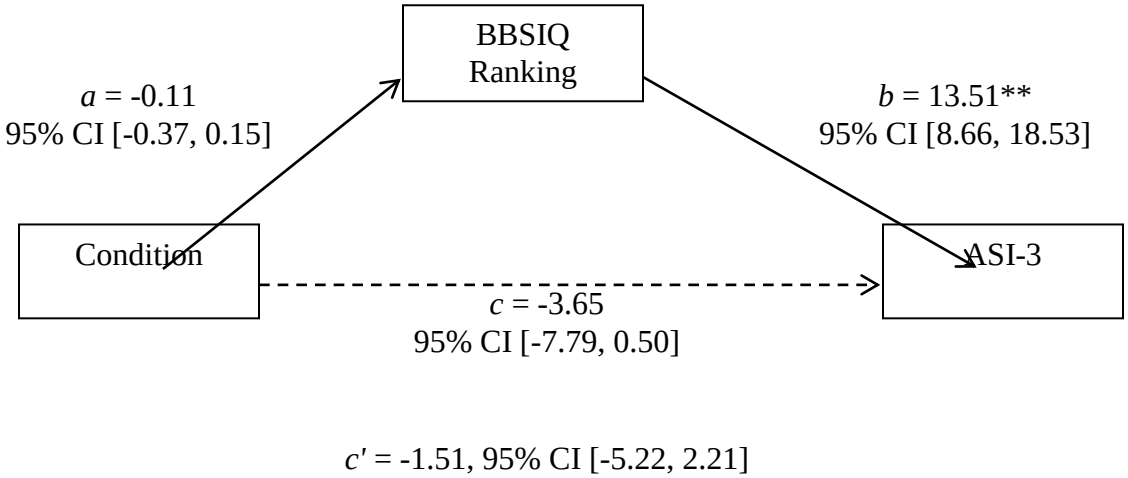

Figure 2. Study 1- Results of the analyses investigating BBSIQ Ranking as a mediator of the effect of training on change in ASI-3 scores. ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). BBSIQ Ranking= Ranking subscale of the *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997). This scale represents the rankings of the negative explanations of ambiguous physical sensations. BBSIQ Ranking is reverse scored; lower scores represent weaker negative interpretive biases in response to ambiguous physical sensations. The fit indices indicated excellent fit, $\chi^2(0)= 0.00$, $p= 1.00$; CFI= 1.00; TLI= 1.00; RMSEA= 0.00. Change in Ranking did not mediate the effect of training on change in ASI-3 scores.
*$p< .05$ **$p<.01$.

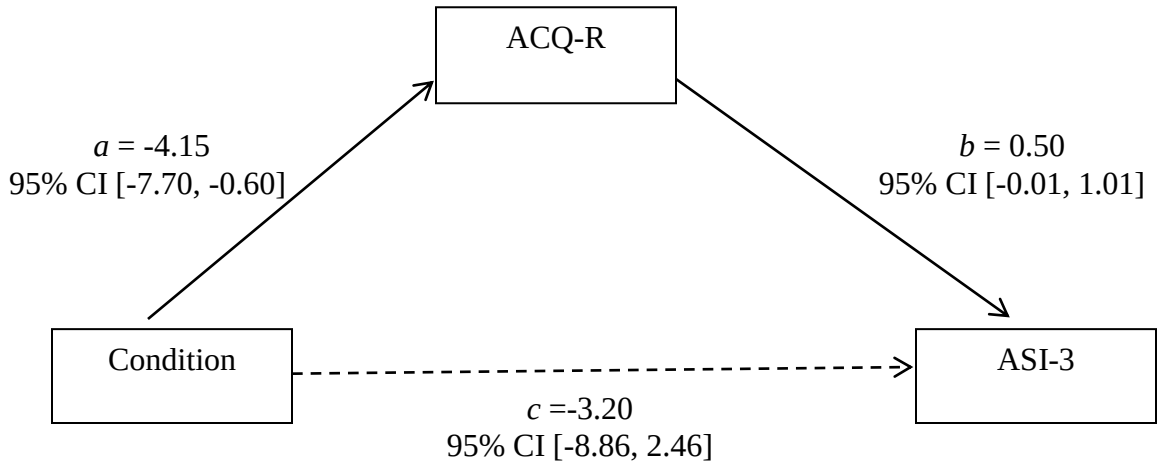

Figure 3. Study 1- Results of the analyses investigating ACQ-R as a mediator of the effect of training on change in ASI-3 scores. ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). ACQ-R= *Anxiety Control Questionnaire- Revised* (Brown et al., 2004). The fit indices indicated excellent fit, $\chi^2(0)= 0.00$, $p= 1.00$; CFI= 1.00; TLI=1.00; RMSEA= 0.00. Change in ACQ-R did not mediate the effect of training on change in ASI-3 scores.
*$p< .05$ **$p<.01$.

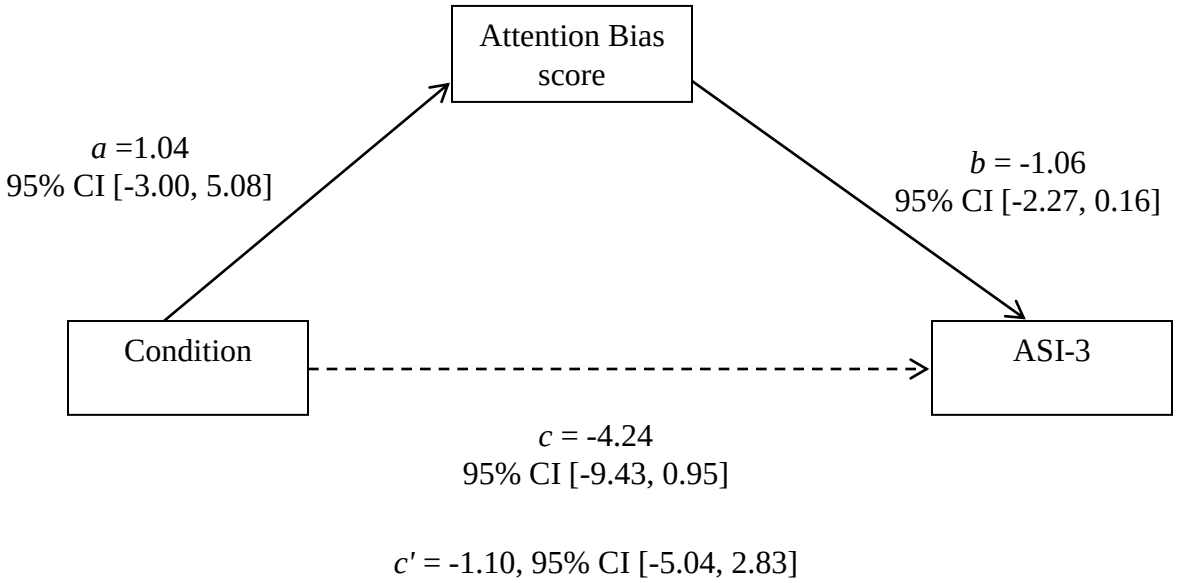

Figure 4. Study 1- Results of the analyses investigating Attention Bias score as a mediator of the effect of training on change in ASI-3 scores. ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). Attention Bias score was calculated by subtracting the mean reaction time when the dot is paired with a threat word from the mean reaction time when the dot is paired with a benign word. The fit indices indicated excellent fit, $\chi^2(0)= 0.00$, $p= 1.00$; CFI= 1.00; TLI= 1.00; RMSEA= 0.00. Change in attention bias scores did not mediate the effect of training on change in ASI-3 scores.
*$p< .05$ **$p<.01$.

Analyses with Homework Completers

As previously noted, homework completion was poor, especially for participants in the ASERT condition, as 36.80% of participants had homework quantity scores of 0 and 47.40% had quality scores of 0. Therefore, almost half of ASERT participants did not complete the treatment as intended, which could have negatively influenced the results discussed in the previous section. To investigate this possibility, Hypotheses 1 and 2 were tested again in a subset of the sample that completed at least some homework. Participants who scored greater than 0 on each homework quantity and quality were included in the sample. This resulted in samples of n= 9 in the ASERT condition and n= 13 in the PHET condition. The n in each condition is extremely small, which potentially creates reliability and validity issues (Snijders, 2005). However, it was considered prudent to investigate the effect of homework completion on treatment efficacy. Therefore, the following analyses should be considered preliminary, and the results must be interpreted in the context of the small sample size.

Within the homework completer subset of the sample, there were no significant differences between the ASERT and PHET conditions on the number of days on which at least some homework was completed, $t(20)$= -0.49, p= .63 (ASERT, M= 26.22, SD= 4.55; PHET, M= 27.31, SD= 5.41). However, homework completed by participants in the PHET condition (M= 0.89, SD= 0.16) was of significantly higher quality, $t(20)$= -2.42, p< .05, than the homework completed by participants in the ASERT condition (M= 0.57, SD= 0.44).

Preliminary analyses.

Baseline between-group differences were found in three measures. For the ASI-3, participants in the ASERT condition (M= 46.44, SD= 10.79) displayed significantly higher scores on the ASI-3 compared to participants in the PHET condition, $t(20)$= 3.25, p< .01,

Cohen's *d*= 1.34 (*M*= 34.38, *SD*= 6.68). Similar pattern of results was found the ACQ-R. Participants in the ASERT condition (*M*= 41.89, *SD*= 8.59) displayed significantly higher scores, *t*(20)= 2.15, *p*< .05, Cohen's *d*= 0.89, compared to participants in the PHET condition (*M*= 35.48, *SD*= 5.42). The final baseline difference was found in the PDSS-SR, as participants in the ASERT condition (*M*= 8.22, *SD*= 4.99) displayed significantly more panic symptoms than participants in the PHET condition, *t*(20)= 2.52, *p*< .05, Cohen's *d*= 1.04 (*M*= 4.00, *SD*= 2.86).

All subsequent analyses controlled for baseline ASI-3 and ACQ-R scores by including ASI-3 and ACQ-R as a covariate in all analyses excluding those involving the ASI-3 and ACQ-R as independent variables, respectively. PDSS-SR was included as a covariate in all analyses of symptom measures, expect those that included PDSS-SR as an independent variable. PDSS-SR could not be controlled for in all analyses due to the limitations of the design and syntax of SPSS. Specifically, stacked data files are required to complete HLM analyses in SPSS, and all variables in each data file must have the same number of time points. PDSS-SR was administered three times over the course of the study, while the process measures were administered four times. Therefore, baseline PDSS-SR was not controlled for in the analyses of the process measures to preserve all data points for theses measures.

Homework completers: Hypothesis 1.

ASI-3. Mean scores and standard deviations for the ASI-3 scores for the homework completers, separated by condition, are reported in Table 18, and the HLM results are presented in Table 19. There was no main effect of time, nor was there an interaction of Time x Condition. There was a main effect of condition, indicating that there was a significant difference in ASI-3 scores between the ASERT and PHET conditions over the whole study. According to the

contrast analyses, only participants in the ASERT condition displayed significant reductions in ASI-3 scores, *b*= -3.93, SE= 1.57.

BBSIQ. Mean scores and standard deviations for all BBSIQ subscales for homework completers, separated by condition, are presented in Table 18, and the HLM results are presented in Tables 21 to 23. There were no main effects, interactions, or contrasts for the Panic-Neg and Panic-Neu subscale. As for the Ranking subscale, there were no significant main effects or interactions. Nonetheless, there was a significant reduction in Ranking scores in only the ASERT condition, *b*= -0.13, SE= 0.05.

ACQ-R. Mean scores and standard deviations for the ACQ-R for homework completers, separated by condition are reported in Table 18, and the HLM results are displayed in Table 24. There was a main effect of condition, with participants in the PHET condition reporting significantly lower ACQ-R scores over the course of the study. There were no other significant main effects, interactions or contrast analyses for the ACQ-R.

Visual Dot-Probe Task. Mean scores and standard deviations for homework completers, separated by condition, are reported in Table 18, and the HLM results are displayed in Table 25. There were no significant main effects, interactions or contrast analyses for the attentional bias score.

Table 18

Means and Standard Deviations of Process Variables For Homework Completers Separated by Condition

	ASERT	Within Cohen's *d*	PHET	Within Cohen's *d*	Between Cohen's *d*
ASI-3 Total					
Baseline [a]	46.44 (10.79)	--	34.38 (6.68)	--	1.34
Posttest	44.11 (12.47)	0.29	33.93 (8.66)	0.06	0.95
2 weeks	40.44 (15.82)	0.51	35.26 (8.22)	-0.09	0.41
4 weeks	34.56 (19.58)	0.86	33.33 (11.93)	0.14	0.08
BBSIQ Beliefs Panic Negative					
Baseline	4.50 (1.58)	--	3.12 (1.83)	--	0.81
Posttest	3.97 (1.71)	0.77	3.12 (1.83)	0.26	0.48
2 weeks	3.97 (1.81)	0.29	3.29 (1.55)	-0.14	0.40
4 weeks	3.02 (1.98)	0.86	3.38 (1.90)	-0.02	-0.18
BBSIQ Beliefs Panic Neutral [b]					
Baseline	5.27 (1.04)	--	5.38 (1.12)	--	-0.10
Posttest	5.55 (1.19)	-0.35	5.63 (1.03)	-0.58	-0.07
2 weeks	5.44 (1.02)	-0.17	5.62 (1.12)	-0.34	-0.17
4 weeks	5.45 (1.20)	-0.26	5.48 (0.96)	-0.41	-0.03
BBSIQ Panic Ranking					
Baseline	2.11 (0.37)	--	1.69 (0.53)	--	0.92
Posttest	1.79 (0.60)	0.70	1.62 (0.56)	0.18	0.29

	ASERT	Within Cohen's *d*	PHET	Within Cohen's *d*	Between Cohen's *d*
2 weeks	1.75 (0.62)	0.71	1.52 (0.51)	0.50	0.41
4 weeks	1.68 (0.73)	0.77	1.56 (0.51)	0.34	0.20
ACQ-R[c]					
Baseline	41.89 (8.59)	--	35.48 (5.42)	--	0.89
Posttest	44.45 (13.26)	-0.32	36.38 (8.46)	-0.15	0.73
2 weeks	40.22 (10.39)	0.35	38.85 (6.64)	-0.50	0.16
4 weeks	40.33 (11.84)	0.29	37.00 (6.14)	-0.24	0.35
Attention Bias Score					
Baseline	-2.12 (9.42)	--	0.38 (8.60)	--	-0.28
Posttest	2.77 (7.66)	-0.50	3.19 (10.22)	-0.21	-0.05
2 weeks	3.84 (11.92)	-0.59	-3.60 (5.99)	0.41	0.79
4 weeks	-1.52 (11.66)	-0.04	-1.07 (9.99)	0.13	-0.04

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). BBSIQ = *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997); BBSIQ Beliefs Panic Negative= rating of the probability of negative explanations of ambiguous physical sensations. BBSIQ Beliefs Panic Neutral= ratings of the probability of neutral explanations of ambiguous physical sensations. BBSIQ Ranking = rankings of the negative explanations of ambiguous physical sensations. BBSIQ Ranking is reverse scored; lower scores represent weaker negative interpretive biases in response to ambiguous physical sensations. ACQ-R= *Anxiety Control Questionnaire- Revised* (Brown et al., 2004). Attention Bias scores calculated by subtracting the mean reaction time when the dot is paired with a threat word from the mean reaction time when the dot is paired with a benign word. Positive attention bias scores represent a bias *towards* benign interpretations. Within Cohen's *d*= within-group Cohen's *d* value representing the magnitude of the change in scores from Visit 1 Baseline to each timepoint. Between Cohen's *d*= between-group Cohen's *d* value representing the magnitude of the difference in scores between the ASERT and PHET conditions.

[a] Participants in the ASERT condition produced significantly higher baseline ASI-3 scores, $t(20)= 3.25$, $p< .01$, Cohen's $d= 1.34$, compared to participants in the PHET condition.

[b] Higher scores on the BBSIQ Panic-Neu subscale represent weaker negative interpretive biases.

[c] Participants in the ASERT condition displayed significantly higher scores on the ACQ-R, $t(20) = 2.15$, $p < .05$, Cohen's $d = 0.89$, compared to participants in the PHET condition.

Table 19

Study 1- Multilevel Models for ASI-3 as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	-4.03	1.99	-2.03*
Time	-0.54	1.32	-0.41
Condition	15.94	3.10	5.15**
Time x Condition	-3.39	2.05	-1.66
Contrasts			
ASERT	-3.93	1.57	-2.51*
PHET	-0.54	1.32	-0.41
Difference	-3.39	2.05	-1.66

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 20

Study 1- Multilevel Models for BBSIQ Beliefs Panic-Negative as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	-0.72	0.61	-1.17
Time	0.09	0.18	0.52
Condition	1.96	0.96	2.04
Time x Condition	-0.50	0.27	-1.82
Contrasts			
ASERT	-0.41	0.21	-1.94
PHET	0.09	0.18	0.52
Difference	-0.50	0.27	-1.82

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. BBSIQ Beliefs Panic Negative= Beliefs Panic subscale of the *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997). This scale represents the rating of the probability of *negative* explanations of ambiguous physical sensations. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 21

Study 1- Multilevel Models for BBSIQ Beliefs Panic-Neutral as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	0.05	0.31	0.16
Time	0.07	0.07	1.03
Condition	-0.09	0.48	-0.19
Time x Condition	-0.01	0.11	-0.12
Contrasts			
ASERT	0.06	0.08	0.70
PHET	0.07	0.07	1.03
Difference	-0.01	0.11	-0.12

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. BBSIQ Beliefs Panic Neutral= Beliefs Panic subscale of the *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997). This scale represents the rating of the probability of *neutral* explanations of ambiguous physical sensations. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 22

Study 1- Multilevel Models for BBSIQ Ranking as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	-0.17	0.15	-1.13
Time	-0.05	0.04	-1.06
Condition	0.47	0.23	2.00
Time x Condition	-0.09	0.07	-1.34
Contrasts			
ASERT	-0.13	0.05	-2.68*
PHET	-0.05	0.04	-1.06
Difference	-0.09	0.07	-1.34

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. BBSIQ Ranking= Ranking subscale of the *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997). This scale represents the rankings of the negative explanations of ambiguous physical sensations. BBSIQ Ranking is reverse scored; lower scores represent weaker negative interpretive biases in response to ambiguous physical sensations. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 23

Study 1- Multilevel Models for ACQ-R as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	-3.03	2.64	-1.15
Time	0.77	0.63	1.21
Condition	8.93	4.13	2.17*
Time x Condition	-1.67	0.97	-1.71
Contrasts			
ASERT	-0.90	0.74	-1.21
PHET	0.77	0.63	1.21
Difference	-1.67	0.97	-1.71

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. ACQ-R= *Anxiety Control Questionnaire- Revised* (Brown et al., 2004). The ACQ-R assesses perceptions of control over aversive experiences and emotional states. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 24

Study 1- Multilevel Models for Attention Bias Scores as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	3.75	2.95	1.27
Time	-1.47	1.16	-1.28
Condition	-3.09	4.59	-0.67
Time x Condition	1.76	1.78	0.99
Contrasts			
ASERT	0.29	1.36	0.21
PHET	-1.47	1.16	-1.28
Difference	1.76	1.78	0.99

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. Attention Bias score was calculated by subtracting the mean reaction time when the dot is paired with a threat word from the mean reaction time when the dot is paired with a benign word. Positive attention bias scores represent a bias *towards* benign interpretations. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Homework completers: Hypothesis 2.

The means and standard deviations of all the symptom measures for homework completers, separated by condition, are reported in Table 19. HLM results are presented in Tables 26 to 33. There were no significant main effects, interactions or contrast analyses for the GAD-Q-IV, DMQ-R, SIP-R, DASS-21 Anxiety and DASS-21 Stress. Although there were no main effects or interactions for the PDSS-SR, contrast analyses revealed a significant reduction in PDSS-SR scores in only the ASERT condition, *b*= -1.72, SE= 0.57. There was a similar pattern of results for the SPIN, as there were no significant main effects or interactions. There was, however, a significant reduction in SPIN scores in only the ASERT condition, *b*= -3.33, SE= 1.55. Finally, on the CESD-R, there was a main effect of condition, *b*= 21.01, SE= 9.03, whereby participants in the PHET condition displayed significantly lower CESD-R scores over the course of the study.

Table 25

Means and Standard Deviations of Symptom Variables For Homework Completers Separated by Condition

	ASERT	Within Cohen's *d*	PHET	Within Cohen's *d*	Between Cohen's *d*
PDSS-SR					
Baseline [a]	8.22 (4.99)	--	4.00 (2.86)	--	1.04
2 weeks	5.22 (4.27)	0.97	3.15 (2.58)	0.32	0.59
4 weeks	4.78 (4.30)	1.01	3.85 (5.21)	0.03	0.19
SPIN					
Baseline	35.44 (20.48)	--	32.92 (12.21)	--	0.15
2 weeks	33.00 (20.59)	0.35	32.98 (11.85)	-0.01	< 0.01
4 weeks	28.78 (20.21)	0.74	29.67 (15.08)	0.44	
GAD-Q-IV					
Baseline	10.55 (1.28)	--	10.29 (0.83)	--	0.24
2 weeks	10.99 (1.62)	-0.05	10.78 (0.55)	-0.56	0.17
4 weeks	11.06 (1.58)	-0.10	10.28 (1.03)	0.20	0.58
CESD-R					
Baseline	35.75 (22.41)	--	20.54 (14.18)	--	0.81
2 weeks	23.78 (16.74)	0.73	17.69 (13.07)	0.25	0.41
4 weeks	25.11 (19.42)	0.61	24.09 (24.33)	-0.14	0.05
DMQ-R					
Baseline	39.43 (20.05)	--	41.00 (23.46)	--	-0.07

	ASERT	Within Cohen's *d*	PHET	Within Cohen's *d*	Between Cohen's *d*
2 weeks	28.00 (9.63)	0.55	33.31 (17.35)	0.57	-0.37
4 weeks	28.00 (9.80)	0.54	35.19 (20.32)	0.32	-0.45
SIP-R					
Baseline	0.22 (0.67)	--	0.77 (2.05)	--	-0.36
2 weeks	0.00 (0.00)	0.33	1.00 (3.06)	-0.09	-0.46
4 weeks	0.00 (0.00)	0.33	0.25 (0.62)	0.35	-0.57
DASS- Anxiety					
Baseline	18.22 (12.71)	--	12.77 (7.05)	--	0.53
2 weeks	15.56 (12.24)	0.22	10.77 (10.28)	0.25	0.42
4 weeks	12.67 (8.25)	0.54	14.31 (11.86)	-0.13	-0.16
DASS-Stress					
Baseline	22.89 (8.55)	--	18.92 (9.89)	--	0.43
2 weeks	21.33 (12.21)	0.22	14.92 (9.00)	0.37	0.59
4 weeks	18.89 (12.57)	0.42	17.38 (12.50)	0.10	0.12

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. PDSS-SR= *Panic Disorder Severity Scale- Self-Report* (Houck et al., 2002). SPIN= *Social Phobia Inventory* (Connor et al., 2000). GAD-Q-IV= *Generalized Anxiety Disorder Questionnaire* (Newman et al., 2002). CESD-R= *Centre for Epidemiological Studies-Depression Scale-Revised* (Eaton et al., 2004). DMQ-R= *Drinking Motives Questionnaire-Revised* (Cooper, 1994). SIP-R= *Short Inventory of Problems-Recent* (Miller et al., 1995). DASS-21 Anxiety= the Anxiety subscale of the *Depression Anxiety Stress Scales-21* (Lovibond & Lovibond 1995). DASS-21 Stress= the Stress subscale of the *Depression Anxiety Stress Scales-21* (Lovibond & Lovibond 1995). Within Cohen's *d*= within-group Cohen's *d* value representing the magnitude of the change in scores from Visit 1 Baseline to each timepoint. Between Cohen's *d*= between-group Cohen's *d* value representing the magnitude of the difference in scores between the ASERT and PHET conditions.

[a] Participants in the ASERT condition produced significantly higher baseline ASI-3 scores, $t(20)= 2.52$, $p< .05$, Cohen's $d= 1.04$, compared to participants in the PHET condition.

Table 26

Study 1- Multilevel Models for PDSS-SR as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	-1.22	1.24	-0.99
Time	-0.60	0.48	-1.22
Condition	5.01	1.93	2.60
Time x Condition	-1.13	0.75	-1.52
Contrasts			
ASERT	-1.72	0.57	-3.04**
PHET	-0.60	0.48	-1.22
Difference	-1.13	0.75	-1.52

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. PDSS-SR= *Panic Disorder Severity Scale- Self-Report* (Houck et al., 2002). The PDSS-SR assesses the severity of panic disorder symptoms. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. *p< .05; **p< .01

Table 27

Study 1- Multilevel Models for SPIN as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	1.27	4.77	0.27
Time	-1.71	1.33	-1.29
Condition	3.85	7.44	0.52
Time x Condition	-1.62	2.04	-0.80
Contrasts			
ASERT	-3.33	1.55	-2.15*
PHET	-1.71	1.33	-1.29
Difference	-1.62	2.04	-0.80

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. SPIN= *Social Phobia Inventory* (Connor et al., 2000). SPIN assesses the severity of social anxiety disorder symptoms. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 28

Study 1- Multilevel Models for GAD-Q-IV as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	0.23	0.42	0.55
Time	-0.11	0.24	-0.44
Condition	-0.16	0.59	-0.26
Time x Condition	0.18	0.35	0.51
Contrasts			
ASERT	0.07	0.25	0.29
PHET	-0.11	0.24	-0.44
Difference	0.18	0.35	0.51

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. GAD-Q-IV= *Generalized Anxiety Disorder Questionnaire* (Newman et al., 2002). This measure assesses the presence of symptoms of GAD. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. **p*< .05; ***p*< .01

Table 29

Study 1- Multilevel Models for CESD-R as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	-8.92	5.81	-1.53
Time	1.31	2.54	0.52
Condition	21.01	9.03	2.33*
Time x Condition	-6.63	3.91	-1.70
Contrasts			
ASERT	-5.32	2.97	-1.79
PHET	1.31	2.54	0.52
Difference	-6.63	3.91	-1.70

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. CESD-R= *Centre for Epidemiological Studies-Depression Scale-Revised* (Eaton et al., 2004). This measure assesses the severity of symptoms of a major depressive episode. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 30

Study 1- Multilevel Models for DMQ-R as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	-0.46	4.95	-0.09
Time	-1.50	2.83	-0.53
Condition	1.28	7.98	0.16
Time x Condition	-3.47	4.43	-0.78
Contrasts			
ASERT	-4.96	3.41	-1.46
PHET	-1.50	2.83	-0.53
Difference	-3.47	4.43	-0.78

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. DMQ-R= *Drinking Motives Questionnaire- Revised* (Cooper, 1994). This measure assesses the motives for consuming alcohol. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 31

Study 1- Multilevel Models for SIP-R as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	0.64	0.70	0.91
Time	-0.26	0.33	0.77
Condition	-0.89	1.09	-0.82
Time x Condition	0.15	0.51	0.28
Contrasts			
ASERT	-0.11	0.39	-0.29
PHET	-0.26	0.33	0.77
Difference	0.15	0.51	0.28

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. SIP-R= *Short Inventory of Problems-Recent* (Miller et al., 1995). The SIP-R assesses the frequency of alcohol-related problems. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 32

Study 1- Multilevel Models for DASS-21 Anxiety as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	-2.26	3.45	-0.65
Time	-0.48	1.29	-0.37
Condition	8.30	5.38	1.54
Time x Condition	-2.30	1.98	-1.16
Contrasts			
ASERT	-2.78	1.51	-1.85
PHET	-0.48	1.29	-0.37
Difference	-2.30	1.98	-1.16

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. DASS-21 Anxiety= the Anxiety subscale of the *Depression Anxiety Stress Scales-21* (Lovibond & Lovibond 1995). This subscale assesses the autonomic arousal and panic symptoms. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Table 33

Study 1- Multilevel Models for DASS-21 Stress as Associated with Time and Condition for Homework Completers

	b	*SE*	*t*
Model Analyses			
Intercept	-0.03	3.15	-0.10
Time	-2.20	1.67	-1.31
Condition	4.52	4.89	0.92
Time x Condition	0.20	2.58	0.08
Contrasts			
ASERT	-2.00	1.96	-1.02
PHET	-2.20	1.67	-1.31
Difference	0.20	2.58	0.08

Note. ASERT= *Anxiety Sensitivity Education and Reduction Training*. PHET= *Physical Health Education Training*. DASS-21 Stress= the Stress subscale of the *Depression Anxiety Stress Scales-21* (Lovibond & Lovibond 1995). This subscale assesses symptoms of negative affect and general distress. Under Contrasts, *ASERT* represents within-group changes in the ASERT condition, and *PHET* represents within-group changes in the control condition. *Difference* represents a test of between-group differences.
*$p < .05$; **$p < .01$

Discussion

The purpose of the present study was to examine the immediate and short-term effects of ASERT, a psychoeducation/interoceptive exposure intervention for high AS, on AS, negative interpretive biases, attentional biases, perceived control, psychopathology symptoms and reactions to physical sensations. Mechanisms of change in AS in response to ASERT were also investigated.

Effect of ASERT on AS, Interpretive biases, Attentional biases and Perceived Control

It was hypothesized that, compared to participants in the control condition, those in the ASERT condition would display lower AS, lower negative interpretive biases in response to physical sensations, lower attentional biases for threatening information and higher perceived control. It was also hypothesized that participants in the ASERT condition would display greater reductions in these constructs. The results demonstrated that there was a significant main effect of condition on AS, with participants in the ASERT condition reporting lower ASI-3 scores compared to participants in the PHET condition. There was no main effect of time, nor was there a significant interaction of Time x Condition. Based on the mean ASI-3 scores at all timepoints (see Table 2), AS decreased in the ASERT condition over the course of the study and remained relatively stable in the PHET condition. This is consistent with previous research, that demonstrates that ASERT leads to reductions in AS (Keough & Schmidt, 2012). However, theses results must be considered in light of a significant baseline difference, whereby participants in the ASERT condition displayed significantly greater AS compared to the PHET condition prior to initiating the intervention (Cohen's d= -0.89). This is a large difference, and confounds the interpretation of the results. Given that random assignment was used to determine condition assignment, baseline differences were unexpected. Of note, the AS level of the ASERT

condition at Visit 3 (*M*= 33.67) was similar to that of the PHET condition at baseline (*M*= 32.67), which highlights the significant discrepancy between the conditions. Additionally, a *posthoc* power analysis indicated that the study was underpowered, power= .64, specifically for the ASI-3 analyses. Although this power analysis was based on a repeated measures ANOVA, which is an obvious limitation, this finding suggests that the sample size may have been too small to find true effects, which resulted in the increased possibility of making a Type II error. Considering all of these factors together, the present study cannot to used to deem ASERT as effective or ineffective at modifying AS.

Nonetheless, there are several factors that (cautiously) support ASERT as a potentially efficacious intervention. First, both conditions displayed clinically significant AS levels at baseline, and only the ASERT condition displayed decreases. Although these changes were statistically nonsignificant, they were of a medium magnitude (Cohen's *d*= 0.54). There was essentially no change in AS in the PHET condition over the course of the study (Cohen's *d*= 0.14). This suggests that there is something unique about the ASERT condition that specifically targets AS and supports the theoretical and clinical efficacy of ASERT. Second, the original Keough and Schmidt (2012) study used an undergraduate sample and reported that the baseline AS level in the ASERT condition was *M*= 29.40, *SD*= 15.38 as assessed via the original ASI (Reiss et al., 1986). The present study used a community sample and the baseline AS level in the ASERT condition was *M*= 40.83, *SD*= 10.94, as assessed via the ASI-3 (Taylor et al., 2007). When standardized as proportions of the total score of each measure, the ASERT condition in the present study displayed higher AS at baseline compared the ASERT in the original study (0.57 versus 0.46, respectively). Additionally, clinical diagnoses were not reported by Keough and Schmidt (2012), so it is not possible to compare psychopathology between the samples. Given

that higher AS is associated with increased psychopathology, the sample in the present study may have had increased psychopathology, and therefore, in general, may have been a more clinically severe sample. This could have negatively influenced the efficacy of the ASERT intervention. Finally, the role of homework must also be considered when interpreting the results. Homework compliance was low, irrespective of condition. The effect of homework noncompliance will be addressed in detail in subsequent sections.

The results of the interpretive bias measures were inconsistent with each other and not in line with hypotheses. There were no changes or differences found in the likelihood ratings of negative and neutral explanations of physical sensations. There was, however, a change in the rankings of negative explanations in only the ASERT condition, as participants rated the negative explanations as *less likely* to come to mind over time. Although it was hypothesized that changes would be found on all measures of interpretation bias, these results make sense given the minimal changes in AS. It is interesting that changes in interpretive biases were only observed in the ranking measure, which is consistent with other studies (e.g., MacDonald et al., 2013). The structure of the interpretation bias measure, the BBSIQ may have contributed to these findings. The Beliefs subscales require participants to rate the likelihood that an outcome of a situation is true, whereas the Ranking subscale requires participants to rank three outcomes in the order that they are likely to come to mind (Clark et al., 1997). Ranking outcomes may require less cognitive effort than considering the outcomes independent of other outcomes, as is the case with the Beliefs subscale. Therefore, the Ranking scale may be more amenable to change in response to ASERT. On the other hand, by being forced to compare outcomes to each other, participants may end up ranking items in a way that do not accurately represent their true beliefs. One way to determine if this is the case is by using an open-ended measure of interpretation bias. For

example, participants could be presented with a scenario describing a physical sensation and asked to describe the outcome of the situation. The *Interpretation Questionnaire* (McNally & Foa, 1987), from which the BBSIQ was developed, is presented in this format. Participants read fourteen ambiguous vignettes and are asked to report the first explanation that comes to mind. Blind raters code responses as anxiety-related, harm-related, or benign (McNally & Foa, 1987). This approach has several advantages, such as not limiting interpretations to those provided in the measure and allowing for assessment of all schemas without restrictions. Unfortunately, this type of measure was not used in the present study and therefore, the results must be considered in light of possible issues with the BBSIQ. Nonetheless, the results of the present study demonstrate that some facets of interpretation bias change in response to psychoeducation and interoceptive exposures designed to target AS.

With regards to changes in attentional biases and perceived control, there were no significant changes or differences observed in either of these constructs. This was not consistent with hypotheses. The visual dot-probe task in the present study was adapted from other studies assessing attentional biases associated with high AS (e.g., Hunt et al., 2006, Keogh et al., 2001, Taake et al., 2001). Given that all previous studies found different patterns of attentional bias in individuals with high versus low AS (or high versus low scores on the physical concerns subscale of the ASI), differences were anticipated in the present study. There are several factors that may have contributed to the null findings. First, these results must be considered in light of the limited changes across all dependent variables. With regards to attentional biases, the *combined cognitive bias hypothesis* suggests that changes in attentional and interpretive biases have an interactive effect on each other (Hirsch et al., 2006). Given that there were very minimal changes in measures of interpretive biases, the lack of changes in attentional biases may not be

surprising. Additionally, attentional bias assessment methods may have contributed to the null findings. In general, attentional bias research is known to have replication issues (Emmelkamp, 2012). It is a widespread and prominent problem, as studies using identical methodology have failed to replicate results. The structure of the visual dot-probe task is also believed to contribute to the problem. The task has limited ecological validity because of the use of single words stimuli (Mogg & Bradley, 1999), and lack of context of the words may wash out any biases that exist. Additionally, Mogg and Bradley (1999) suggested that participants might develop a biased monitoring strategy, and overly attend to one side of the computer screen, regardless of threat. This would skew the reaction times for trials where the dot is located on the other side of the screen. Unfortunately, these are participant-specific issues, and there is no way to predict for whom they will occur, which contributes to the replication challenges of the visual dot-probe task. It may be possible to investigate this idea using eye-tracking technology, which can determine the specific stimuli to which the participant attends, and the duration of attention on a given stimulus (Armstrong & Olatunji, 2012). Future research using eye-tracking could help understand some of the methodological issues in the attentional bias literature. As such, this issue is not limited to the present study. Moreover, the sample may have contributed to the null effects. In previous studies using the visual dot-probe task, participants with high AS were compared to participants with low AS, while in the present study, all participants had high AS at baseline. Despite changes in the ASERT condition, participants in both conditions were still classified as having high AS at the end of the study. High AS is defined as scoring ≥ 23 on the ASI-3, and at the final visit, the mean ASI-3 score in the ASERT condition was 33.67 and 33.33 in the PHET condition. This particular version of the visual dot-probe task may not have been sensitive enough to detect attentional bias changes in participants who were still considered to have high

AS. Taken together, the present results may have been confounded by methodological issues, and should not be considered evidence against the efficacy of ASERT training in modifying attentional biases.

There were no significant changes or differences on the measure of perceived control. This is in contrast to past research that consistently demonstrates low perceived control changes in response to interventions that modify AS (e.g., Gallagher et al., 2014). It is unclear why perceived control did not change, although it is possible that these analyses were afflicted by the same issues as the previous ones; that is, that the ASERT intervention had only minimal effects on AS, and these changes may not have been sufficient to warrant changes in constructs associated with high AS. Another explanation is that a general measure of perceived control may not have been sensitive to changes in facets of perceived control, as would be measured by the subscales of the ACQ-R (Brown et al., 2004). Interestingly, high perceived control was positively correlated with high AS in the present study at all time points, although, the correlation was significant only at the post assessment (i.e., end of Visit 1; $r = .42$, $p < .05$). This is in contrast to research that finds that high AS is positively correlated with *low perceived control* (e.g., Bentley et al., 2013). This was an unexpected finding, and it is unclear whether this was a random effect or a true effect. It is possible that, in the present study, participants with high AS may have genuinely believed that they had control over their emotional states, threatening experiences, and when experiencing stress. This sample was not treatment seeking and had responded to an advertisement looking for people who experience physical sensations and find them distressing. Presumably, participants were not experiencing significant impairment prior to the study because they had not sought treatment for their symptoms. Therefore, they may have believed that they could control their symptoms and experiences, and may have considered

their belief in their ability to control their symptoms as a positive or protective trait. Nonetheless, given the lack of changes in AS and the unexpected positive correlation between AS and perceived control, the results of the present study should be interpreted with caution. Based on previous research, perceived control tends to change in response to interventions for AS and that target AS, and may change in response to ASERT. Conclusive evidence for or against this hypothesis was not provided by this study.

Effect of ASERT on Psychopathology Symptoms

It was hypothesized that participants who completed the ASERT intervention would report lower psychopathology symptoms compared to participants who completed the PHET intervention, and psychopathology symptoms would only be reduced in the ASERT condition. In general, hypotheses were only partially supported. Contrary to hypotheses, participants in the ASERT and PHET conditions did not display differences in on psychopathology symptoms at any point during the study. Only participants in the ASERT condition displayed significant reductions in social anxiety symptoms and motivations to consume alcohol over the course of the study. There were no changes observed in panic symptoms, GAD symptoms, depressive symptoms, problems associated with alcohol use, general autonomic arousal symptoms and negative affect/distress.

Again, there are several possible explanations for the mainly null findings. First, although there were changes in AS in the ASERT condition, participants were still considered to have clinical levels of AS at the end of the study. Therefore, the changes in AS may not have been large enough to result in changes in psychopathology symptoms. Moreover, it is possible that the psychoeducation and interoceptive exposures were too general to result in changes in specific types of symptoms. AS interventions have been adapted to target specific sets of symptoms. For

example, Zvolensky and colleagues (2008) developed an intervention for smokers with high AS and examined the treatment efficacy in a case series. The treatment consisted of cognitive restructuring and interoceptive exposures aimed at reducing AS in the context of physical sensations associated with smoking cessation. The final part of the treatment consisted of behavioural counselling for smoking cessation. Four weeks after baseline, all three participants remained smoke free and demonstrated large and clinically significant change in AS over 4 weeks (Zvolensky, Yartz, Gregor, Gonzalez, & Bernstein, 2008). Given the lack of specificity in the ASERT intervention, it simply may not have targeted psychopathology symptom sets, such as the symptoms of generalized anxiety disorder, which may have contributed to the null effects. Adaptations of the ASERT intervention may be more effective at targeting specific sets of symptoms. Finally, homework noncompliance may have negatively influenced the results, which will be discussed in detail in a forthcoming section.

Despite these factors and the small changes in AS, there were reductions in social anxiety symptoms and motivation to consume alcohol in the ASERT condition. It is unclear why only these two sets of psychopathology symptoms improved. The psychoeducation presentation could have directly targeted SAD symptoms by means of targeting the social concerns of AS. For example, biased beliefs about the consequences of experiencing physical sensations in social settings were specifically discussed during the presentation. As for reductions in motivations to consume alcohol, these could have been related to the reduction in social anxiety symptoms. Participants may have been using alcohol to deal with anxiety in social situations, and had less need to consume alcohol as their anxiety decreased. This possibility was investigated *posthoc* by examining within-group changes in the ASERT condition on the coping subscale of the DMQ-R, which assesses the degree to which coping with negative emotions leads to alcohol consumption.

There were significant reductions in scores on the coping subscale from baseline to Visit 2, $t(12)= 2.91$, $p< 0.5$, and baseline to Visit 3, $t(12)= 2.42$, $p< .05$. However, this is a nonspecific subscale and inquires about mood, worries, and self-confidence concerns as motivations (Cooper, 1994), so it is not possible to definitively determine if decreased anxiety in social situations led to decreased motivation to drink. Additionally, scores on the SPIN and DMQ-R were not correlated at any time point, $r= -.26$ to $.02$, $p= .22$ to $.95$, which suggests that the two are not related. Finally, given the minimal changes in AS and lack of changes in other psychopathology symptoms, these findings could be spurious and unrelated to the intervention. In light of the previously discussed issues with the present study, more research is needed to be able to put forth conclusions about the effect of ASERT on psychopathology symptoms.

The CO_2 Challenge

The present study sought to extend the literature on the ASERT intervention by examining the effect of the intervention reactions to *in vivo* physical sensations on a CO_2 challenge. This was the first known study to attempt to examine the differences in CO_2 responses before and after the ASERT intervention. Unfortunately, very few participants were eligible to complete the CO_2 challenge due to the stringent medical/health exclusion criteria, which were necessary to ensure participant safety during the task. Moreover, of the few participants who completed the CO_2 challenge, several completed invalid trials, which meant that they might not have inhaled enough CO_2 to ensure that there would be clinical effects. Given the extremely small sample size, the CO_2 challenge was removed from the study, which is unfortunate. In this study, the problems associated with the CO_2 challenge, such as very strict inclusion/exclusion criteria, outweighed the benefits of the task, which included controlled and consistent induction

of sensations across participants. It is still known if reactions to physical sensations would have changed in response to the ASERT intervention, which is a question for future research.

Cognitive Mediators of Change in AS

Another goal of the present study was to investigate the degree to which changes in negative interpretive biases, perceived control, and attentional biases mediated change in AS in response to the ASERT intervention. Based on previous research and theoretical rationale, it was hypothesized that all three constructs would each mediate the effect of treatment on change in AS. None of these hypotheses were supported. Only changes in interpretive biases significantly predicted changes in AS, but yet it did not mediate the effect of treatment on change in AS. This is consistent with research finding that AS and negative interpretive biases change in accordance with each other (Richards et al., 2001) and adds to the literature by demonstrating that change in negative interpretive biases predict changes in AS. Given the lack of significant changes in AS, the null pathways in the mediation model are to be expected, and these results are inconclusive as to the mediating role of negative interpretive biases.

Perceived control and attentional biases also did not predict changes in AS, nor did condition or any interaction effects in either of these mediation analyses. However, these results must be interpreted in light of the minimal effects of ASERT across study outcomes. Although there was an main effect of condition on AS, these differences were likely driven by baseline differences, and were not the result of changes in response to the intervention, which may have confounded all of the mediation analyses. Moreover, ASERT training had no effect on perceived control and attentional biases. Considering that the mediation analyses were examining the mediating role of *changes* in perceived control and attentional biases, the nonsignificant mediation pathways is to be expected. Unfortunately, the lack of effects in response to the

intervention have also confounded the mediation results and these results should not be considered evidence for or against perceived control and attentional biases as cognitive mediators of AS change in response to ASERT.

The Role of Homework Completion

Homework compliance was limited in the present study. Almost 40% of participants in the ASERT condition completed no homework. Given that the ASERT intervention includes a psychoeducation session and 1 month of interoceptive exposures for homework, participants who did not complete homework completed only a small portion of the intervention as it was intended. Therefore, the effect of the ASERT intervention was examined in a subset of the sample that completed at least some homework. Participants who had scores above 0 on both the quality and quantity homework measures were included in the sample, which resulted in a very small sample (ASERT, *n*= 9; PHET, *n*= 13). This sample was extremely small, and any results should be interpreted with caution. The results differed slightly from those of the full sample. First, there were baseline differences on measures of AS, perceived control, and panic symptoms, whereby participants in the ASERT condition had significantly higher scores on all measures. These baseline differences contributed to the main effects of condition that were found for the measures of AS and perceived control. Similar to the results with the full sample, there were significant reductions in interpretation bias (assessed via the BBSIQ Ranking subscale) and social anxiety symptoms in the ASERT condition only. There was also a significant reduction in AS and panic symptoms in only the ASERT condition, which were not found in the analyses of the full sample. Finally, there was a significant effect of condition on depression, whereby participants in the ASERT condition had significantly higher depressive symptoms over the course of the study.

Overall, the results of analyses with the homework completers provide limited support for the hypotheses. In addition to the size of the sample, the criteria used to define *homework completers* should be considered when interpreting these findings. Participants who scored greater than 0 on both homework quantity and quality were included in the homework completer sample. This inclusion criterion was liberal and was selected to maximize the number of participants in this subsample. However, using a liberal cut score resulted in a sample with a wide range of homework quality and quantity scores. Although the inclusion criterion may have defeated the purpose of doing homework analyses, using more stringent inclusion criteria would have resulted in an extremely small sample size, for which HLM analyses could not have been conducted. Participants in this study, particularly in the ASERT condition, simply did not complete homework, which is a major limitation of the study, and make it difficult to determine the efficacy of the ASERT intervention. Additionally, as previously discussed, the present sample was more clinically severe than in the only other investigation of ASERT. When coupled with the fact that homework was generally not done, the null findings are not surprising. These results, however, should not be considered conclusive evidence against psychoeducation and interoceptive exposures as a treatment of psychopathology. Although the ASERT intervention generally did not modify cognitive processes, beliefs, and psychopathology symptoms, participants in the ASERT condition displayed (nonsignificant) changes in AS that were of a medium magnitude (Keough & Schmidt, 2012). Some part of the intervention was effective. Unfortunately, it is not possible to draw other conclusions from the present data, as there are numerous issues across the study.

The low level of homework compliance raises another issue: why did participants not do the interoceptive exposures between sessions? A simple explanation is that there was too much

homework. In the ASERT condition, participants were asked to complete up to three sets of interoceptive everyday for 4 weeks. In reality, this is a substantial undertaking and participants may not have been willing to commit to that much work outside of study visits. Keough and Schmidt (2012) did not report homework compliance. However, the Keough and Schmidt (2012) study was based on a doctoral dissertation by Keough (2011), which provided a more detailed description of the homework in the ASERT condition only, as homework quality and quantity scores were not calculated for participants in the PHET condition. In the ASERT condition, participants completed an average of 111.13 (*SD*= 58.39) interoceptive exposure trials over an average of 23.94 days (*SD*= 7.52). In the present study, participants completed an average of 137.50 (*SD*= 125.98) interoceptive exposure trials over an average of 15.08 days (*SD*=13.14). Therefore, it appears that participants in the present study completed more interoceptive exposure trials over fewer days, which suggests that homework compliance was not vastly different between the two studies, and cannot fully explain the discrepancy in findings. Regardless of homework compliance, 36.8% of participants in the ASERT condition did not complete any interoceptive exposures, suggesting that there may have been something interfering with homework completion. It is possible that participants did not fully understand the rationale for the exposures, and therefore, did not see the homework as an important part of the intervention. The rationale for exposures was discussed during the psychoeducation presentation. Participants also had the opportunity to ask the experimenter questions during the presentation and during the first set of interoceptive exposures completed in session with the experimenter. However, participants may have benefited from more explicit information about the rationale during the presentation. Moreover, there was no measure of rationale comprehension/internalization. Therefore, there was no way to assess their explicit

understanding of the relationship between AS, sensations and interoceptive exposures. The credibility and expectancy measures provided a general measure of participants' understanding of the ASERT intervention, and suggested that participants may not have fully understood the rationale, or at the very least, had some doubts about the intervention. Participants in the ASERT condition viewed the treatments as credible but reported low expectancy for change, as compared to the *a priori* benchmark scores. Essentially, participants believed that the treatment made sense, but were slightly doubtful that it would change their symptoms, which suggests a breakdown in at least part of the rationale comprehension.

This breakdown may have been related to the interoceptive exposures completed during the psychoeducation sessions. Although participants were supposed to complete enough trials for their fear/distress to decrease to 0 or 1, many participants asked to stop after three trials (which was lowest recommended number of trials for each set of exposures), and therefore did not complete a full set of exposures prior to beginning the homework. This could have negatively influenced participants in several ways. First, by not experiencing a reduction in fear/distress, participants did not have the opportunity to learn that their distress will decrease over multiple trials done in rapid succession. In other words, participants did not have a corrective learning experience during the first visit, and therefore, they may have been less likely to internalize the rationale and less likely to engage in the exposures for homework. Moreover, the experimenter may have unintentionally reinforced the beliefs about the dangerousness of the sensations by allowing the participants to stop/avoid the exposure after three trials. This is inconsistent with the goal of the exposure, and also may have decreased the likelihood of completing homework between sessions. Additionally, the ASERT intervention assumes a decontextualized approach to the interoceptive exposures, as participants are simply asked to complete the exposures and

records their experiences. Participants' specific AS beliefs/concerns were considered when selecting their interoceptive exposures, but were not explicitly challenged during the homework. The intervention assumes that decreasing fear of any physical sensations will lead to changes in AS beliefs. More explicit belief testing may be needed. For example, someone who has strong fears about the social consequences of physical sensations may benefit from testing their beliefs about negative evaluation or judgment through, for example, cognitive restructuring. This may be an important treatment consideration because decreasing the distress associated with the physical sensations does not address these specific beliefs. Taken together, the motivation to complete the exposures and the credibility/expectancy beliefs could have been low, which could have contributed to the low homework compliance. Finally, there may have also been external factors that inhibited participants from completing the homework, such as lack of time. Participants in the present study were not treatment seeking, and may have been less inclined to believe that their symptoms were distressing or interfering in their lives compared to people who were seeking treatment for similar symptoms. Intrinsic motivation to change, which stems from personal beliefs and values and not from external sources (Miller & Arkowitz, 2015), was likely low. Moreover, even assuming that participants had high intrinsic motivation for change, they may have had reservations about the treatment methods. Purposefully inducing physical sensations could be overwhelming to a person with fear of the consequences of physical sensations. Furthermore, the act of monitoring and examining anxious thoughts could be aversive. When considered together, even a highly motivated participant could have experienced ambivalence about the method of change (Slagle & Gray, 2007), which could have interfered with the homework compliance.

Of note, Keough and Schmidt (2012) reported that neither homework quality nor quantity predicted change in AS scores 1 week or 1 month following treatment. Therefore, increasing homework compliance may not have influenced results. Considering that the homework compliance was generally consistent with Keough and Schmidt (2012), as reported in Keough (2011), and was low in both studies, the effect of high homework compliance is unknown. Taken together, homework compliance was a notable issue in the present study, and its causes and implications are unclear. Future investigations of ASERT would benefit from paying specific attention to the cause and effect of homework noncompliance.

Limitations

This study has numerous limitations, all of which have been previously mentioned. First, the analyses of the efficacy of the ASERT intervention were confounded by baseline differences in AS, which is the primary dependent variable. This was a large difference (Cohen's *d*= -0.89), with participants in the ASERT condition showing significantly higher AS compared to participants in the PHET condition. Interpretation of the rest of the results must be considered in light of the fact that the ASERT condition had higher AS prior to any intervention. Relatedly, the study appeared to be underpowered for the ASI-3 analyses, so the risk of making a Type II error was high. Third, homework compliance was very low in the present study, with almost half of participants completing no homework at all. Homework is a substantial part of the intervention, and considering that a large portion of the sample did not do homework in the manner in which it was intended, many participants did not complete the ASERT protocol. This, unfortunately, is a problem with ASERT research in general, as participants in Keough and Schmidt (2012) had similar rates of homework compliance as participants in the present study. Nonetheless, this study did not test the efficacy of the complete ASERT protocol, as was the goal of the study.

Because there was no effect of the intervention, the mediation analyses were compromised and interpretations were limited. Moreover, as discussed, there may have been problems with some of the measures, such as those measuring interpretation bias and attentional biases. The CO_2 challenge is the clearest example of a problematic measure. The task was dropped from the study because of the stringent inclusion/exclusion criteria for participating in the task and the high standards for a valid trial. Therefore, there was no measure of *in vivo* reactions to physical sensations, so it is not known if the ASERT intervention led to any change in reactions to induced physical sensations.

Future Directions

Given the significant limitations of the present study, there are many possible avenues of future research. This study did not test the efficacy of the ASERT intervention as it was designed to be implemented. Therefore, replication is needed to investigate whether ASERT modifies interpretive biases, perceived control, attentional biases and psychopathology symptoms. Any future investigations should focus on increasing homework compliance. Despite the fact that Keough and Schmidt (2012) found that homework compliance did not predict treatment outcome, homework compliance was not overly high. Research consistently demonstrates that homework compliance is associated with greater treatment efficacy (e.g., Mausbach, Moore, Roesch, Cardenas & Patterson, 2010) and predicts symptom reduction in anxiety disorders in response to CBT or acceptance and commitment therapy (ACT; LeBeau, Davies, Culver & Craske, 2013). Therefore, it is worth investigating the effect of increased homework compliance as it relates to ASERT efficacy. Homework compliance could possibly be increased in several ways, including having a more in depth discussion of the rationale for interoceptive exposures during the psychoeducation presentation and formally assessing understanding of the rationale.

Between-session check-ins could be scheduled to troubleshoot any issues and encourage homework completion, or possibly adding in-person check-ins to provide direct feedback about exposure completion. Asking participants to record the homework data on a study website every day may provide opportunities for daily feedback, which could increase the quality and quantity of homework completed. Relatedly, measures of homework compliance are generally not standardized, as compliance tends to be based on treatment-specific factors. For example, LeBeau et al. (2013) assigned specific homework tasks after each session of CBT or ACT, such as practicing self-monitoring, breathing retraining or exposures. Clinicians rated participants' compliance based on the proportion of assigned tasks that were completed each week, which was averaged across weeks to devise a general compliance measure (LeBeau et al., 2013). In a recent investigation of internet based-CBT, homework compliance was measured as the proportion of assigned modules that were completed (Rozental, Forsell, Svensson, Andersson, & Carlbring, 2015). It may be beneficial to develop general measures of homework compliance that could be administered across different types of treatment studies as a method of standardizing the assessment of compliance. Additionally, as previously discussed, there are issues with some of the measures in this study, including those assessing interpretation biases, attentional biases and reactions to physical sensations. It would be prudent to consider using other measures that address some of the limitations, such as using open-ended questions to assess interpretation biases and possibly developing new stimuli for the visual dot-probe that may be sensitive to small changes in AS. Moreover, the mechanisms of change in AS in response to ASERT are still unclear. The mediation analyses were likely confounded by the lack of changes in response to ASERT, which may have increased the possibility of making a Type II error. Future research should continue to investigate the mediating effect of changes in attentional biases and perceived

control on changes in AS, possibly with other measures. Additionally, there are other possible cognitive mediators that could be considered in future investigations. AS is considered one of three fundamental sensitivities (Reiss, 1991) and is closely related to both fear of negative evaluation and fear of illness/injury. These fears are believed to interact to predict behaviour (Reiss, 1991), and are therefore be closely related. As such, one or both of the constructs may mediate change in AS. Moreover, intolerance of uncertainty (IU) is a set of negative beliefs about uncertainty (Dugas, Gagnon, Ladouceur, & Freeston, 1998). High IU is associated with high AS, although the two are considered distinct constructs (Carleton, Sharpe, & Asmundson, 2007). Conceptually, there is an element of uncertainty that accompanies ambiguous physical sensations. AS reductions could be the result of increased ability to tolerate uncertainty. Investigating these factors as potential cognitive mediators of change in AS is worthy of future research.

Conclusion

The present study attempted to extend the literature on psychoeducation and interoceptive exposures interventions for high AS by examining the effect of ASERT on AS and related cognitive variables and psychopathology symptoms. There was minimal effect on AS and negative interpretive biases, which is not consistent with the only other known study to examine the efficacy of the ASERT intervention (Keough & Schmidt, 2012). Moreover, the present study demonstrated that ASERT has limited effects on psychopathology symptoms. However, there were several noteworthy limitations of the present study, including homework noncompliance, which confounded conclusions that can be drawn from the results. Dismissal of the ASERT intervention as an ineffective transdiagnostic treatment is premature at this point. More research is needed to address the limitations of the present study and to complete a comprehensive

investigation of the effects of psychoeducation and interoceptive exposures for high AS as a brief, transdiagnostic treatment.

Chapter 3: An Investigation of the Immediate and Short-Term Efficacy and Cognitive Mechanisms of Cognitive Bias Modification for High Anxiety Sensitivity

Introduction

Anxiety sensitivity (AS) is a set of beliefs about the negative implications of arousal-related physical sensations (Reiss & McNally, 1985). Individuals with strong AS beliefs catastrophize when experiencing uncomfortable but benign physiological sensations, such as sweating or shortness of breath, because they believe that these sensations will have negative physical, social or cognitive implications. AS is believed to be a stable, trait-like set of beliefs (McNally, 1994) and, despite originally being considered only in relation to panic disorder (e.g., McNally, 1994), is known to be a transdiagnostic construct. Elevated AS has been reported in individuals with anxiety, mood, and alcohol-use disorders (e.g., Carleton et al., 2009, Gillihan et al., 2011; Simon et al., 2005; Weeks et al., 2005). With regards to alcohol-use, high AS is associated specifically with higher motivation to consume alcohol and more problems associated with alcohol-use (Chavarria et al., 2015; Howell et al., 2010).

Given that AS reductions coincide with reductions in symptoms of disorders associated with elevated AS (e.g., Olthuis et al., 2014; Schmidt et al., 2007), AS-specific interventions have the potential to be *transdiagnostic* interventions. Transdiagnostic treatments are of interest as methods of streamlining treatment and targeting symptoms of multiple disorders through a single intervention (McManus et al., 2010). Additionally, efforts to streamline treatments have also focused on developing *brief* treatments. Brief treatments are advantageous over full-length psychological treatments for several reasons, including reduced time commitment on the part of both clients and clinicians. With shorter treatments, clients may be more likely to commit to and complete treatment, and clinicians could see more clients, thereby reducing costs and waitlists,

and increasing overall access to treatment (Crawley et al., 2013; Otto et al., 2012).

Relatedly, computerized interventions are also of research interest because they can be delivered without therapist interaction. Computerized treatments can increase treatment availability, especially for people who otherwise may not have access to treatment due to geographical or other reasons (Beard, 2011). Taken together, there is considerable interest in developing and understanding brief, transdiagnostic treatments that can be delivered via computers or other electronic devices.

Cognitive Bias Modification

Cognitive bias modification (CBM) is a brief, computerized intervention that has the potential to be transdiagnostic. CBM originated in the experimental psychopathology literature, and is designed to experimentally manipulate information processing biases associated with a variety of emotional states or symptoms, including but not limited to psychopathology (Baert, Koster, & De Raedt, 2011). CBM involves completing a computerized task designed to reinforce specific patterns in cognitive processing (MacLeod & Mathews, 2012). It can involve repeatedly presenting participants with a sentence or vignette that supports a specific type of belief (i.e., a more helpful belief), or it may be an active task whereby participants are required to generate a response to each *trial* (Hoppitt, Mathews, Yiend, & Mackintosh, 2010). For example, participants may be presented with a word on the computer screen and they would have to make an interpretation about the word as benign or threatening, and indicate their interpretation by responding on their keyboard. They would receive feedback that was designed to reinforce a specific type of interpretations (Beard & Amir, 2008). CBM tasks can be administered with paper and pencil, although most modern CBM tasks are presented via computer, and require participants to provide responses on a keyboard (Beard, 2011). CBM has been designed to target

several types of information-processing biases, including interpretive bias, which is the tendency to perceive ambiguous information as consistent with pre-existing schemas (Beard & Amir, 2008). Negative interpretive biases have been observed in response to emotional states (i.e., positive interpretive bias during positive mood states; Mathews, Mackintosh, & Fulcher, 1997). Interpretation biases have also been observed in many psychological disorders, including panic disorder, SAD, GAD, depression, and alcohol-use disorders (e.g., Beard, 2011; Mathews & MacLeod, 2005; Stacy & Weirs, 2010).

CBM can be used to modify negative interpretive biases. Meta-analyses demonstrate that CBM is generally associated with large changes in interpretive biases (effect sizes range from 0.90 to 1.08; Menne-Lothmann et al., 2014). CBM has been used successfully to induce positive and negative biases (Mathews & Mackintosh, 2000) and to reduce negative interpretive biases in people high in trait anxiety (Salemink, van den Hout, & Kindt, 2009). Interpretive bias changes can be achieved with a relatively small amount of training (e.g., a single session of training lasting between 12 and 20 minutes). Given the interest in, and benefits of, developing brief interventions, the therapeutic potential of computerized CBM as a stand-alone treatment for emotional problems, in particular, anxiety and depression, is being studied (e.g., Beard, 2011).

However, more research is needed before CBM can be considered a treatment in its own right. The effect of CBM on symptoms of, and negative interpretive biases associated with, psychopathology must be determined. Research demonstrates that CBM generally leads to reductions in psychopathology symptoms. A recent meta-analysis found that CBM is associated with small to moderate reductions in general anxiety (Hedges' g= .38) and depression (Hedges' g= .43; Cristea, Kok, & Cuijpers, 2015). CBM is associated with reductions in negative interpretive biases and social anxiety symptoms in socially anxious children and adults (Beard &

Amir, 2008; Bowler et al., 2012; Klein et al., 2015; Murphy, Hirsch, Mathews, Smith & Clark, 2007) and in those diagnosed with SAD (Amir & Taylor, 2011; Beard, Weisberg & Amir, 2011; Carlbring et al., 2012), as found in controlled studies. Moreover, CBM for GAD is associated with moderate reductions in negative interpretive biases (*r*= .54) and GAD symptoms (*r*= .52; McNally, 2014). CBM is also associated with large reductions in negative interpretive biases associated with depression (within-group partial $\eta^2 = 0.54$) and symptoms of depression (within-group partial $\eta^2 = 0.42$; Blackwell & Holmes, 2010). Finally, CBM has successfully induced an alcohol-avoidance bias in alcohol-dependant participants in a controlled study ($\eta_p^2 = 0.08$; Eberl et al., 2013).

The results of the aforementioned CBM studies, however, are limited in their generalizability, as each employed a CBM protocol designed to target interpretive biases and symptoms of a specific disorder or problem-set. As previously discussed, high AS is associated with numerous psychological disorders. Regardless of psychological diagnoses, people high (versus low) in AS display negative interpretive biases in response to ambiguous, physical sensations (e.g., Keogh, Hamid, Hamid & Ellery, 2004; Rosmarin et al., 2009; Van Cleef & Peters, 2008). Furthermore, people high in AS without a diagnosis of psychopathology display negative interpretive biases that are similar to those observed in people with comparably high levels of AS accompanied by a psychological disorder (Teachman, 2005; Clark et al., 1997). Accordingly, targeting AS via its negative interpretive biases may be a way to target a variety of psychopathology symptoms via a single intervention.

CBM for AS

To date, three studies have investigated the modification of negative interpretive biases associated with high AS via CBM. In a study by Steinman and Teachman (2010), participants

were presented with a short vignette that reflected a concern related to AS and the final word in the vignette was missing a letter. Participants had to complete the word, which resolved the situation in accordance with their training condition. In the positive training condition, the vignettes were always resolved in a positive manner (e.g., "You are riding on a motorcycle. Your heart rate begins to accelerate. You feel thr_lled", with the final word being "thrilled"). In the neutral condition, half the vignettes were resolved in a positive manner and the rest in a negative manner. Finally, participants in the control condition did not complete interpretation training (Steinman & Teachman, 2010). Following training, participants engaged in two Behavioural Approach Tasks (BATs) that were designed to induce uncomfortable, panic-like physical sensations, and were used to assess fear of arousal-related physical sensations. The two BATs were candle blowing (i.e., participants pretended their finger was a candle and attempted to blow it out for up to 60 seconds) and straw breathing (i.e., participants breathed through a narrow straw while holding their nostrils closed for up to 60 seconds). After a single training session, participants in the positive training condition made more benign interpretations when presented with new ambiguous situations as compared to participants in the control condition (Cohen's *d*= 0.88 and Cohen's *d*= 0.76 on two measures of interpretation bias). In addition, participants in the positive training condition reported significantly lower levels of AS compared to participants in the neutral training condition (between-group Cohen's *d*=0.34) and the control condition (between-group Cohen's *d*=0.44). Training also did not appear to influence performance on the BATs (Steinman & Teachman, 2010).

MacDonald, Koerner, and Antony (2013) conducted the second known study on the modification of negative interpretive biases associated with AS and found similar results using different CBM training task. MacDonald et al. (2013) adapted the CBM protocol developed by

Beard and Amir (2008). In this computerized training, participants were first presented with a word representing either a benign interpretation (e.g., "invigorating") or threat interpretation (e.g., "dangerous") of a situation. They were then presented with a sentence describing an ambiguous physical sensation (e.g., "You are jogging and your heart starts to beat quickly."). Participants were asked to indicate if the word and sentence were related by responding on a keyboard, and they received immediate feedback. In the training condition, participants received positive feedback for endorsing benign interpretations and rejecting negative interpretations of the situations. Participants in the "sham" training condition received inconsistent feedback (i.e., positive feedback for 50% of trials and negative feedback for the other 50% of trials, regardless of response). Reactions to physical sensations were assessed via two BATs, straw breathing and chair spinning (i.e., participants spun in a swivel task chair for up to 60 seconds). Immediately following training, participants in the training condition reported weaker negative interpretive biases (within-group Cohen's d= 0.69) and lower AS (within-group Cohen's d= 0.82) compared to their baseline scores. These changes were maintained at follow-up 48 hours later (MacDonald et al., 2013). There was no effect of training on reactions to physical sensations.

Clerkin, Beard, Fisher, and Schofield (2015) completed the third known study examining CBM for high AS. The investigators sought to build upon the research from the previous two studies, and increased the dose of training to two sessions, separated by 2 days. Participants with high AS (i.e., scores of > 26.45 on the ASI) were recruited from an undergraduate sample. Similar to MacDonald et al. (2013), the training task was adapted from Beard and Amir (2008). Participants were required to determine if a word and a sentence were related by responding on a keyboard. In the training condition, the word represented a neutral or threatening interpretation. In the control condition, the words were either related or unrelated to the content of the sentence.

Training stimuli were developed exclusively for this study, and five doctorate level graduate students rated the extent to which the words were relevant to panic. All participants received feedback on the computer screen based on their responses (i.e., "You are correct!" or "You are incorrect."). At the end of the second visit, participants were also asked to engage in three BATs (i.e., jumping jacks, candle blowing and chair spinning), for 2 minutes each. The results demonstrated that the CBM training successfully modified negative interpretation biases, as participants in the training condition made significantly fewer threatening interpretations (between-group Cohen's *d*= 1.62) and significantly more benign interpretations (between-group Cohen's *d*= 1.41) compared to the control condition after two CBM training sessions. CBM training, however, was not associated with significant reductions in AS (Clerkin et al., 2015). Nonetheless, the magnitude of change in AS was moderate to large in the CBM condition (within-group Cohen's *d*= 0.74 from baseline to Time 1; within-group Cohen's *d*= 1.48 from baseline to Time 2) and in the control condition (within-group Cohen's *d*= 0.53 from baseline to Time 1; within-group Cohen's *d*= 0.82 from baseline to Time 2). Similar to the results of Steinman and Teachman (2010) and MacDonald and colleagues (2013), CBM training did not influence performance on the BATs, with the exception of time spent engaging in the task that each participant perceived as the most anxiety-provoking. For this task, participants in the control condition spent significantly longer engaging in the task, as compared to participants in the CBM condition (between-group Cohen's *d*= 0.54). The authors suggested that these mixed findings could be due to insufficient training in the CBM condition. Additionally, the authors proposed that their control task may have also unintentionally trained benign interpretive biases, given that there were nonsignificant between-group differences, and significant within-group effects in the control condition (Clerkin et al., 2015). Even when considering the results of

Clerkin et al. (2015), these three studies demonstrate that the negative interpretive biases associated with AS can be modified with CBM, and that modifying these biases is associated with reductions in AS.

Limitations of the CBM for AS literature. There are several methodological limitations of the abovementioned studies that may account for the null or small effects observed, and there are several ways to improve upon their methodologies. First, all three aforementioned studies used similar BATs, and all studies failed to find changes in response to physical sensations. There may have been ceiling effects, as 88% of participants in the Steinman and Teachman (2010) study, 71% of participants in the MacDonald et al. (2013) study and 66% of participants in the Clerkin et al. (2015) were able to complete at least one BAT for the maximum time. Furthermore, the dose of CBM training may have been insufficient to produce significant differences/changes in reactions to physical sensations in all three studies. Multiple training sessions produce larger changes in interpretive biases and associated symptoms (Hallion & Ruscio, 2011). Finally, with regard to the training paradigm used by MacDonald et al. (2013), training effects may have been underestimated due to the sham training. Participants in the sham training condition received positive feedback for making positive interpretations for 50% of trials, regardless of response. If, for example, participants would have made positive interpretations 20% of the time on a free response task, the sham training could have induced a positive bias by presenting participants with positive interpretations more than they would have made them on their own (Salemink, van den Hout, Kindt, & Rienties, 2008). Clerkin et al. (2015) attempted to account for this issue by using a control training task that was believed to be more neutral than that used in the previous studies. The words presented in the control training were related or unrelated to a superficial aspect of the sentence (e.g., “Table” and “Staircase” were

presented with the sentence "After climbing the stairs your heart begins to beat faster than usual"). However, as Clerkin et al. suggested, the results of may have been negatively affected by some of the other abovementioned limitations, such as insufficient dose of training.

None of the three aforementioned studies examined the immediate or short-term effects of CBM on psychopathology symptoms. It is, therefore, not known whether CBM that targets the negative interpretive biases associated with high AS also influences psychopathology symptoms. Treatments that target AS lead to reductions in symptoms of psychopathology associated with AS. For example, Olthuis and colleagues (2014) examined the effect of CBT for high AS on psychopathology symptoms. CBT was delivered via 8 weekly telephone sessions. Follow-up assessment occurred 4 weeks after the end of treatment. Compared to participants in the waitlist control condition, those in the CBT condition reported significantly lower AS ($d_{GMA\text{-}raw}$[2] = 0.77), panic symptoms ($d_{GMA\text{-}raw}$ = 0.70), and social anxiety symptoms ($d_{GMA\text{-}raw}$ = 0.34). Therefore, examining the effects of CBM for high AS on changes in psychopathology symptoms is an important first step in the consideration of an AS-specific CBM protocol as a stand-alone preventive intervention or treatment.

Moreover, there has yet to be an investigation of the cognitive mechanisms of change in CBM for AS. This issue is of particular importance in the CBM literature, as the pathways through which CBM influences change are not understood. Cognitive mechanisms have been suggested, such as that CBM corrects maladaptive beliefs about the danger of physical sensations (Steinman & Teachman, 2010) or that repeated exposure to benign interpretations trains a benign cognitive style (MacLeod, Koster, & Fox, 2009). More generally, research on the cognitive mechanisms of CBM has important implications for cognitive theories and clinical application.

[2] $d_{GMA\text{-}raw}$ = Cohen's *d* for the difference in the pre-post change in the measure between the CBT and waitlist control condition (Olthuis et al., 2014).

First, CBM can be used to test cognitive theories, including the transdiagnosticity of AS. By directly manipulating interpretive biases associated with AS, the direction of the relationships among AS, negative interpretive biases and psychopathology symptoms can be examined. As for clinical implications, by understanding how CBM exerts its effects on AS, CBM protocols can be refined and improved upon, which could lead to more effective CBM procedures, and eventually, more treatment options for people with high AS. Without explicit investigation, however, the cognitive mechanisms of CBM for AS are speculative. In the following section, three possible pathways through which AS changes in response to CBM are reviewed.

Potential Cognitive Mechanisms of Change of CBM for AS

The three mediators that were examined in Study 1 were also examined in the present study (see Chapter 2, pp. 19-27). To summarize briefly, an *interpretive bias* results in ambiguous information being perceived as consistent with pre-existing schemas (Beard & Amir, 2008). People with elevated AS display negative interpretive biases in response to ambiguous physical sensations that leads to these sensations being perceived as threatening (e.g., Van Cleef & Peters, 2008). AS-related negative interpretive biases change in response to treatment, and those changes correspond with changes in AS (e.g., Clark et al., 1997; Gloster et al., 2014; Teachman et al., 2010). When considered together, there is strong evidence to suggest that changes in negative interpretive biases will mediate the effects of CBM on AS.

The second potential cognitive mediator is *attentional bias*, which is the tendency to attend to information consistent with pre-existing schemas (Van Bockstaele et al., 2014). People with high AS display specific attentional biases for threatening information about anxiety symptoms (Hunt et al., 2006). Unlike research on negative interpretation biases, negative attentional biases have not been explicitly examined as a cognitive mediator of psychological

treatment. However, there are several reasons to believe that this may be the case. The strength of negative attentional bias decreases in response to CBT (e.g., Tobon et al., 2011), and attentional and interpretive biases are interrelated and interdependent (Everaert et al., 2014). As such, changes in interpretive biases lead to changes in attentional biases and *vice versa*. When considered with the research on the relationship between negative interpretive biases and high AS, attentional biases may mediate the relationship between treatment and changes in AS.

The third and final proposed cognitive mediator is *perceived control*. This is the (perceived) ability to influence one's emotional experiences, stressful experiences, and/or external threats (Barlow, 2002). Low perceived control is associated with high AS (Bentley et al., 2013; Viana & Gratz, 2012). Perceived control increases in response to psychological treatments and predicts changes in symptoms (Gallagher et al., 2014). Although the aforementioned research has been conducted primarily in panic disorder, perceived control is transdiagnostic and is associated with AS, regardless of psychopathology. Therefore, perceived control was investigated with negative interpretive biases and attentional biases as potential mediators of change in AS.

Order of change in response to CBM. Related to the limited research on cognitive mechanisms of CBM, there is no known research on the order of change of cognitive processes in response to CBM. Cognitive models of psychopathology suggest that maladaptive beliefs, such as AS, and information-processing biases, such as negative interpretive biases, are implicated in the development of psychopathology symptoms (e.g., Barlow, 2002; Clark, 1986). These models suggest that maladaptive beliefs and information-processing biases develop prior to psychopathology symptoms, although the relationship between development of cognitive processes and symptoms is bidirectional. These models also imply that change in maladaptive

cognitions and cognitive styles could occur *before* changes in symptoms in response to treatment (Casey et el., 2005), which is consistent with empirical research. Changes in dysfunctional beliefs (assessed via the *Agoraphobic Cognitions* Questionnaire; Chambless et al., 1984) change before panic symptoms (Bouchard, Pelletier, Gauthier, Coté, & Laberge, 2007), and both AS and negative interpretive biases regarding the consequences of physical sensations change during the early stages of CBT treatment (e.g., Casey et al., 2005; Gallagher et al., 2013). These theoretical models, however, may not account for all of the relationships between cognitive factors. Hirsch and colleagues (2006) suggest that several different biased cognitive processes can occur concurrently or in quick succession, and that the interaction of these processes maintains psychopathology symptoms. This may be the case with AS beliefs and negative interpretive biases. Although AS and negative interpretive biases are conceptually similar and share some variance in the prediction of anxiety symptoms, they are in fact distinct constructs and contribute unique variance to the prediction of anxiety symptoms (Olthuis, Stewart, Watt, Sabourin, & Keogh, 2012). There is no known research on which factor changes first in response to treatment, much less in response to a CBM intervention for high AS. Two studies have demonstrated that CBM for high AS influences AS and negative interpretive biases (MacDonald et al., 2013; Steinman & Teachman, 2010). Both of these studies, however, consisted of one session of CBM training that was preceded by baseline measures and followed by posttest measures. Therefore, neither study was designed to examine the order of change in variables. Therefore, the temporal precedence of changes in AS and negative interpretive biases were investigated in the present study. This has important implications for understanding the cognitive mechanisms of CBM, as examining order of change will help determine which factors are being targeted by CBM training.

The Present Study

The purpose of the present study was to: (1) test the immediate and short-term effects of CBM for high AS on AS and psychopathology symptoms; (2) investigate the degree to which changes in negative interpretive biases, perceived control, and attentional biases mediate change in AS in response to CBM for high AS and; (3) investigate the temporal order of change of AS and negative interpretive biases. The present study also extended existing research on the modification of the negative interpretive biases associated with AS by addressing several of the limitations of previous research in this area, such as ceiling effects with the BATs and control conditions that may have minimized training effects. The hypotheses were as follows:

1a. Averaged across all visits, participants in the CBM condition would report lower AS, weaker negative interpretive biases in response to physical sensations, weaker attentional biases for threatening information and lower perceived control compared to participants in the control condition.

1b. Averaged across all visits, only participants in the CBM condition would display significant reductions in AS, negative interpretive biases in response to hypothetical physical sensations, and attentional biases for threatening information related to physical sensations, and increased perceived control.

2a. At 2-week and 4-week follow-up, participants in the CBM condition would report significantly: lower symptoms of panic disorder, SAD, GAD, depression; fewer problems as a result of alcohol consumption; lower motivation to consume alcohol and; lower general symptoms of distress, compared to participants in the control condition.

2b. At 2-week and 4-week follow-up, only participants in the CBM condition would report significant reductions in: symptoms of panic disorder, SAD, GAD, depression;

problems as a result of alcohol consumption; motivation to consume alcohol and; general symptoms of distress compared to baseline.

3a. At 2-week and 4-week follow-up, participants in the CBM condition would report significantly lower fear and anxiety during the BATs, compared to participants in the control condition.

3b. Across Visits 1, 4 and 5, only participants in the CBM condition would report significant reductions in fear and anxiety during the BATs.

4. Changes in negative interpretive biases, perceptions of control and attentional biases would each mediate the relation between intervention assignment and changes in AS.

5. Due to a lack of research on the temporal precedence of changes in AS and negative interpretive biases, this research question was exploratory. No *a priori* hypotheses were advanced about the order of changes in AS and negative interpretive biases.

Method

Participants

Participants between the ages of 18 and 65 were recruited from the community via newspaper advertisements, online advertisements (i.e., Craigslist, Kijiji, *Cognition and Psychopathology Lab* website) and flyers (see Appendix A for recruiting materials). The recruitment materials were designed to attract people with high AS by stating that this study is recruiting people who experience specific arousal-related physical sensations. Each person who responded to the advertisement was invited to complete the telephone screen to determine eligibility status. The telephone screen consisted of the ASI-3 (Taylor et al., 2007) and specific sections of the *Mini International Neuropsychiatric Interview-7* (MINI 7.0; Sheehan, 2014) that assessed symptoms of disorders in the *Diagnostic and Statistical Manual of Mental Disorders,*

Fifth Edition (DSM-5; APA, 2013). Eligible participants scored 23 or higher on the ASI-3, which is one standard deviation above the mean in a nonclinical population (*M*= 12.8, *SD*= 10.6; Reiss, Peterson, Taylor, Schmidt, & Weems, 2008).

Exclusion criteria were as follows: (1) current/past psychotic episode, current/past manic/hypomanic episode, criteria for any substance use disorder met in the past 3 months; (2) currently receiving CBT treatment, or initiation/completion within the past 6 months of CBT that included psychoeducation about, or exposure to, arousal-related physical sensations; (3) clinically significant suicidal intent; (4) limited use of psychotropic medications (i.e., have not taken psychotropic medication for at least 1 month [3 months for fluoxetine]; if taking antidepressant/antipsychotics, stable use for at least 6 weeks; no daily benzodiazepine use); (5) medical conditions that would prohibit participation in assessments of reactions to physical sensations, such as respiratory conditions (e.g., asthma, lung disease), cardiovascular conditions (e.g., history of heart attack, stroke, hypertension), neurological conditions (e.g., epilepsy, brain tumour) or balance-related medical conditions (e.g., inner-ear problems).

In total, 201 potential participants completed the telephone screen during the recruitment phase for the present study, 59 of whom were invited to the lab to complete the present study. Participants were excluded specifically for endorsing low AS, substance use, manic/hypomanic symptoms, psychotic symptoms, medical conditions (including respiratory, cardiac conditions) or current CBT. Nine participants did not attend the first session (i.e., lost contact; failed to attend the first session; withdrew participation). Of the 50 participants who completed the study, two participants were excluded from data analysis due to low AS1-3 scores at the baseline, in-session assessment (ASI-3 Total score= 4 and 7, respectively). Therefore, the final sample

included 48 participants (24 per condition). Randomization will be discussed in detail in the Procedure section (pp. 157).

Sample characteristics of the final study sample, separated by condition, are presented in Table 34. The majority of participants reported: being female, identifying their ethnicity as Caucasian, being employed part-time, being single, and being enrolled in an educational program. With regards to DSM-5 diagnoses, the most common disorder diagnosed was social anxiety disorder (31.1% of the total sample), followed by GAD (29.2%) and panic disorder (29.2%). Table 34 provides breakdown of all DSM-5 diagnoses, separated by condition.

There were no significant between-condition differences in demographic characteristics; nor were there significant differences in the number of days between study visits.

Table 34

Study 2- Sample Characteristics Separated by Study Condition

	CBM (*n* = 24)	Control (*n* = 24)
Age in years - *M* (*SD*)	32.04 (12.93)	28.25 (12.46)
Gender - Frequency (%)		
Women	19 (79.20%)	18 (75.00%)
Men	4 (16.7%)	6 (25.00%)
Genderfluid	1 (4.20%)	0 (0%)
Sex – Frequency (%)		
Female	19 (82.60%)	18 (75.00%)
Male	4 (17.40%)	6 (25.00%)
Race/Ethnicity - Frequency (%)		
Caucasian	11 (45.80%)	10 (41.70%)
East Asian	5 (20.80%)	6 (25.00%)
Arab/West Asian	1 (4.20%)	1 (4.20%)
South East Asian	0 (0%)	2 (8.30%)
Latin American	0 (0%)	1 (4.20%)
Black	4 (16.70%)	1 (4.20%)
Mixed Race	2 (8.30%)	3 (12.50%)
Other Ethnicity	1 (4.20%)	0 (0%)
Employment Status - Frequency (%)		
Not working	10 (41.70%)	5 (20.80%)
Employed part-time	10 (41.70%)	14 (58.30%)

	CBM (*n* = 24)	Control (*n* = 24)
Employed full-time	4 (16.70%)	5 (20.80%)
Marital Status - Frequency (%)		
Single	19 (79.20%)	21 (87.50%)
Divorced/Widowed	2 (8.30%)	1 (4.20%)
Married/Common-law	3 (12.50%)	2 (8.30%)
Enrolled in Educational Program- Frequency (%)		
Yes	14(58.30%)	12 (50.00%)
No	10 (41.70%)	12 (50.00%)
Highest Education - Frequency (%)		
Some High School	0 (0%)	1 (8.30%)
High School Diploma	1 (10.00%)	1 (8.30%)
College Diploma	2 (20.00%)	4 (33.30%)
Undergraduate Degree	6 (60.00%)	5 (41.70%)
Master's Degree	1 (10.00%)	1 (8.30%)
Diagnoses - Frequency (%)		
Social Anxiety Disorder	9 (37.50%)	6 (25.00%)
Generalized Anxiety Disorder	8 (33.30%)	6 (25.00%)
Panic Disorder	8 (33.30%)	6 (25.00%)
Major Depressive Disorder	7 (29.20%)	4 (17.40%)
Panic Attack Specifier	4 (16.70%)	4 (16.70%)
Obsessive-Compulsive Disorder	3 (12.50%)	0 (0%)
Alcohol-Use Disorder	0 (0%)	3 (12.50%)

	CBM (*n*=24)	Control (*n* = 24)
Agoraphobia	1 (4.20%)	1 (4.20%)
Binge Eating Disorder	0 (0%)	1 (4.20%)
Days between Study Visits - *M* (*SD*)		
Baseline to Day 5	5.63 (2.24)	5.30 (2.96)
Day 5 to Day 10	10.57 (3.49)	9.23 (2.86)
Day 10 to Day 15	15.27 (2.80)	15.55 (4.10)
Day 15 to Day 30	29.90 (5.03)	32.35 (10.67)

Note. CBM= *Cognitive Bias Modification.* There were no significant differences between conditions on any of the variables.

Materials

Telephone Screening measures.

Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007). The ASI-3 assesses fear of anxiety-related physical sensations due to the belief that they have negative consequences. Each of the 18 items is rated on a 5-point Likert scale, and total scores range from 0 to 72. The ASI-3 has retained the three lower-order factors from the original ASI (i.e., Physical Concerns, Social Concerns, and Cognitive Concerns; Reiss et al., 1986). Given that the lower-order factors of the original ASI do not have good psychometric properties, the ASI-3 was developed as a more psychometrically-sound, multidimensional measure of AS (Carter et al., 2009; Wheaton et al., 2012). The ASI-3 has excellent psychometric properties, with internal consistencies ranging from α=.73 to α=.90 for each of the subscales (Taylor et al., 2007; Wheaton et al., 2012) and α=.93 for the total score (Wheaton et al., 2012). Scores from the ASI-3 telephone administration were only used for the purposes of determining eligibility, and were not included in the analyses of the present study. This decision was made to standardize the amount of time between the baseline ASI-3 assessment and the intervention, as participants completed the telephone screen up to 28 days before attending the first session.

Mini International Neuropsychiatric Interview 7.0 (MINI 7.0; Sheehan, 2014). The MINI 7.0 is a brief, semistructured clinical interview that assesses for symptoms of certain DSM-5 disorders (APA, 2013). *Select sections* of the MINI 7.0 were administered to assess for current suicidal intent or current/past diagnosis of a psychotic episode, substance dependence, or manic/hypomanic episode, all of which were exclusion criteria for the present study.

Testing measures.

MINI 7.0 (Sheehan, 2014). During visit 1, the MINI 7.0 was administered *in its entirety*

to assess for the presence of psychopathology.

Demographics Questionnaire. A demographics measure was administered to collect data on participants' gender, age, race, marital status, education level, and employment type and status. This measure was adapted from a general demographic questionnaire that is frequently used in the *Cognition and Psychopathology Lab*.

Process Measures.

Anxiety Sensitivity Index-3 (ASI-3; Taylor et al., 2007). In addition to being used as a screening measure, the ASI-3 was used to assess AS.

Brief Bodily Sensations Interpretation Questionnaire (BBSIQ; Clark et al., 1997). The BBSIQ is a 14-item measure that assesses negative interpretive biases about physical sensations. Participants are presented with descriptions of ambiguous situations that describe internal sensations or external events and receive three explanations that disambiguate the scenario, one of which resolves the situation in a negative manner, and the other two resolve the situation in a positive/neutral manner. The BBSIQ has two separate scales. The Belief scale requires that participants rate the plausibility of each explanation, thereby assessing the belief that each explanation would occur. Belief scores are derived from the mean rating of the negative explanations and the mean of the positive/neutral explanations. This results in four Belief scores: Internal Negative (negative interpretations of physical sensations), Internal Neutral (neutral interpretations of physical sensations), External Negative (negative interpretations of external situations) and External Neutral (neutral interpretations of external situations). The Ranking Subscale assesses specific interpretations of ambiguous physical sensations and external situations. Participants rank the order in which each explanation comes to mind (i.e., 1^{st}, 2^{nd}, 3^{rd}) given each scenario. This scale is reverse-scored and scores of 3, 2, or 1 are assigned for

providing rankings of 1, 2, or 3, respectively. Two Ranking scores are derived by calculating the mean rankings of the negative explanations for situations describing physical sensations (Internal Ranking) and external events (External Ranking), respectively. For the present study, only the subscales related to internal sensations were included in the analyses. The BBSIQ has adequate internal consistency for each subscale (α= .74 to .90; Clark et al., 1997). Test-retest reliability is satisfactory for the Ranking subscale (*r* = .73 to .75) and for the Beliefs subscales (*r* = .41 to .81; Clark et al., 1997).

Anxiety Control Questionnaire-Revised (ACQ-R; Brown et al., 2004). The ACQ-R assesses perceptions of control over aversive experiences and emotional states. The measure is composed of 15 items that are rated on a 6-point Likert scale. The ACQ-R total score assesses general perceptions of control, and the three lower-order factors assess perceptions of control over emotional states, threatening events, and when experiencing stress, respectively (Brown et al., 2004). The total score has high internal consistency (α= .85), and the three subscales have moderate internal consistency (α= .71 to .73; Brown et al., 2004). The total score had high reliability (ρ= .85), while the reliability of the subscales was moderate to high (ρ= .65 -.74; Brown et al., 2004).

Visual Dot-Probe Task. Attentional biases were assessed using an adapted version of the visual dot-probe task (MacLeod, Mathews, & Tata, 1986). In each trial, a fixation point was displayed in the middle of the computer screen. After 500ms, the fixation point disappeared and a pair of words appeared with one word on either side of the screen. One word was a threatening/emotional word (e.g., sweat), whereas the other word was neutral (e.g., spoon). After 500ms, the words disappeared and one word was replaced by a dot. Participants indicated, as quickly as possible, whether the dot-probe appeared on the left or right by pressing the "A" or

"L" key, respectively. Upon responding, the dot-probe disappeared and the next trial began 500ms later.

Trials that met at least one of the following criteria were removed prior to data analysis: incorrect response; reaction time less than 150ms; reaction time greater than 2000ms; or *z* score greater than |2.5| (e.g., Maoz et al., 2013). The number of trials retained for each visit ranged between 93.8% and 95.0% of total trials, which is consistent with the proportion of eliminated trials from other research (Maoz et al., 2013). There were no between-group differences in the number of trials retained for analyses any time point (p= .15-.90). Attention bias scores were calculated by subtracting the mean reaction time when the dot was paired with a threat word from the mean reaction time when the dot was paired with a benign word. Positive attention bias scores represent a bias *towards benign words*.

The 52 word pairs were adapted from studies that assessed attentional biases associated with AS (e.g., Hunt et al., 2006; Keogh et al., & Hunt, 2001; Taake et al., 2009). All of the word pairs included a threat word (e.g., gasping; pounding) and a neutral word (e.g., hallway; cupboard). Word frequency and word length were matched (see Hunt et al., 2006, Keogh et al., 2001, Taake et al., 2001 for description of development of word lists). Each word pair was administered four times during one administration of the visual dot-probe task (with the threat word appearing on the left and right side of the computer screen twice each), for a total of 208 trials per administration. The word pairs were presented in random order for each administration.

Word Sentence Association Paradigm (WSAP; Beard & Amir, 2008). The WSAP is a computerized interpretation bias assessment. Participants were presented with 36 sentences that described an ambiguous situation related to an AS belief (e.g., "You are carrying groceries and your arms feel weak and shaky."). Each sentence was presented twice, one time with a word that

represented a benign interpretation (e.g., "Heavy") and another time with a word that represented a threatening interpretation (e.g., "Dangerous"), for a total of 64 trials per WSAP. The WSAP word and sentence pairs were adapted from MacDonald et al. (2013).

The WSAP results were used as a manipulation check for CBM training effects. The WSAP was administered at Visit 1, prior to completing any CBM training, and at Visit 5, two weeks after completing the final CBM training session. The same stimuli were presented during both administrations.

Symptom measures. All symptom measures in the present study were adapted to inquire about symptoms over the past 2 weeks (See *Procedure* for description of assessment points).

Panic Disorder Severity Scale- Self-Report (PDSS-SR; Houck, Spiegel, Shear, & Rucci, 2002). The PDSS-SR was adapted from a clinician-administered interview (i.e., *Panic Disorder Severity Scale* [PDSS]; Shear et al., 1997). The PDSS-SR is a 7-item, multiple-choice measure of the severity of symptoms of panic disorder. The PDSS-SR has good internal consistency (α= .92; Houck et al., 2002), and good convergent validity with the PDSS (Wuyek et al., 2011). The PDSS-SR has good test-retest reliability over 1 day (r= .94; Lee et al., 2009) and 2 days (intraclass correlation coefficient [ICC]= .83; Houck et al., 2002). A five-item version of the PDSS-SR was inadvertently administered throughout the present study. The last two PDSS-SR items (i.e., distress and impairment questions) were accidentally omitted from the final questionnaire by Wuyek et al. (2011), and the same version was administered in the present study. The five-item PDSS-SR assessed panic symptoms only.

Social Phobia Inventory (SPIN; Connor et al., 2000). The SPIN is a 17-item measure of SAD symptom severity. Items are rated on a 5-point Likert scale. The SPIN assesses fear, avoidance, and physiological arousal associated with SAD. The SPIN has excellent internal

consistency and convergent validity (Antony et al.,, 2006; Connor et al., 2000). The test-retest reliability is excellent over 1 to 3 weeks (*r*= .78 to .89; Antony, Ledley, Liss, & Swinson, 2006; Connor et al., 2000).

Generalized Anxiety Disorder Questionnaire-IV (GAD-Q-IV; Newman et al., 2002). The GAD-Q-IV is a 14-item self-report measure that assesses the presence of GAD symptoms, as per *Diagnostic and Statistical Manual of Mental Disorders, 4th edition, Text revision* criteria (DSM-IV-TR; APA, 2000). Given that the diagnostic criteria for GAD that are assessed by the GAD-Q-IV have not changed in the DSM-5 (APA, 2013), the GAD-Q-IV is still a useful measure of GAD symptoms. The total score on the GAD-Q-IV ranges from 0 to 13, and scores equal to or greater than 7.67 suggest a diagnosis of GAD. The GAD-Q-IV has good convergent validity with a clinician-administered interview that assesses symptoms of GAD (*Anxiety Disorders Interview Schedule for DSM-IV*; $\kappa = 0.67$; Di Nardo et al., 1994) and self-report measures of pathological worry (*Penn State Worry Questionnaire*; *r* = .66; Meyer et al., 1990). The test-retest reliability of the GAD-Q-IV is good over 2 weeks (κ= .64; Newman et al., 2002).

Centre for Epidemiological Studies-Depression Scale-Revised (CESD-R; Eaton, et al., 2004). The CESD-R assesses the frequency and severity of DSM-IV-TR major depressive episode symptoms (APA, 2000). The CESD-R is based on the original CES-D (Radloff, 1977) and was adapted to more precisely assess the symptoms of a DSM-IV-TR major depressive episode. Given that these diagnostic criteria have not changed DSM-5, the CESD-R continues to be a useful tool in assessing symptoms of a major depressive episode. The 20 items are rated on a 4-point Likert scale, with higher scores representing more severe depressive symptomatology. The CES-D has high internal consistency (α= .93; Van Dam & Earleywine, 2011). Although there is no known information on the test-retest reliability of the CESD-R, it is strongly

correlated with the CES-D (Eaton et al., 2004), which has acceptable test-retest reliability over 2 weeks (r= .51), considering normal fluctuations in depressive symptoms (Radloff, 1977).

Drinking Motives Questionnaire-Revised (DMQ-R; Cooper, 1994). The DMQ-R assesses motives for consuming alcohol. It consists of 20 items that are each rated on a 5-point Likert scale, with higher scores indicating greater coping motives. The DMQ-R has four subscales that reflect different motives for consuming alcohol: social, coping, enhancement, and conformity. The DMQ-R is a valid assessment of motives to consume alcohol in adolescents, undergraduate students, and adults (MacLean & Lecci, 2000; Piasecki et al., 2014). The DMQ-R has good internal consistency (α= .89; Chandley et al., 2013) and good criterion-related validity (Cooper, 1994).

Short Inventory of Problems-Recent (SIP-R; Miller et al., 1995). The SIP-R assesses the frequency of alcohol-related problems. With 15 items, it is a brief version of the 50-item *Drinker Inventory of Consequences* (DrInC; Miller et al., 1995). Items are rated on a 4-point Likert scale, with higher scores associated with greater frequency of negative consequences of consuming alcohol. The SIP has five subscales that assess the frequency of different types of consequences, including physical, interpersonal, intrapersonal, impulse control, and social responsibility consequences. The SIP-R has good convergent validity, as the total and subscale are strongly correlated to the corresponding subscales of the DrInC (r= .80 to .96; Forcehimes et al., 2007). Furthermore, the SIP-R total score has good internal consistency (α= .89; Miller et al., 1995), excellent test-retest reliability (r= .94; Miller et al., 1995) and good convergent validity with another measure of alcohol-related problems (r= .68 with the *Addiction Severity Index-6*; Alterman, Cacciola, Habing, Ivey, & Lynch, 2009).

Depression Anxiety Stress Scales-21 item version (DASS-21; Lovibond & Lovibond, 1995). The DASS-21 is a 21-item measure depression, anxiety and stress, with each assessed by a 7-item subscale. The Depression subscale assesses dysphoric mood symptoms (e.g., feeling worthless), while the Anxiety subscale assesses autonomic arousal and panic symptoms (e.g., trembling), and the Stress scale assesses symptoms of negative affect and general distress (e.g., overreacting to situations). The DASS-21 is a brief version of the DASS-42 (Lovibond & Lovibond, 1995). DASS-21 subscale scores are multiplied by two, and are therefore comparable to DASS-42 scores. The DASS-21 has excellent psychometric properties. The internal consistency of the total score is α= .88 (Henry & Crawford, 2005), and α= .82 to .94 for the three scales (Antony et al., 1998; Henry & Crawford, 2005). The scales demonstrate high convergent validity (Antony et al., 1998), as the Depression scale is correlated with the BDI-II (*r*= 0.79), and the Anxiety scale is correlated with the *Beck Anxiety Inventory* (BAI; Beck & Steer, 1990) (*r*= 0.85). The Stress scale is correlated with the BDI-II (*r*= .69), BAI (*r*= .70) and the *State-Trait Anxiety Inventory- Trait* (STAI-T; Spielberger et al., 1983) (*r*= .68). The 3-month test-retest reliability for the scales is *r*= .59 for the Depression scale, *r*= .65 for the Anxiety scale, and *r*= .77 for the Stress scale (Gomez, Summers, Summers, Wolf, & Summers, 2007). Of note, the DASS-21 depression subscale was not included in the present study as the CESD-R was the primary depression measure.

Treatment Credibility and Change Expectancy Measure.

Credibility/Expectancy Questionnaire (CEQ; Borkovec & Nau, 1972). The CEQ is a 6-item measure of perceptions of intervention credibility and expectations of change in response to the intervention under investigation. Credibility and expectancy are assessed on separate, 3-item subscales, respectively. All items on the credibility subscale are rated on a 9-point Likert scale

(i.e., 1 to 9). One item on the expectancy subscale is rated on the same scale and the other two items are rated on an 11-point Likert scale (i.e., 0% to 100%, in increments of 10%). Therefore, items 4 and 6 were standardized and subjected to linear transformations to create distributions with a minimum of 1 and a maximum of 9 (Devilly & Borkovec, 2000; Smeets, 2006). Total scores were created by finding the mean score on each respective subscale. Scores on the credibility and expectancy subscales have excellent internal consistency (α= .86 and .90, respectively; Devilly & Borkovec, 2000). The 1-week test-retest reliability of the credibility subscale is good (r= .75), and excellent for the expectancy subscale (r= .82; Devilly & Borkovec, 2000). The CEQ was administered to participants in both conditions after the first session of computerized training.

CEQ results were compared to *benchmarks* set by Beard et al. (2011) in their investigation of a combined interpretation and attention bias modification intervention. Benchmarks of acceptable credibility and expectancy ratings were based on prior research and considered in light of the unique aspects of CBM (e.g., computerized intervention with no clinician contact and minimal face validity). The authors considered a mean score $\geq$ 5 on the credibility subscale and mean score $\geq$ 50% (i.e., 5 after standardizing scores) on the expectancy subscale as appropriate benchmarks. These values were applied to the results of the present study.

Behavioural Assessment. Reactions to physical sensations were assessed with idiographic Behavioural Approach Tasks (BATs). Two BATs were chosen for each participant based on the procedures used in other treatment studies to determine the participants' most fear-inducing interoceptive exposures (e.g., Keough & Schmidt, 2012). During the first visit, participants were asked to engage in a number of BATs that induced varied physical sensations.

For each BAT, participants were asked to report: 1) the sensations that they experienced; 2) the intensity of the sensations, from 0 to 100; and 3) the intensity of their distress as a result of the sensations, from 0 to 100 (see Appendix F for the BAT assessment form). The two BATs that induced the most distress were recorded for each participant, and participants were asked to engage in those specific BATs again, and at the 2-week follow-up and 4-week follow-up visits. When more than two BATs resulted in identical distress levels, the BATs that induced the most intense sensations (as determined by self-reported ratings) were selected. Administration of the BATs was counterbalanced across assessment points.

During each BAT administration, participants were asked to engage in the activity for as long as they could, up to the maximum time limit, which was known to them and was between 30 and 120 seconds, depending on the activity. Participants were instructed that they could stop at any time. Avoidance and fear were assessed during the BATs. Two avoidance measures were used. The first measure was the amount of time (in seconds) that the participants engaged in the BATs. The second measure was the extent to which participants wanted to stop engaging in the task, as recorded by participants on a 10cm VAS. Fear experienced during the BATs was also assessed with a 10cm VAS measure.

Interpretation Training

The Cognitive Bias Modification (CBM) training task was adapted from MacDonald et al. (2013). Each CBM trial had four phases. First, a white cross appeared on the computer screen for 500ms. Next, a word flashed on the computer screen for 500ms. An ambiguous sentence that describes an AS-related concern then appeared. The sentence remained on the screen until participants decided if the word was related to the sentence by pressing either “1” to indicate that it was related or “3” to indicate that it was not related. Participants then received feedback about

the accuracy of their response. The words and feedback were based on participants' randomly assigned training condition.

In the training (i.e., CBM) condition, the word represented either a positive/benign (e.g., "Energized") or negative (e.g., "Worried") interpretation of the sentence (e.g., "You are at a loud concert of your favourite band and your head is pounding."). Participants in this condition received positive feedback (i.e., "You are CORRECT!") when they endorsed benign interpretations or rejected threat interpretations. Participants received negative feedback (i.e., "You are INCORRECT.") when they endorsed threat interpretations or rejected benign interpretations. The stimuli in the training task were successfully used to modify AS in a previous study of CBM for AS (MacDonald et al., 2013).

The sham training task was adapted from Beard et al. (2011). Participants in the control condition were presented with words that were related (e.g., Music) or unrelated (e.g., Tennis) to the content of the sentence (e.g., "You are at a loud concert of your favourite band and your head is pounding."). Although one of the words was clearly related to the sentence, neither word was related to AS beliefs. Participants received positive and negative feedback based on their responses. The stimuli for the sham training task were piloted at Ryerson University. Graduate students (n= 9) were given a list of 168 sentences, each paired with a word that was considered related or unrelated to the content of the sentence. Participants were asked to rate the relationship between the words and sentences (0= "not at all related" and 8= "extremely closely related"). The mean rating of the related words was 7.49 (range= 7 to 8), and the mean rating of the unrelated words was 0.16 (range= 0 to 1).

Participants completed four training sessions over 2 weeks. This number of training sessions was chosen because it has been hypothesized to be the lowest number of training

sessions that results in significant training effects, as per Brosan et al. (2011). Research is consistent with this hypothesis, and four sessions of CBM training have resulted in moderate to large changes in depression- related interpretive biases (Micco et al., 2014) and large reductions in anxiety symptoms (Brosan et al., 2011). In the present study, each training session consisted of 128 trials. There were 64 sentences, and each sentence was presented once with its corresponding benign/positive or threat word (in the training condition) or its related and unrelated word (in the control condition). The trials were presented in random order.

Procedure

The study procedure is depicted in Figure 5. Potential participants first completed a telephone screen involving verbal administration of the ASI-3 (Taylor et al., 2007) and specific sections of the MINI 7.0. Eligible participants were invited to the PRTC.

Visit 1. After participants provided written informed consent (Appendix G), the MINI 7.0 was administered. They then completed the Demographics Questionnaire (Appendix E), the self-report measures, the WSAP, and the visual dot-probe task. Participants then completed all the BATs to determine which ones induced the most fear, followed by two sets of the interoceptive exposures of the activities that induced the most fear. The experimenter then read the rationale for computerized training as an intervention for fear of anxiety. The same rationale was provided to participants in both conditions (adapted from Beard, 2012; Beard et al., 2011), after which participants were randomly assigned to CBM training (experimental) or the sham training (control) condition, and completed the corresponding training. Immediately after the training, participants were asked to complete the process measures (i.e., ASI-3, BBSIQ, ACQ-R and the visual dot-probe task), and the CEQ.

Visit 2. Participants returned to the PRTC approximately 5 days after Visit 1. They were asked to complete ASI-3 and BBSIQ followed by the same training task from Visit 1.

Visit 3. Participants returned to the PRTC approximately 10 days after Visit 1, and were again asked to complete ASI-3 and BBSIQ, followed by the training task from Visit 1.

Visit 4. Participants returned to the PRTC approximately 14 days after Visit 1. They completed the same training task from Visit 1, followed by the outcome measures, including the self-report scales, the BATs and the visual dot-probe task.

Visit 5. The final visit was approximately 28 days after Visit 1. Participants were asked to complete the self-report measures, the BATs, the visual dot-probe task, and the WSAP. Finally, participants were debriefed and compensated for their time (see Appendix H for debriefing form).

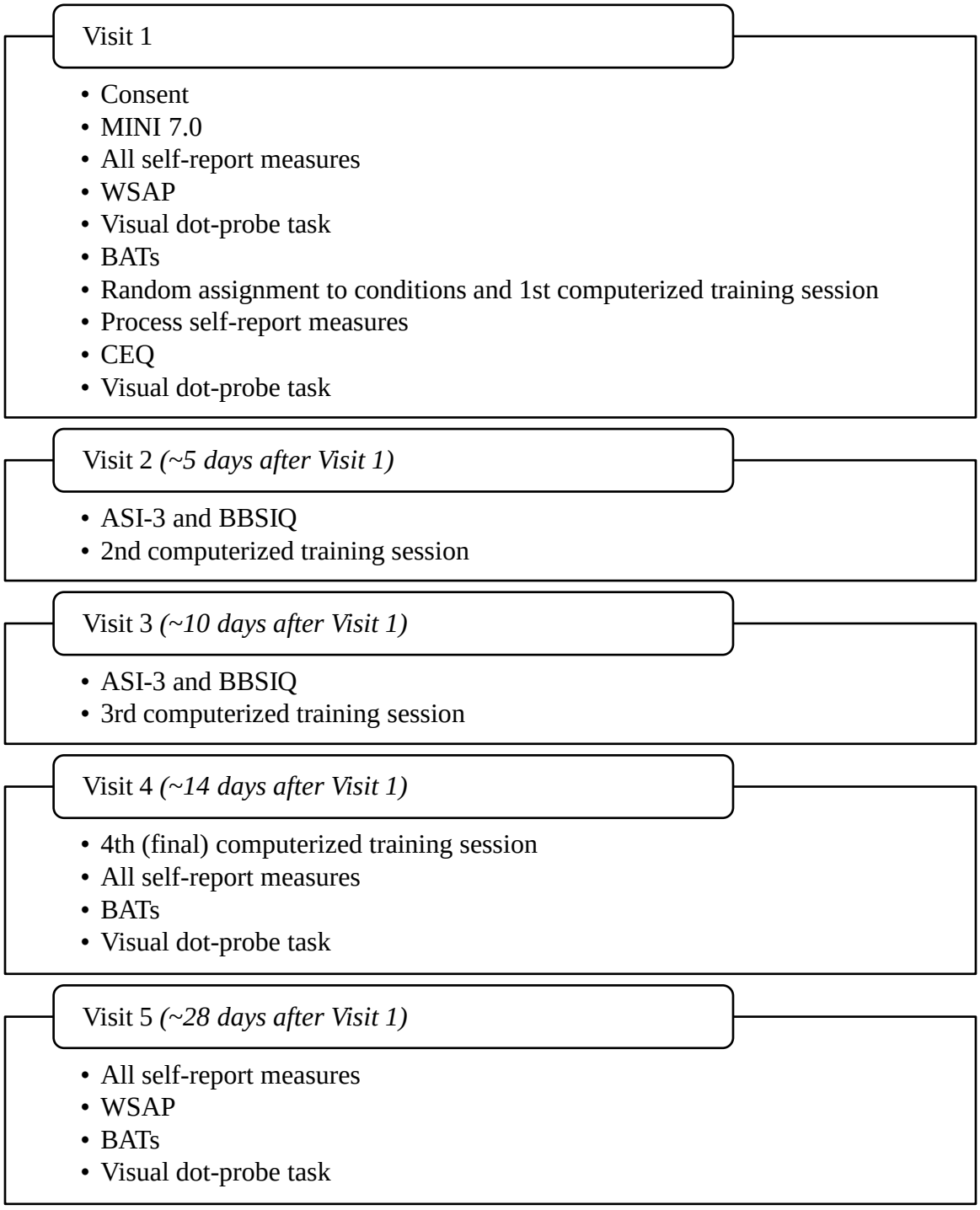

Figure 5. Outline of Study 2 Procedure. MINI 7.0= *Mini International Neuropsychiatric Interview 7.0* (Sheehan, 2014); ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). BBSIQ = *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997); WSAP= *Word Sentence Association Paradigm* (Beard & Amir, 2008). BATs= *Behavioural Approach Tasks*; Training= CBM or sham training.

Results

Data Screening

The data were screened for outliers, using methods described by Tabachnick and Fidell (2007). Outliers were data points with *z*-scores greater than |3.29|. Using this criterion, 25 outliers were identified and replaced by the second most extreme value in the distribution. Additionally, independent *t*-tests were used to assess between-group differences on outcome measures at pretest. There were no significant differences between the CBM and control conditions on any pretest measures. Means and standard deviations of all study variables, separated by condition, are presented in Tables 35, 43 and 52.

Analytic Plan

Hierarchical Linear Modeling (HLM; Raudenbush et al., 2004) was applied to test main effects of time and condition, and interaction of Time x Condition for Hypotheses 1-3. HLM has several advantages over traditional analyses to compare means (e.g., Analyses of Variance). First, HLM is robust to violations of the assumption of normality (Maas & Hox, 2004). Second, HLM allows for the inclusion of all participants in a given study, regardless of missing data (Raudenbush & Bryk, 2002). Finally, HLM analyses account for the reliability of within-group scores, between-group scores and the number of observations, and therefore, provides a better estimate of means (Nelzek, 2008).

Data were transformed using grand mean centering prior to all HLM analyses. In multilevel data, grand mean centering is used to increase the precision of estimates of main effects and interactions. This is accomplished by dictating the location of the intercept in each analysis (Wu & Wooldridge, 2005). Grand mean centering is recommended over other types of

transformations because it reduces covariance between intercepts and slopes, and therefore reduces multicollinearity (Hofmann & Gavin, 1998).

To fully investigate the effects of CBM training (Hypotheses 1 to 3), two sets of analyses were conducted for each outcome measure. First, HLM analyses were applied to the total model to examine the effects of CBM training over the whole study period. Main effects of Time and Condition, and an interaction of Time x Condition were produced by the HLM analyses. Planned contrasts were applied to examine within-condition changes in the CBM and control conditions, respectively and to test between-condition differences. Planned contrasts were conducted, regardless of significant omnibus tests. This is consistent with previous research (e.g., Hancock & Klockars, 1996) and was necessary to examine both the within-and between-group hypotheses. Bonferonni corrections were applied to all analyses.

Second, *piecewise analyses* were conducted to examine the change in scores over the intervention period (i.e., between Visits 1 and 4, during which participants were completing CBM training), and over the follow-up period (i.e., between Visits 4 and 5). This approach is considered appropriate when the data are believed to be nonlinear (Raudenbush & Bryk, 2002). It was deemed important for the present study given the state of the literature on CBM for high AS. Three known studies have investigated CBM for high AS, all of which included up to two training sessions, and follow-up periods of up to 2 days. Separating the study into two time periods (i.e., intervention and follow-up), allowed for separate examination of: 1) efficacy of CBM for high AS, and 2) stability of the training effects over a 2-week follow-up period. In the piecewise analyses, main effects of time and the interaction of Time x Condition were reported separately for the intervention and follow-up periods. Planned contrasts were conducted to examine the within-group changes in each condition in the intervention and follow-up periods,

respectively. Between-group differences were also tested during each phase. Bonferonni corrections were applied to all analyses.

Mediation analyses were conducted via *Mplus* 7.0 (Muthén & Muthén, 2015) to test Hypothesis 4. Mplus uses Structural Equation Modeling (SEM) to examine the direct and indirect pathways of change and to determine whether the theoretical model provides a good fit to the data. Several indices are used to examine proposed fit. Adequate model fit is characterized by: comparative fit index (CFI) and Tucker-Lewis Index (TLI) ≥ 0.95; and root-mean-square error of approximation (RMSEA) ≤ 0.06 (Byrne, 2011).

Finally, cross lag panel analyses were conducted via *Mplus* 7.0 (Muthén & Muthén, 2015) to investigate the temporal order of change of AS and negative interpretation biases. This type of analysis evaluates the extent to which scores on a measure at an earlier assessment point predict scores on a measure at the next assessment point, and therefore allows for examination of longitudinal relations (Kazdin, 2007). A significant coefficient demonstrates that earlier levels of one variable (i.e., the lag variable) predict later changes in the second variable (i.e., outcome). Of note, cross lag panel analyses control for earlier levels of each variable, which increases the precision of the analyses and results (Meuret et al., 2010).

Manipulation check

The WSAP was administered at Visits 1 and 5 as a manipulation check to assess changes in negative interpretation biases. Scores on the WSAP range between 0 and 1, and represent the proportion of trials during which the participant made a benign interpretation (i.e., accepted the benign interpretation or rejected the threat interpretation). Participants in the CBM condition produced scores of *M*= 0.51 (*SD*= 0.08) and *M*= 0.62 (*SD*= 0.20) at Visit 1 and 5, respectively. Participants in the control condition produced scores of *M*= 0.52 (*SD*= 0.11) and *M*= 0.64 (*SD*=

0.11) at Visit 1 and 5, respectively. There was a main effect of time, *b*= 0.14, SE= 0.04, *t*(46.28)= 3.08, *p*<.01, with participants making significantly more benign interpretations over time, collapsed across conditions. Relatedly, contrasts analyses revealed that participants in the CBM condition made significantly more benign interpretations at Visit 5 compared to Visit 1, *b*= 0.10, SE= 0.04, *t*(55.42)= 2.28, *p*<.05, indicating negative interpretive biases were modified. However, participants in the control condition also made significantly more benign interpretations at Visit 5, *b*= 0.14, SE= 0.03, *t*(46.26)= 3.97, *p*<.01, relative to at Visit 1. The magnitude of change did not differ significantly between the CBM and control conditions, *b*= -0.04, SE= 0.05, *t*(52.69)= -0.71, *p*= .48.

Treatment expectancy and credibility

The CEQ was administered to all participants immediately after the first computer training session. Scores on each subscale range from 1 to 9. In the present study, scores on the credibility subscale ranged from 1 to 8 in the CBM condition and 1 to 9 in the control condition. Mean scores were as follows: CBM condition: *M*= 4.56, *SD*= 1.72; control condition *M*= 3.94, *SD*= 1.95. When compared to the previously reported benchmark of a credibility score of ≥ 5, it appears that participants in both conditions did not view the treatment as credible. With regards to the expectancy subscale, scores ranged from 1 to 8.13 in the CBM condition and 1 to 7.40 in the control condition. Mean expectancy scores were as follows: CBM condition: *M*= 3.56, *SD*= 1.62; control condition *M*= 3.78, *SD*= 1.87. The benchmark for acceptable expectancy for change was set at ≥ 5. Therefore, participants in both conditions had low expectancy for change.

Independent samples *t*-tests were conducted to examine whether credibility of the intervention and/or the expectancy of effects of the intervention varied between conditions. Analyses revealed no significant differences in credibility beliefs between the CBM and control

conditions, $t(45)= 1.16$, $p= .25$. Analyses also revealed no significant differences in expectancy beliefs between the CBM and control conditions, $t(45)= -0.42$, $p= .68$.

Correlation analyses were conducted to examine the relationship between credibility beliefs, expectancy beliefs and constructs under investigation in the present study. Change scores were calculated by subtracting scores at Visit 5 from baseline scores. Of all the process, symptom, and BAT measures, CEQ credibility and expectancy scores were significantly correlated with three variables. Improvement in ASI-3 scores was positively correlated with the credibility, $r= .43$, $p< .01$, and expectancy, $r= .44$, $p< .01$, subscales. Improvement in SPIN scores was positively correlated with the credibility, $r= .46$, $p< .01$, and expectancy, $r= .36$, $p< .05$. Finally, improvement in DMQ-R scores was positively correlated with only the credibility subscale, $r= .36$, $p< .05$. Correlations with the other measures ranged from $r= -.31$ to .28 for the credibility subscale, and $r= -.21$ to .21 for the expectancy subscale.

***Posthoc* Power Analysis**

A *posthoc* power analysis was conducted with *G*Power 3.1* (Faul et al., 2009) to determine the statistical power of the present analyses. Unfortunately, G*Power is not able to compute power of HLM analyses, so the power of a repeated measures ANOVA was calculated. A repeated-measures ANOVA was considered an adequate substitution because of its ability to analyze longitudinal data and to compute a Time x Condition interaction. Independent variables were time (six assessment points) and condition (CBM versus control). ASI-3 score was the dependent variable, as it is one of the primary dependant variables in the present study. Although estimating power for a similar analysis to the one reported in the study has significant limitations, the benefits of having an approximate power value outweighed the problems associated with this approach. The results provided a power estimate of .77, which is almost

equal to the .80 power level recommended by Cohen (1988). Analyses also revealed that 52 participants would be required for an 80% of this effect being detected at the α= .05 level.

Hypothesis 1: Process Measures

ASI-3

Mean scores and standard deviations for the ASI-3, separated by condition, are reported in Table 35. The results of the HLM analyses for the ASI-3 are displayed in Table 39. There was a main effect of time, whereby, ASI-3 scores decreased over the course of the study in the sample, regardless of assigned condition. There was no main effect of condition, and no interaction of Time x Condition. When examining the magnitude of change within each condition, the CBM and control conditions showed significant reductions in ASI-3 scores. However, the CBM condition displayed greater magnitude of change, *b*= -3.23, SE= 0.59, compared to the control condition, *b*= -2.03, SE= 0.59. The results of piecewise analyses revealed differences between the intervention (i.e., Visits 1-4) and follow-up (Visits 4-5) periods. During the intervention period, there was a main effect of time, and a significant interaction of Time x Condition. There were no significant main effects during the follow-up period. Contrasts revealed that, during the intervention period, both the CBM and control conditions showed significant reductions in ASI-3 scores. The rate of change differed significantly between the conditions, with participants in the CBM condition, *b*=-1.10, SE= 0.20, displaying significantly greater changes in ASI-3 scores compared to the control condition, *b*= -0.51, SE= 0.20. Alternately, during the follow-up period, only the control condition showed significant reductions in ASI-3 scores, *b*= -6.41, SE=3.20. In summary, AS decreased, regardless of condition assignment, although during the intervention period the reductions in the CBM condition were significantly greater than those in the control condition.

BBSIQ

The means and standard deviations of the three BBSIQ subscales, separated by condition, are presented in Table 35.

The Panic-Negative Beliefs (Panic-Neg) subscale assessed the degree to which participants believed that a hypothetical situation involving ambiguous physical sensations would be resolved in a negative manner. The results of the HLM analyses for the Panic-Neg subscale are presented in Table 40. There were no significant main effects or interactions for the Panic-Neg subscale. However, the CBM condition displayed significant reductions in Panic-Neg scores, *b*= -0.20, SE= 0.08. The control condition showed nonsignificant reductions, *b*= -0.10, SE=0.07, and the rate of change was not significantly different between the conditions. Piecewise analyses revealed similar results, as there were no significant main effects or interactions for either of the time periods. Only the CBM condition showed a significant reduction in Panic-Neg scores over the intervention period, *b*= -0.18, SE= 0.06.

The Panic-Neutral Beliefs (Panic-Neu) subscale assessed the degree to which participants believed that a hypothetical situation involving ambiguous physical sensations would be resolved in a neutral or positive manner. The results of the HLM analyses for the Panic-Neu subscale are reported in Table 41. There were no significant main effects, interactions or contrasts for the Panic-Neu subscale. Piecewise analyses revealed a significant main effect of time during the intervention period only. There were no other significant main effects or interactions. Contrasts revealed significant increases in Panic-Neu scores in both the CBM, *b*= 0.13, SE= 0.04, and control, *b*= 0.10, SE= 0.04, conditions. There were no significant between-group differences; nor were there significant changes or differences for the follow-up period.

The Ranking subscale represents participants' rankings of the negative explanations for the ambiguous physical sensations in each hypothetical scenario. Items on the Ranking subscale are reverse coded; therefore, lower scores represent weaker negative interpretive biases regarding ambiguous physical sensations. The results of the HLM analyses for the Ranking subscale are displayed in Table 42. There was a significant main effect of time, as all participants ranked negative items as less likely to occur. There were no other main effects or interactions. According to the contrasts, participants in both the CBM and control conditions displayed significant reductions, *b*= -0.08, SE= 0.02, and *b*= -0.05, SE= 0.02, respectively, although the difference between the conditions was nonsignificant. Piecewise analyses revealed a significant main effect of time and a significant interaction of Time x Condition, both for the intervention period only. There were no other significant main effects or interactions. Contrasts for the intervention period revealed that both the CBM, *b*= -0.11, SE= 0.02, and control conditions, *b*= -0.05, SE= 0.02, showed significant reductions in Ranking scores. The magnitude of change in the CBM condition was significantly greater than that of the control condition. As for the follow-up period, participants in the CBM condition displayed significant increases in Ranking scores, *b*= 0.22 SE= 0.10, although these changes did not differ from those observed in the control condition.

In summary, participants in the CBM condition demonstrated reductions in negative interpretive biases across all three measures of interpretive bias. The control condition also demonstrated reductions in the strength of negative interpretive biases in the measures of neutral beliefs and ranking.

Table 35

Study 2- Means and Standard Deviations of ASI-3 and BBSIQ Scores Separated by Condition

	CBM	Within Cohen's *d*	Control	Within Cohen's *d*	Between Cohen's *d*
ASI-3					
Baseline	41.33 (11.26)	--	36.88 (11.20)	--	-0.39
Posttest	33.71 (12.51)	0.54	33.90 (13.65)	0.67	0.01
Day 5	32.00 (12.13)	0.83	33.00 (11.73)	0.45	0.08
Day 10	31.31 (12.48)	0.75	31.77 (14.50)	0.43	0.03
Day 15	25.43 (12.99)	0.71	31.00 (13.76)	0.57	0.42
Day 30	22.52 (15.63)	1.25	22.15 (11.02)	0.98	-0.03
BBSIQ Beliefs Panic Negative					
Baseline	2.80 (1.80)	--	2.86 (1.87)	--	0.03
Posttest	2.27 (1.80)	0.37	2.56 (1.70)	0.10	0.17
Day 5	2.40 (1.81)	0.28	2.61 (1.62)	0.18	0.12
Day 10	2.09 (1.52)	0.38	2.51 (1.89)	0.23	0.25
Day 15	2.01 (1.66)	0.33	2.36 (1.74)	0.40	0.21
Day 30	1.86 (1.51)	0.41	2.09 (1.57)	0.50	0.15
BBSIQ Beliefs Panic Neutral [a]					
Baseline	5.20 (1.23)	--	5.19 (1.12)	--	-0.01
Posttest	5.41 (1.34)	0.02	5.47 (1.03)	-0.88	0.05
Day 5	5.54 (1.14)	0.18	5.59 (1.26)	-0.39	0.04
Day 10	5.73 (1.08)	0.38	5.85 (1.00)	-0.79	0.11

	CBM	Within Cohen's *d*	Control	Within Cohen's *d*	Between Cohen's *d*
Day 15	5.64 (1.13)	0.27	5.57 (1.13)	-0.56	0.06
Day 30	5.64 (1.13)	0.21	5.65 (1.32)	-0.58	0.01
BBSIQ Panic Ranking					
Baseline	1.70 (0.52)	--	1.63 (0.40)	--	0.15
Posttest	1.40 (0.49)	0.62	1.47 (0.38)	0.63	-0.16
Day 5	1.39 (0.42)	0.67	1.40 (0.31)	0.58	-0.03
Day 10	1.26 (0.33)	0.81	1.36 (0.36)	0.66	-0.39
Day 15	1.24 (0.39)	0.74	1.42 (0.34)	0.59	-0.49
Day 30	1.29 (0.42)	0.61	1.35 (0.31)	0.75	-0.16

Note. CBM= *Cognitive Bias Modification.* ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). BBSIQ = *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997); BBSIQ Beliefs Panic Negative= rating of the probability of negative explanations of ambiguous physical sensations. BBSIQ Beliefs Panic Neutral= ratings of the probability of neutral explanations of ambiguous physical sensations. BBSIQ Ranking = rankings of the negative explanations of ambiguous physical sensations. BBSIQ Ranking is reverse scored; lower scores represent weaker negative interpretive biases in response to ambiguous physical sensations. Within-group Cohen's *d*= the magnitude of change in scores at each visit, as compared to scores at Baseline. Between-group Cohen's *d*= the magnitude of the difference in scores between the CBM and control conditions at each time point.

[a] Higher scores on the BBSIQ Panic-Neu subscale represent weaker negative interpretive biases.

Table 36

Study 2- Multilevel Models and Piecewise Analyses for ASI-3 as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	0.11	2.96	0.04
Time	-2.03	0.59	-3.41**
Condition	4.29	4.19	1.02
Time x Condition	-1.20	0.83	-1.44
Contrasts			
CBM	-3.23	0.59	-5.49 **
Control	-2.03	0.59	-3.41**
Difference	-1.20	0.83	-1.44
Piecewise Analyses			
Intercept	-1.07	1.14	-0.94
Time 1[a]	-0.51	0.20	-2.60*
Time 2[b]	-0.98	1.41	-0.70
Condition	2.63	1.61	1.64
Time 1 x Condition	-0.59	0.28	-2.12*
Time 2 x Condition	0.30	1.99	0.30
Time 1 Contrasts			
CBM	-1.10	0.20	-5.66**
Control	-0.51	0.20	-2.60*

	b	*SE*	*t*
Difference	-0.59	0.28	-2.12*
Time 2 Contrasts			
CBM	-2.77	3.20	-0.39
Control	-6.41	3.20	-2.00*
Difference	3.64	4.53	0.80

Note. CBM= *Cognitive Bias Modification.* ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:

[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).

[b] Time 2= Follow-up period (i.e., Visits 4 to 5)

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

Table 37

Study 2- Multilevel Models and Piecewise Analyses for BBSIQ Beliefs Panic-Negative as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	0.04	0.40	0.10
Time	-0.10	0.07	-1.38
Condition	0.06	0.56	0.10
Time x Condition	-0.10	0.10	-0.93
Contrasts			
CBM	-0.20	0.08	-2.72*
Control	-0.10	0.07	-1.38
Difference	-0.10	0.10	-0.93
Piecewise Analyses			
Intercept	<0.01	0.32	0.01
Time 1[a]	-0.92	0.06	-1.50
Time 2[b]	-0.09	0.41	-0.22
Condition	0.05	0.45	0.10
Time 1 x Condition	-0.08	0.09	-0.96
Time 2 x Condition	0.16	0.57	0.29
Time 1 Contrasts			
CBM	-0.18	0.06	-2.87**
Control	-0.09	0.06	-1.50

	b	*SE*	*t*
Difference	-0.08	0.09	-0.96
Time 2 Contrasts			
CBM	0.07	0.40	0.19
Control	-0.09	0.41	-0.22
Difference	0.16	0.57	0.29

Note. CBM= *Cognitive Bias Modification.* BBSIQ Beliefs Panic Negative= Beliefs Panic subscale of the *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997). This scale represents the rating of the probability of *negative* explanations of ambiguous physical sensations. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:

[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).

[b] Time 2= Follow-up period (i.e., Visits 4 to 5)

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

Table 38

Study 2- Multilevel Models and Piecewise Analyses for BBSIQ Beliefs Panic-Neutral as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	0.05	0.23	0.22
Time	0.08	0.05	1.79
Condition	-0.11	0.33	-0.34
Time x Condition	0.01	0.07	0.10
Contrasts			
CBM	0.10	0.05	1.96
Control	0.08	0.05	1.79
Difference	0.01	0.07	0.10
Piecewise Analyses			
Intercept	0.02	0.23	0.10
Time 1[a]	0.10	0.04	2.26*
Time 2[b]	-0.11	0.30	-0.37
Condition	-0.18	0.37	-0.54
Time 1 x Condition	0.03	0.06	0.53
Time 2 x Condition	-0.22	0.42	-0.52
Time 1 Contrasts			
CBM	0.13	0.04	3.03**
Control	0.10	0.04	2.26*

	b	*SE*	*t*
Difference	0.03	0.06	0.53
Time 2 Contrasts			
CBM	-0.33	0.29	-1.13
Control	-0.11	0.30	-0.37
Difference	-0.22	0.42	-0.52

Note. CBM= *Cognitive Bias Modification.* BBSIQ Beliefs Panic Neutral= Beliefs Panic subscale of the *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997). This scale represents the rating of the probability of *neutral* explanations of ambiguous physical sensations. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*p< .05; **p< .01

Table 39

Study 2- Multilevel Models and Piecewise Analyses for BBSIQ Ranking as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	0.06	0.06	-1.09
Time	-0.05	0.02	-2.17*
Condition	0.08	0.08	0.94
Time x Condition	-0.03	0.03	-1.04
Contrasts			
CBM	-0.08	0.02	-3.68**
Control	-0.05	0.02	-2.17*
Difference	-0.03	0.03	-1.04
Piecewise Analyses			
Intercept	-0.06	0.08	-0.76
Time 1[a]	-0.05	0.02	-2.92**
Time 2[b]	-0.03	0.10	0.29
Condition	0.14	0.11	1.25
Time 1 x Condition	-0.06	0.02	-2.40*
Time 2 x Condition	0.19	0.14	1.30
Time 1 Contrasts			
CBM	-0.11	0.02	-6.33**
Control	-0.05	0.02	-2.92**

	b	*SE*	*t*
Difference	-0.06	0.02	-2.40*
Time 2 Contrasts			
CBM	0.22	0.10	2.15*
Control	-0.03	0.10	0.29
Difference	0.19	0.14	1.30

Note. CBM= *Cognitive Bias Modification.* BBSIQ Ranking= Ranking subscale of the *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997). This scale represents the rankings of the negative explanations of ambiguous physical sensations. BBSIQ Ranking is reverse scored; lower scores represent weaker negative interpretive biases in response to ambiguous physical sensations.
Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*p< .05; **p< .01

ACQ-R

The ACQ-R assessed participants' perceptions of control over aversive experiences and emotional states. The means and standard deviations of the ACQ-R, separated by condition, are presented in Table 35 and the results of the HLM analyses for the ACQ-R are displayed in Table 43. There were no significant main effects, interactions or contrast analyses for the ACQ-R. With regards to the piecewise analyses, there were also no significant main effects, interactions or contrast analyses during either time period. In summary, scores on the ACQ-R did not change, and this was true regardless of training condition.

Visual Dot-Probe Task

Positive attention bias scores represent a bias *towards* benign interpretations, with larger scores representing *stronger* biases. The means and standard deviations separated by condition, are presented in Table 35, and the HLM results are displayed in Table 44. There were no significant main effects, interactions or contrast analyses for the attentional bias score, The piecewise analyses also revealed no significant main effects, interactions or contrast analyses. Neither the changes in each condition, nor the difference between the conditions, was significant in either time period. In summary, scores on the visual dot-probe task did not change, regardless of training condition.

Table 40

Study 2- Means and Standard Deviations of ACQ-R and Attention Bias Scores, Separated by Condition

	CBM	Within Cohen's *d*	Control	Within Cohen's *d*	Between Cohen's *d*
ACQ-R Total					
Baseline	36.29 (7.57)	--	37.09 (8.43)	--	0.10
Posttest	37.24 (8.14)	-0.29	37.54 (7.67)	< 0.01	0.04
Day 15	37.39 (8.13)	-0.21	36.09 (9.90)	0.03	-0.14
Day 30	37.26 (11.36)	-0.12	34.63 (7.73)	0.20	-0.27
Attention Bias Score					
Baseline	-1.29 (14.79)	--	-0.09 (15.51)	--	-0.08
Posttest	0.38 (16.68)	-0.12	-1.23 (10.38)	0.19	0.12
Day 15	2.60 (21.04)	0.17	1.23 (12.57)	-0.09	0.08
Day 30	4.35 (15.81)	0.20	2.68 (14.58)	0.21	0.11

Note. CBM= *Cognitive Bias Modification.* ACQ-R= *Anxiety Control Questionnaire- Revised* (Brown et al., 2004). Attention Bias scores calculated by subtracting the mean reaction time when the dot is paired with a threat word from the mean reaction time when the dot is paired with a benign word. Positive attention bias scores represent a bias *towards* benign interpretations. Within-group Cohen's *d*= the magnitude of change in scores at each visit, as compared to scores at Baseline. Between-group Cohen's *d*= the magnitude of the difference in scores between the CBM and control conditions at each time point.

Table 41

Study 2- Multilevel Models and Piecewise Analyses for ACQ-R as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	1.56	1.80	0.86
Time	-0.65	0.60	-1.08
Condition	-1.77	2.53	-0.70
Time x Condition	1.03	0.85	1.21
Contrasts			
CBM	0.37	0.60	0.63
Control	-0.65	0.60	-1.08
Difference	1.03	0.85	1.21
Piecewise Analyses			
Intercept	0.90	2.03	0.44
Time 1[a]	-0.26	0.76	-0.34
Time 2[b]	-1.40	2.50	-0.56
Condition	-2.24	2.87	-0.78
Time 1 x Condition	1.33	1.07	1.24
Time 2 x Condition	-0.86	3.50	-0.25
Time 1 Contrasts			
CBM	1.07	0.76	1.41
Control	-0.26	0.76	-0.34

	b	*SE*	*t*
Difference	1.33	1.07	1.24
Time 2 Contrasts			
CBM	-2.26	2.45	-0.92
Control	-1.40	2.50	-0.56
Difference	-0.86	3.50	-0.25

Note. CBM= *Cognitive Bias Modification.* ACQ-R= *Anxiety Control Questionnaire- Revised* (Brown et al., 2004). The ACQ-R assesses perceptions of control over aversive experiences and emotional states. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:

[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).

[b] Time 2= Follow-up period (i.e., Visits 4 to 5)

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

Table 42

Study 2- Multilevel Models and Piecewise Analyses for Attention Bias Scores as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	0.45	4.08	0.11
Time	0.30	1.59	0.19
Condition	-4.08	5.65	-0.72
Time x Condition	1.22	2.23	0.55
Contrasts			
CBM	1.52	1.56	0.98
Control	0.30	1.59	0.19
Difference	1.22	2.23	0.55
Piecewise Analyses			
Intercept	1.52	5.12	0.30
Time 1[a]	0.30	2.33	-0.13
Time 2[b]	1.96	6.37	0.31
Condition	-4.46	7.15	-0.62
Time 1 x Condition	1.36	3.31	0.41
Time 2 x Condition	-0.33	9.04	-0.04
Time 1 Contrasts			
CBM	1.07	2.35	0.46
Control	0.30	2.33	-0.13

	b	*SE*	*t*
Difference	1.36	3.31	0.41
Time 2 Contrasts			
CBM	1.62	6.42	0.25
Control	1.96	6.37	0.31
Difference	-0.33	9.04	-0.04

Note. CBM= *Cognitive Bias Modification.* Attention Bias score was calculated by subtracting the mean reaction time when the dot is paired with a threat word from the mean reaction time when the dot is paired with a benign word. Positive attention bias scores represent a bias *towards* benign interpretations. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*p< .05; **p< .01

Hypothesis 2: Symptom Measures

The means and standard deviations of all symptom measures, separated by condition, are presented in Table 35.

PDSS-SR

The PDSS-SR assesses the severity of symptoms of panic disorder. The results of the HLM analyses for the PDSS-SR are reported in Table 45. There was a main effect of time, as all participants showed decreased panic symptoms, regardless of assigned condition. There was no main effect of condition, nor an interaction of Time x Condition. Contrasts revealed that only participants in the control condition displayed significant reductions in PDSS-SR scores, *b*= -0.71, SE= 0.33. Piecewise analyses revealed a significant main effect of time for both the intervention and follow-up periods only. Both the CBM, *b*= -1.33, SE= 0.52, and control conditions, *b*= -1.81, SE= 0.52, showed significant changes over the intervention period, and the magnitude of change was not significantly different. During the follow-up period, there was a significant increase in in PDSS-SR scores in only the control condition, *b*= 2.37, SE= 1.09. The difference between the conditions was nonsignificant. In summary, all participants, regardless of training condition, showed reductions in panic symptoms during the intervention period, while only participants in the control condition demonstrated reductions over the whole study.

SPIN

The SPIN assesses the severity of symptoms of social anxiety disorder. The results of the HLM analyses for the SPIN are reported in Table 46. HLM analyses revealed a main effect of time, as SPIN scores decreased across conditions over the course of the study. There was no main effect of condition, nor a significant interaction of Time x Condition. Contrast analyses revealed that all participants displayed significant reductions in SPIN scores, regardless of

training condition. Although the magnitude of change in the CBM condition, *b*= -4.85, SE= 1.21, was larger than that of the control condition, *b*= -3.04, SE= 1.21, there were no significant between-group differences. Piecewise analyses revealed no main effects or interactions for neither the intervention nor follow-up periods. For the intervention period, only the CBM condition displayed significant reductions in SPIN scores, *b*= -7.00, SE= 2.13. There were no significant changes or differences during the follow-up period. In summary, participants, regardless of condition, displayed reductions in social anxiety symptoms over the whole study, although only those in the CBM condition displayed reductions during the intervention period.

GAD-Q-IV

The GAD-Q-IV assesses presence of symptoms of GAD. The results of the HLM analyses for the GAD-Q-IV are reported in Table 47. There were no main effects, interactions or contrast analyses for the whole study. With regards to the piecewise analyses, there was a main effect of time for the intervention period. There were no other main effect or interactions in either time period. Contrasts revealed that participants in the control condition displayed significant decreases in GAD symptoms over the intervention period, *b*= -1.42, SE= 0.56. There were no other significant changes or differences. In summary, scores on the GAD-Q-IV did not change, and this was true regardless of training condition.

CESD-R

The CESD-R assessed the frequency and severity of DSM-IV-TR major depressive episode symptoms. The results of the HLM analyses for the CESD-R are reported in Table 48. There were no significant main effects, interactions, or contrast analyses. As for piecewise analyses, there was a significant main effect of condition over both time periods, and a significant interaction of Time x Condition for the intervention period only. Contrasts for the

intervention period revealed a significant reduction in CESD-R score in the CBM condition only. Moreover, the magnitude of change in the CBM condition, *b*= -9.69, SE= 2.04, was significantly greater than the magnitude of change in the control condition, *b*= -2.83, SE= 2.04. During the follow-up period, only the CBM condition displayed a significant increase in CESD-R scores, *b*= 9.76, SE= 4.62. In summary, changes in CESD-R scores during the intervention period were significantly greater in the CBM condition as compared to the control condition, although there was a significant increase in CESD-R scores in the CBM condition during the follow-up period.

DMQ-R

The DMQ-R assesses motives to consume alcohol. The results of the HLM analyses for the DMQ-R are displayed in Table 49. There was a main effect of time, as all participants showed decreased motivation to consume alcohol over the course of the study, regardless of training condition. There were no other main effects, interactions or contrast analyses. For the intervention period, there was a main effect of time, and significant reductions in DMQ-R scores in the control condition, *b*=-4.52, SE= 2.05. There were no other significant reductions or differences. In summary, only participants in the control condition displayed reductions in DMQ-R scores and only during the intervention period.

SIP-R

The SIP-R assesses the frequency of problems associated with alcohol-use. HLM results are displayed in Table 50. There were no significant main effects, interactions or contrast analyses for the SIP-R over the whole study, nor were there significant results during the intervention or follow-up period. In summary, scores on the SIP-R did not change, and this was true regardless of training condition.

DASS-21

The DASS-21 Anxiety subscale assesses autonomic arousal and panic symptoms, and the results of the HLM analyses are presented in Table 51. Analyses revealed a significant main effect of time, and no significant main effect of condition, nor a significant interaction of Time x Condition. Contrasts revealed significant reductions in anxiety symptoms in both conditions, CBM, *b*= -2.40, SE= 1.15; control, *b*= -3.00, SE= 1.17. The magnitude of change was not significantly different across conditions. With regards to the piecewise analyses, there were no significant main effects or interactions for either the intervention or follow-up period. As for contrast analyses, the CBM condition displayed a significant reduction in anxiety symptoms during the intervention period only, *b*= -4.93, SE= 1.71. There were no significant changes or differences during the follow-up period. In summary, participants in both conditions displayed reductions in DASS-21 anxiety scores over the whole study, and only participants in the CBM condition displayed significant reductions during the intervention period.

The DASS-21 stress subscale assesses negative affect and general distress, and the results of the HLM analyses are presented in Table 52. With regards to analyses, there was a significant main effect of time only. Contrasts demonstrated significant reductions in stress symptoms in both the CBM and control conditions, CBM, *b*= -2.95, SE= 0.89; control, *b*= -3.54, SE= 0.90. The rate of change between conditions was not significantly different. Piecewise analyses revealed similar results. For the intervention period, there was a main effect of time, and significant reductions in DASS-21 anxiety scores in both the CBM, *b*= -4.69, SE= 1.63, and control conditions, *b*= -5.12, SE= 1.63, although there were no significant between-group difference. There were no significant changes or differences during the follow-up period. In

summary, scores on the DASS-21 stress scale significantly decreased during the whole study and during the intervention period, irrespective of training condition.

Table 43

Study 2- Means and Standard Deviations of Symptom Measures Separated by Condition

	CBM	Within Cohen's *d*	Control	Within Cohen's *d*	Between Cohen's *d*
PDSS-SR					
Baseline	5.58 (3.41)	--	5.25 (3.53)	--	-0.10
Day 15	4.05 (3.64)	0.46	3.33 (2.52)	0.75	-0.23
Day 30	4.58 (4.38)	0.38	3.89 (3.98)	0.40	-0.16
SPIN					
Baseline	39.79 (11.92)	--	35.75 (9.27)	--	-0.39
Day 15	33.57 (16.66)	0.61	31.15 (12.45)	0.42	-0.16
Day 30	32.32 (16.46)	0.96	29.35 (12.21)	0.67	-0.20
GAD-Q-IV					
Baseline	8.13 (3.44)	--	8.20 (3.60)	--	0.02
Day 15	7.09 (4.09)	0.35	7.28 (3.69)	0.55	0.05
Day 30	7.38 (3.81)	0.14	6.96 (4.43)	0.38	-0.10
CESD-R					
Baseline	32.71 (21.58)	--	23.83 (15.93)	--	-0.47
Day 15	18.57 (12.59)	0.86	20.05 (15.17)	0.28	0.11
Day 30	19.32 (16.66)	0.92	16.95 (14.48)	0.47	-0.15
DMQ-R					
Baseline	42.13 (22.47)	--	42.86 (19.38)	--	0.03
Day 15	40.10 (21.19)	0.43	38.59 (19.56)	0.47	-0.07

	CBM	Within Cohen's *d*	Control	Within Cohen's *d*	Between Cohen's *d*
Day 30	38.53 (21.74)	0.65	37.32 (18.76)	0.44	-0.06
SIP-R					
Baseline	1.13 (2.50)	--	2.42 (4.63)	--	0.35
Day 15	0.86 (1.77)	0.02	1.59 (3.57)	0.20	0.26
Day 30	1.47 (3.50)	-0.02	1.63 (3.65)	0.33	0.04
DASS- Anxiety					
Baseline	16.83 (9.81)	--	15.58 (8.63)	--	-0.14
Day 15	11.52 (8.62)	0.64	13.27 (8.93)	0.15	0.20
Day 30	12.21 (9.50)	0.64	8.63 (6.87)	0.65	-0.43
DASS-Stress					
Baseline	22.83 (9.83)	--	22.42 (10.99)	--	-0.04
Day 15	17.43 (10.57)	0.65	16.63 (11.06)	0.52	-0.07
Day 30	16.21 (11.01)	0.81	14.31 (10.86)	0.74	-0.17

Note. CBM= *Cognitive Bias Modification.* PDSS-SR= *Panic Disorder Severity Scale- Self-Report* (Houck et al., 2002). SPIN= *Social Phobia Inventory* (Connor et al., 2000). GAD-Q-IV= *Generalized Anxiety Disorder Questionnaire* (Newman et al., 2002). CESD-R= *Centre for Epidemiological Studies-Depression Scale-Revised* (Eaton et al., 2004). . DMQ-R= *Drinking Motives Questionnaire- Revised* (Cooper, 1994). SIP-R= *Short Inventory of Problems-Recent* (Miller et al., 1995). . DASS-21 Anxiety= the Anxiety subscale of the *Depression Anxiety Stress Scales-21* (Lovibond & Lovibond 1995). DASS-21 Stress= the Stress subscale of the *Depression Anxiety Stress Scales-21* (Lovibond & Lovibond 1995). Within-group Cohen's *d*= the magnitude of change in scores at each visit, as compared to scores at Baseline. Between-group Cohen's *d*= the magnitude of the difference in scores between the CBM and control conditions at each time point.

Table 44

Study 2- Multilevel Models and Piecewise Analyses for PDSS-SR as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	0.24	0.81	0.29
Time	-0.71	0.33	-2.11*
Condition	0.22	1.14	0.20
Time x Condition	0.16	0.47	0.33
Contrasts			
CBM	-0.55	0.33	-1.68
Control	-0.71	0.33	-2.11*
Difference	0.16	0.47	0.33
Piecewise Analyses			
Intercept	1.67	0.94	1.78
Time 1[a]	-1.81	0.52	-3.51**
Time 2[b]	2.37	1.09	2.18*
Condition	-0.20	1.33	-0.15
Time 1 x Condition	0.50	0.73	0.66
Time 2 x Condition	-0.75	1.53	-0.50
Time 1 Contrasts			
CBM	-1.33	0.52	-2.58*
Control	-1.81	0.52	-3.51**

	b	*SE*	*t*
Difference	0.50	0.73	0.66
Time 2 Contrasts			
CBM	1.61	1.07	1.50
Control	2.37	1.09	2.18*
Difference	-0.75	1.53	-0.50

Note. CBM= *Cognitive Bias Modification.* PDSS-SR= *Panic Disorder Severity Scale- Self-Report* (Houck et al., 2002). The PDSS-SR assesses the severity of panic disorder symptoms. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*$p < .05$; **$p < .01$

Table 45

Study 2- Multilevel Models and Piecewise Analyses for SPIN as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	1.09	3.00	0.36
Time	-3.04	1.21	-2.52*
Condition	4.73	4.24	1.11
Time x Condition	-1.80	1.71	-1.06
Contrasts			
CBM	-4.85	1.21	-4.01**
Control	-3.04	1.21	-2.52*
Difference	-1.80	1.71	-1.06
Piecewise Analyses			
Intercept	2.34	3.80	0.62
Time 1[a]	-4.00	2.13	-1.88
Time 2[b]	2.07	4.35	0.48
Condition	6.32	5.38	1.18
Time 1 x Condition	-3.00	3.00	-1.00
Time 2 x Condition	2.85	6.15	0.46
Time 1 Contrasts			
CBM	-7.00	2.13	-3.29**
Control	-4.00	2.13	-1.88

	b	*SE*	*t*
Difference	-3.00	3.00	-1.00
Time 2 Contrasts			
CBM	4.91	4.35	1.13
Control	2.07	4.35	0.48
Difference	2.85	6.15	0.46

Note. CBM= *Cognitive Bias Modification.* SPIN= *Social Phobia Inventory* (Connor et al., 2000). SPIN assesses the severity of social anxiety disorder symptoms. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*$p < .05$; **$p < .01$

Table 46

Study 2- Multilevel Models and Piecewise Analyses for GAD-Q-IV as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	0.33	0.88	0.38
Time	-0.60	0.31	-1.90
Condition	-0.59	1.24	-0.47
Time x Condition	0.41	0.44	0.92
Contrasts			
CBM	-0.19	0.31	-0.60
Control	-0.60	0.31	-1.90
Difference	0.41	0.44	0.92
Piecewise Analyses			
Intercept	1.39	1.01	1.38
Time 1[a]	-1.42	0.56	-2.52*
Time 2[b]	1.71	1.20	1.43
Condition	-0.54	1.44	-0.38
Time 1 x Condition	0.39	0.80	0.49
Time 2 x Condition	-0.10	1.67	-0.06
Time 1 Contrasts			
CBM	-1.03	0.56	-1.83
Control	-1.42	0.56	-2.52*

	b	*SE*	*t*
Difference	0.39	0.80	0.49
Time 2 Contrasts			
CBM	1.62	1.17	1.39
Control	1.71	1.20	1.43
Difference	-0.10	1.67	-0.06

Note. CBM= *Cognitive Bias Modification.* GAD-Q-IV= *Generalized Anxiety Disorder Questionnaire* (Newman et al., 2002). This measure assesses the presence of symptoms of GAD. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*p< .05; **p< .01

Table 47

Study 2- Multilevel Models and Piecewise Analyses for CESD-R as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	-1.84	3.28	-0.56
Time	-2.43	2.13	-1.14
Condition	8.59	4.63	1.85
Time x Condition	-1.70	3.01	-0.57
Contrasts			
CBM	-4.13	2.13	-1.94
Control	-2.43	2.13	-1.14
Difference	-1.70	3.01	-0.57
Piecewise Analyses			
Intercept	-1.33	4.06	-0.33
Time 1[a]	-2.83	2.04	-1.38
Time 2[b]	0.55	4.62	0.12
Condition	15.18	5.74	2.64**
Time 1 x Condition	-6.86	2.89	-2.37*
Time 2 x Condition	9.20	6.53	1.41
Time 1 Contrasts			
CBM	-9.69	2.04	-4.74**
Control	-2.83	2.04	-1.38

	b	*SE*	*t*
Difference	-6.86	2.89	-2.37*
Time 2 Contrasts			
CBM	9.76	4.62	2.11*
Control	0.55	4.62	0.12
Difference	9.20	6.53	1.41

Note. CBM= *Cognitive Bias Modification.* CESD-R= *Centre for Epidemiological Studies-Depression Scale-Revised* (Eaton et al., 2004). This measure assesses the severity of symptoms of a major depressive episode. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*p< .05; **p< .01

Table 48

Study 2- Multilevel Models and Piecewise Analyses for DMQ-R as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	3.21	4.40	0.73
Time	-2.56	1.15	-2.23*
Condition	-1.37	6.21	-0.22
Time x Condition	-0.62	1.61	-0.41
Contrasts			
CBM	-3.22	1.13	-2.85**
Control	-2.56	1.15	-2.23*
Difference	-0.62	1.61	-0.41
Piecewise Analyses			
Intercept	5.74	4.94	1.16
Time 1[a]	-4.52	2.05	-2.20*
Time 2[b]	4.03	3.73	1.08
Condition	-3.14	6.98	-0.45
Time 1 x Condition	0.72	2.90	0.25
Time 2 x Condition	-2.78	5.26	-0.53
Time 1 Contrasts			
CBM	-3.81	2.05	-1.85
Control	-4.52	2.05	-2.20*

	b	*SE*	*t*
Difference	0.72	2.90	0.25
Time 2 Contrasts			
CBM	1.25	3.70	0.34
Control	4.03	3.73	1.08
Difference	-2.78	5.26	-0.53

Note. CBM= *Cognitive Bias Modification.* DMQ-R= *Drinking Motives Questionnaire- Revised* (Cooper, 1994). This measure assesses the motives for consuming alcohol. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*$p < .05$; **$p < .01$

Table 49

Study 2- Multilevel Models and Piecewise Analyses for SIP-R as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	0.91	0.80	1.14
Time	-0.32	0.25	-1.29
Condition	-1.60	1.13	-1.41
Time x Condition	0.37	0.36	1.05
Contrasts			
CBM	0.05	0.25	0.19
Control	-0.32	0.25	-1.29
Difference	0.37	0.36	1.05
Piecewise Analyses			
Intercept	1.07	0.84	1.27
Time 1[a]	-0.45	0.43	-1.04
Time 2[b]	0.24	0.97	0.25
Condition	-1.68	1.20	-1.41
Time 1 x Condition	0.44	0.61	0.72
Time 2 x Condition	-0.12	1.37	-0.09
Time 1 Contrasts			
CBM	-0.01	0.43	-0.03
Control	-0.45	0.43	-1.04

	b	*SE*	*t*
Difference	0.44	0.61	0.72
Time 2 Contrasts			
CBM	0.13	0.96	0.13
Control	0.24	0.97	0.25
Difference	-0.12	1.37	-0.09

Note. CBM= *Cognitive Bias Modification.* SIP-R= *Short Inventory of Problems-Recent* (Miller et al., 1995). The SIP-R assesses the frequency of alcohol-related problems. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*$p < .05$; **$p < .01$

Table 50

Study 2- Multilevel Models and Piecewise Analyses for DASS-21 Anxiety as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	2.80	2.09	1.34
Time	-3.00	1.17	-2.56*
Condition	-0.60	2.93	-0.21
Time x Condition	0.59	1.64	0.36
Contrasts			
CBM	-2.40	1.15	-2.09*
Control	-3.00	1.17	-2.56*
Difference	0.59	1.64	0.36
Piecewise Analyses			
Intercept	1.22	2.87	0.42
Time 1[a]	-1.78	1.71	-1.04
Time 2[b]	-2.59	3.32	-0.78
Condition	4.27	4.06	1.05
Time 1 x Condition	-3.15	2.42	-1.30
Time 2 x Condition	7.83	4.67	1.68
Time 1 Contrasts			
CBM	-4.93	1.71	-2.88**
Control	-1.78	1.71	-1.04

	b	*SE*	*t*
Difference	-3.15	2.42	-1.30
Time 2 Contrasts			
CBM	5.25	3.29	1.60
Control	-2.59	3.32	-0.78
Difference	7.83	4.67	1.68

Note. CBM= *Cognitive Bias Modification.* DASS-21 Anxiety= the Anxiety subscale of the *Depression Anxiety Stress Scales-21* (Lovibond & Lovibond 1995). This subscale assesses the autonomic arousal and panic symptoms. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*p< .05; **p< .01

Table 51

Study 2- Multilevel Models and Piecewise Analyses for DASS-21 Stress as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	3.07	2.56	1.20
Time	-3.54	0.90	-3.92**
Condition	-0.62	3.62	-0.17
Time x Condition	0.59	1.26	0.47
Contrasts			
CBM	-2.95	0.89	-3.32**
Control	-3.54	0.90	-3.92**
Difference	0.59	1.26	0.47
Piecewise Analyses			
Intercept	5.12	2.95	1.73
Time 1[a]	-5.12	1.63	-3.13**
Time 2[b]	3.25	3.41	0.95
Condition	-0.43	4.17	-0.10
Time 1 x Condition	0.43	2.31	0.19
Time 2 x Condition	0.26	4.80	0.06
Time 1 Contrasts			
CBM	-4.69	1.63	-2.87**
Control	-5.12	1.63	-3.13**

	b	*SE*	*t*
Difference	0.43	2.31	0.19
Time 2 Contrasts			
CBM	3.51	3.37	1.04
Control	3.25	3.41	0.95
Difference	0.26	4.80	0.06

Note. CBM= *Cognitive Bias Modification.* DASS-21 Stress= the Stress subscale of the *Depression Anxiety Stress Scales-21* (Lovibond & Lovibond 1995). This subscale assesses symptoms of negative affect and general distress. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*p< .05; **p< .01

Hypothesis 3: BATS

Participants completed two BATs that were selected specifically to induce fear and distress. The top two fear-producing BATS were randomly designated BAT 1 or BAT 2. BATs were administered at Visit 1 baseline, Visit 1 posttest, Visit 4 and Visit 5, and the order of administration of the two BATs was counterbalanced. Means and standard deviations, separated by condition, are presented in Table 52.

The most common BAT was straw breathing, with 26 participants reporting that it was one of the top two fear producing BATs. The next most common BATs were spinning in a computer chair (*N*= 19), breath holding (*N*= 17) and head shaking (*N*= 10). There were no significant differences in the types of BATs that were completed the in CBM and control conditions for either BAT 1, χ^2= 12.97, *p*= .11, or BAT 2, χ^2= 8.39, *p*= .29. Time, Fear and Avoidance ratings were recorded for each BAT. The maximum time to complete each BAT varied, and the time variables were standardized by determining the proportion of time each participant spent engaging in the BAT out of the maximum time allowed for each BAT. Mean scores and standard deviations for all the BAT variables, separated by condition, are presented in Table 38.

In general, 75% of participants were able to complete at least one BAT for the maximum time over the course of the study. A large proportion of participants were able to complete the BATs for the maximum amount of time at baseline. In the CBM condition, 44% (*n*= 11) and 52% (*n*=13) of participants completed BAT 1 and BAT 2, respectively, for the maximum time at baseline. In the control condition, 48% (*n*= 12) and 44% (*n*=11) of participants completed BAT 1 and BAT 2, respectively, for the maximum time at baseline. Similar proportions of participants were able to complete the BATs for the maximum time at Visit 4, as 48% (*n*=12) and 36% (*n*=9)

of participants in the CBM condition completed BAT 1 and BAT 2, respectively, for the maximum time. Similarly, 48% (*n*=12) and 44% (*n*=11) of participants in the control condition completed BAT 1 and BAT 2, respectively, during Visit 4. At the final visit, 44% (*n*= 11) and 36% (*n*=9) of participants in the CBM condition completed BAT 1 and BAT 2, respectively, for the maximum time. Similarly, 36% (*n*= 9) and 56% (*n*=14) of participants in the control condition completed BAT 1 and BAT 2, respectively, for the maximum time at the final visit.

BAT 1 Time

The results of the HLM analyses are reported in Table 53. There were no significant main effects, interactions or contrast analyses for BAT 1 Time over the whole study, nor during the intervention or follow-up periods.

BAT 1 Fear

The results of the HLM analyses are reported in Table 54. There was a main effect of time, with fear during BAT 1 decreasing over the study across conditions. There were no other significant main effects or interactions. Contrasts revealed that only participants in the control condition showed significant decreases in fear, *b*= -6.41, SE= 2.61. Piecewise analyses revealed no significant main effects, interactions, or contrasts.

BAT 1 Avoid

The results of the HLM analyses are reported in Table 55. Similar to the BAT 1 Time results, there were no significant main effects, interactions or contrast analyses for BAT 1 Avoid. Piecewise analyses also revealed no significant main effects, interactions, or contrasts.

BAT 2 Time

The results of the HLM analyses are reported in Table 56. There was a main effect of time, with time spent engaging in BAT 2 increasing over the study across conditions. There were

no other significant main effects or interactions. Contrast revealed that only participants in the control condition displayed significant increases in BAT 2 Time, *b*= 0.06, SE= 0.03. Piecewise analyses revealed no significant main effects, interactions or contrast analyses.

BAT 2 Fear

The results of the HLM analyses are reported in Table 57. Analyses revealed a main effect of time, as BAT 2 Fear scores decreased across both conditions over the course of the study. There was no main effect of condition, nor a significant interaction of Time x Condition. Contrasts revealed that only the control condition, *b*= -13.47, SE= 3.98, displayed significant reductions in fear. Piecewise analyses revealed a main effect of time for the intervention period only. There were no other main effects or interactions. During the intervention period, only the control condition displayed a significant reduction in fear, *b*= -22.47, SE= 5.80. There were no significant changes or differences during the follow-up period.

BAT 2 Avoid

The results of the HLM analyses are reported in Table 58. There was a main effect of time, as BAT 2 Avoid scores decreased across conditions over the course of the study. There was no other main effects or interactions. Contrasts revealed significant reductions in desire to avoid in both the CBM, *b*= -8.77, SE= 3.60, and control, *b*= -8.25, SE= 3.60, conditions, although these changes were not significantly different. Piecewise analyses revealed a main effect of time during the intervention period only. There were no other main effects or interactions. During the intervention period, the control condition displayed significant reductions in fear, *b*= -11.12, SE= 5.52. There were no significant changes or differences during the follow-up period.

To summarize the results of BAT 1, there were no changes or differences detected on any measure except fear, as participants in the control condition displayed reductions in fear over the

whole study. As for BAT 2, only the control condition displayed significant increases in time and decreases in fear. Participants in both conditions displayed significant decreases in avoidance during the whole study, although the control condition also displayed significant reductions during the intervention period.

Table 52

Study 2- Means and Standard Deviations of BAT Scores Separated by Condition

	CBM	Within Cohen's *d*	Control	Within Cohen's *d*	Between Cohen's *d*
BAT 1 time [a]					
Baseline	0.72 (0.31)	--	0.74 (0.35)	--	-0.06
Day 15	0.76 (0.34)	-0.08	0.78 (0.33)	-0.02	-0.06
Day 30	0.78 (0.31)	-0.04	0.75 (0.32)	0.25	0.10
BAT 1 Fear					
Baseline	35.71 (27.76)	--	49.67 (26.02)	--	0.52
Day 15	34.52 (26.30)	- 0.01	42.05 (30.39)	0.29	0.26
Day 30	31.37 (27.55)	0.10	35.65 (29.01)	0.48	0.15
BAT 1 Avoid					
Baseline	66.92 (24.84)	--	69.47 (28.42)	--	0.10
Day 15	62.10 (23.53)	0.14	66.05 (30.41)	0.10	0.15
Day 30	57.79 (32.80)	0.21	59.35 (29.46)	0.21	0.05
BAT 2 time [a]					
Baseline	0.79 (0.28)	--	0.75 (0.29)	--	0.14
Day 15	0.75 (0.29)	0.06	0.77 (0.28)	0.02	0.07
Day 30	0.85 (0.24)	0.36	0.94 (0.16)	-0.48	0.44
BAT 2 Fear					
Baseline	40.21 (30.89)	--	54.48 (26.23)	--	0.50
Day 15	26.28 (24.53)	0.22	30.55 (25.56)	0.78	0.17

	CBM	Within Cohen's *d*	Control	Within Cohen's *d*	Between Cohen's *d*
Day 30	25.47 (29.05)	0.38	31.63 (29.48)	0.76	0.21
BAT 2 Avoid					
Baseline	70.50 (24.45)	--	76.71 (24.16)	--	0.26
Day 15	60.17 (24.12)	0.24	65.35 (26.31)	0.39	0.21
Day 30	51.93 (30.69)	0.59	62.44 (27.49)	0.88	0.36

Note. CBM= *Cognitive Bias Modification.* BAT= Behavioural Approach Task. Time = time spent engaging in each BAT. The maximum time to complete each BAT varied between 30 and 120 seconds and the time variables were standardized by determining the proportion of time each participant spent engaging in the BAT out of the maximum time allowed for each BAT. Fear = fear experienced during each BAT. Fear was rated on a 10cm VAS. Avoid = extent to which participant wanted to stop engaging in each BAT, and was rated on a 10cm VAS. Within-group Cohen's *d*= the magnitude of change in scores at each visit, as compared to scores at Baseline. Between-group Cohen's *d*= the magnitude of the difference in scores between the CBM and control conditions at each time point.

[a] Time spent participating in the BAT was expected to increase over the course of the study, and Cohen's *d* are positive to account for the expected direction of change.

Table 53

Study 2- Multilevel Models and Piecewise Analyses for BAT 1 Time as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	0.06	0.08	0.74
Time	-0.02	0.04	-0.36
Condition	-0.10	0.11	-0.88
Time x Condition	0.03	0.06	0.54
Contrasts			
CBM	0.02	0.04	0.41
Control	-0.02	0.04	-0.36
Difference	0.03	0.06	0.54
Piecewise Analyses			
Intercept	0.02	0.10	0.18
Time 1[a]	0.01	0.06	0.24
Time 2[b]	-0.06	0.12	-0.51
Condition	-0.07	0.14	-0.50
Time 1 x Condition	0.01	0.08	0.18
Time 2 x Condition	0.04	0.16	0.22
Time 1 Contrasts			
CBM	0.03	0.06	0.51
Control	0.01	0.06	0.24

	b	*SE*	*t*
Difference	0.01	0.08	0.18
Time 2 Contrasts			
CBM	-0.02	0.11	-0.22
Control	-0.06	0.12	-0.51
Difference	0.04	0.16	0.22

Note. CBM= *Cognitive Bias Modification.* BAT= Behavioural Approach Task. BAT1 time = time spent engaging in BAT 1. The maximum time to complete each BAT varied between 30 and 120 seconds and the time variables were standardized by determining the proportion of time each participant spent engaging in the BAT out of the maximum time allowed for each BAT. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*p< .05; **p< .01

Table 54

Study 2- Multilevel Models and Piecewise Analyses for BAT 1 Fear as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	11.50	6.91	1.66
Time	-6.41	2.61	-2.45*
Condition	-14.26	9.47	-1.51
Time x Condition	5.02	3.57	1.41
Contrasts			
CBM	-1.39	2.43	-0.57
Control	-6.41	2.61	-2.45*
Difference	5.02	3.57	1.41
Piecewise Analyses			
Intercept	11.65	8.72	1.33
Time 1[a]	-6.52	4.52	-1.44
Time 2[b]	0.57	8.29	0.07
Condition	-16.01	11.99	-1.33
Time 1 x Condition	6.36	6.24	1.02
Time 2 x Condition	-3.15	11.40	-0.28
Time 1 Contrasts			
CBM	-0.16	4.30	-0.04
Control	-6.52	4.52	-1.44

	b	*SE*	*t*
Difference	6.36	6.24	1.02
Time 2 Contrasts			
CBM	-2.58	7.82	-0.33
Control	0.57	8.29	0.07
Difference	-3.15	11.40	-0.28

Note. CBM= *Cognitive Bias Modification.* BAT= Behavioural Approach Task. BAT1 fear = fear experienced during BAT 1. Fear was rated on a 10cm VAS. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*$p < .05$; **$p < .01$

Table 55

Study 2- Multilevel Models and Piecewise Analyses for BAT 1 Avoid as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	3.42	6.84	0.50
Time	-3.20	3.84	-0.83
Condition	0.66	9.36	0.07
Time x Condition	-0.87	5.24	-0.16
Contrasts			
CBM	-4.07	3.58	-1.14
Control	-3.20	3.84	-0.83
Difference	-0.87	5.24	-0.16
Piecewise Analyses			
Intercept	2.03	9.47	0.21
Time 1[a]	-2.14	5.53	-0.39
Time 2[b]	-2.65	10.87	-0.24
Condition	2.35	13.01	0.18
Time 1 x Condition	-2.15	7.63	-0.28
Time 2 x Condition	2.99	14.91	0.20
Time 1 Contrasts			
CBM	-4.29	5.26	-0.82
Control	-2.14	5.53	-0.39

	b	*SE*	*t*
Difference	-2.15	7.63	-0.28
Time 2 Contrasts			
CBM	0.34	10.22	0.03
Control	-2.65	10.87	-0.24
Difference	2.99	14.91	0.20

Note. CBM= *Cognitive Bias Modification.* BAT= Behavioural Approach Task. BAT1 avoid = extent to which participant wanted to stop engaging in BAT 1, and was rated on a 10cm VAS. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*p< .05; **p< .01

Table 56

Study 2- Multilevel Models and Piecewise Analyses for BAT 2 Time as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	-0.08	0.08	-0.97
Time	0.06	0.03	2.23*
Condition	0.04	0.12	0.36
Time x Condition	-0.03	0.04	-0.80
Contrasts			
CBM	0.03	0.03	1.15
Control	0.06	0.03	2.23*
Difference	-0.03	0.04	-0.80
Piecewise Analyses			
Intercept	-0.01	0.07	-0.06
Time 1[a]	-0.01	0.03	-0.03
Time 2[b]	0.14	0.07	1.99
Condition	-0.01	0.10	-0.10
Time 1 x Condition	0.01	0.04	0.30
Time 2 x Condition	-0.10	0.10	-1.00
Time 1 Contrasts			
CBM	0.01	0.03	0.40
Control	-0.01	0.03	-0.03

	b	*SE*	*t*
Difference	0.01	0.04	0.30
Time 2 Contrasts			
CBM	0.04	0.06	0.62
Control	0.14	0.07	1.99
Difference	-0.10	0.10	-1.00

Note. CBM= *Cognitive Bias Modification.* BAT= Behavioural Approach Task. BAT2 time = time spent engaging in BAT 2. The maximum time to complete each BAT varied between 30 and 120 seconds and the time variables were standardized by determining the proportion of time each participant spent engaging in the BAT out of the maximum time allowed for each BAT. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*p< .05; **p< .01

Table 57

Study 2- Multilevel Models and Piecewise Analyses for BAT 2 Fear as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	17.71	6.92	2.56*
Time	-13.47	3.98	-3.38**
Condition	-17.67	9.61	-1.84
Time x Condition	6.68	5.64	1.18
Contrasts			
CBM	-6.80	4.00	-1.70
Control	-13.47	3.98	-3.38**
Difference	6.68	5.64	1.18
Piecewise Analyses			
Intercept	29.49	9.77	3.02**
Time 1[a]	-22.47	5.80	-3.88**
Time 2[b]	21.65	11.35	1.91
Condition	-26.51	13.56	-1.95
Time 1 x Condition	13.31	8.23	1.62
Time 2 x Condition	-16.70	16.13	-1.04
Time 1 Contrasts			
CBM	-9.17	5.83	-1.57
Control	-22.47	5.80	-3.88**

	b	*SE*	*t*
Difference	13.31	8.23	1.62
Time 2 Contrasts			
CBM	4.95	11.47	0.43
Control	21.65	11.35	1.91
Difference	-16.70	16.13	-1.04

Note. CBM= *Cognitive Bias Modification.* BAT= Behavioural Approach Task. BAT2 fear = fear experienced during BAT 2. Fear was rated on a 10cm VAS. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*$p < .05$; **$p < .01$

Table 58

Study 2- Multilevel Models and Piecewise Analyses for BAT 2 Avoid as Associated with Time and Condition

	b	*SE*	*t*
Total Model Analyses			
Intercept	10.61	6.47	1.64
Time	-8.25	3.60	-2.30*
Condition	-4.77	8.97	-0.53
Time x Condition	-0.52	5.08	-0.10
Contrasts			
CBM	-8.77	3.60	-2.44*
Control	-8.25	3.60	-2.30*
Difference	-0.52	5.08	-0.10
Piecewise Analyses			
Intercept	14.37	9.18	1.57
Time 1[a]	-11.12	5.52	-2.01*
Time 2[b]	7.41	10.65	0.70
Condition	-8.27	12.74	-0.65
Time 1 x Condition	2.17	7.83	0.28
Time 2 x Condition	-7.42	15.14	-0.50
Time 1 Contrasts			
CBM	-8.95	5.54	-1.62
Control	-11.12	5.52	-2.01*

	b	*SE*	*t*
Difference	2.17	7.83	0.28
Time 2 Contrasts			
CBM	-0.02	10.76	-0.01
Control	7.41	10.65	0.70
Difference	-7.42	15.14	-0.50

Note. CBM= *Cognitive Bias Modification.* BAT= Behavioural Approach Task. BAT 2 avoid = extent to which participant wanted to stop engaging in BAT 2, and was rated on a 10cm VAS. Under Contrasts, *CBM* represents within-group changes in the CBM condition, and *Control* represents within-group changes in the control condition. *Difference* represents a test of between-group differences. For the *Piecewise Analyses*, the study was divided into two different periods:
[a] Time 1= Intervention period, during which participants were completing the CBM or sham computer training (i.e., Visits 1-4).
[b] Time 2= Follow-up period (i.e., Visits 4 to 5)
*p< .05; **p< .01

Hypothesis 4: Mediation analyses

It was hypothesized that change in negative interpretation bias, perceived control and negative attentional bias would each predict changes in AS. Therefore, three separate mediation analyses were conducted. The variables included in each analysis were similar: Condition was the independent variable, ASI-3 scores were the dependent variable, and negative interpretation bias, perceived control and negative attentional bias were the mediator variables, respectively. The BBSIQ Panic-Neg subscale was the measure of negative interpretive bias in the mediation analyses, as it was found to have the largest effect of the three negative interpretive bias measures. Effect sizes were calculated by standardizing the effect of the interaction of Time x Condition by calculating the absolute value of the *estimate divided by the standard error*. This produced a *t* score, with larger values representing larger effects (Garson, 2013). The absolute value of the Panic-Neg statistic was $t = 0.93$, which is larger than that of the Panic-Neu measure, $t = 0.09$, and the Ranking scale, $t = 0.67$. Therefore, Panic-Neg was used in the mediation analysis.

Mediation analyses were conducted in the absence of treatment effects (i.e., direct effects). Several factors could contribute to indirect effects being observed in the absence of a direct effect, including the precision of variable measurement, strength of relationships between the variables, suppression effects, and size of the total effect (Rucker et al., 2011). Therefore, to fully investigate the effects of the proposed mediators, mediation analyses were conducted for all three hypothesized mediators, as per the *a priori* analytical plan.

The first mediation analysis examined the effects of change in negative interpretation bias on change in AS level, and is depicted in Figure 6. The fit indices indicated poor fit, $\chi^2 (0) = 0.00$, $p = 0.00$, to excellent fit, CFI= 1.00; TLI= 1.00; RMSEA= 0.00. Change in BBSIQ Panic-Neg scores predicted change in ASI-3 total scores, $b = 5.53$, $p < .01$, 95% CI [4.15, 6.92]. Condition

did not predict Panic-Neg scores, *a*= 0.28, *p*= .52, 95% CI [-0.43, 0.98], or change in ASI-3 scores, *c*=-1.47, *p*= .50, 95% CI [-5.08, 2.13]. The indirect effect was nonsignificant, *c'*=1.52, *p*= .52, 95% CI [-2.37, 5.41]. Therefore, change in Panic-Neg did not mediate the effect of the intervention on change in ASI-3 scores.

The second mediation analysis is depicted in Figure 7 and examined the effects of change in perceived control on change in AS level. The fit indices again indicated poor fit, χ^2 (0)= 0.00, *p*= 0.00, to excellent fit, CFI= 1.00; TLI=1.00; RMSEA= 0.00. Change in ACQ-R scores did not predict change in ASI-3 scores, *b*= 0.38, *p*= .17, 95% CI [-0.16, 0.93]. Condition also did not predict change in ACQ-R scores, *a*= -0.14, *p*= .95, 95% CI [-4.29, 4.00], and ASI-3 scores, *c*=-0.20, *p*= .95, 95% CI [-6.06, 5.66]. Again, the indirect effect was not significant, *c'*=-0.05, *p*= .95, 95% CI [-1.64, 1.54]. Therefore, change in ACQ-R did not mediate the effect of the intervention on change in ASI-3 scores.

The third mediation analysis examined the effects of change in negative attentional bias on change in AS level (see Figure 8). The fit indices indicated poor fit, χ^2 (0)= 0.00, *p*= 0.00; CFI= 0.00, to excellent fit, TLI= 1.00; RMSEA= 0.00. Change in attention bias scores did not predict change in ASI-3 scores, *b*= -0.11, *p*= .71, 95% CI [-0.70, 0.48], nor did Condition, *a*= -0.33, *p*= .92, 95% CI [-6.38, 5.73]. Condition did not predict change in attention bias scores, *c*=-0.15, *p*= .96, 95% CI [-5.70, 5.40]. The indirect effect was again nonsignificant, *c'*=0.02, *p*= .96, 95% CI [-0.59, 0.63]. Therefore, change in attention bias scores did not mediate the effect of the intervention on change in ASI-3 scores.

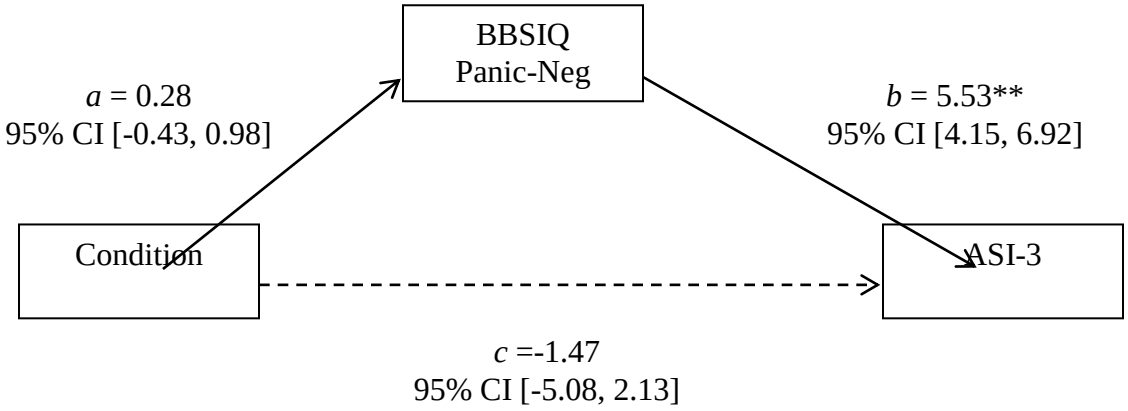

Figure 6. Study 2- Results of the analyses investigating BBSIQ Panic-Neg as a mediator of the effect of training on change in ASI-3 scores. ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). BBSIQ = *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997); BBSIQ Panic-Neg= Panic negative Beliefs subscale; rating of the probability of negative explanations of ambiguous physical sensations. The fit indices indicated poor to excellent fit, χ^2 (0)= 0.00, *p*= 0.00; CFI= 1.00; TLI= 1.00; RMSEA= 0.00. Change in Panic-Neg did not mediate the effect of training on change in ASI-3 scores.
**p*< .05 ***p*<.01.

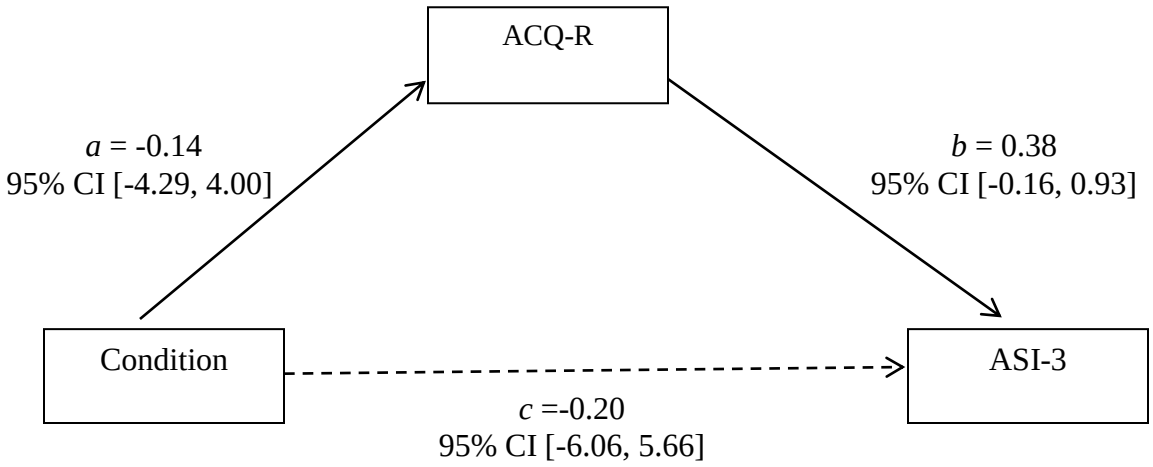

Figure 7. Study 2- Results of the analyses investigating ACQ-R as a mediator of the effect of training on change in ASI-3 scores. ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). ACQ-R= *Anxiety Control Questionnaire- Revised* (Brown et al., 2004). The fit indices indicated poor to excellent fit, χ^2 (0)= 0.00, p= 0.00; CFI= 1.00; TLI=1.00; RMSEA= 0.00. Change in ACQ-R did not mediate the effect of training on change in ASI-3 scores.
*p< .05 **p<.01.

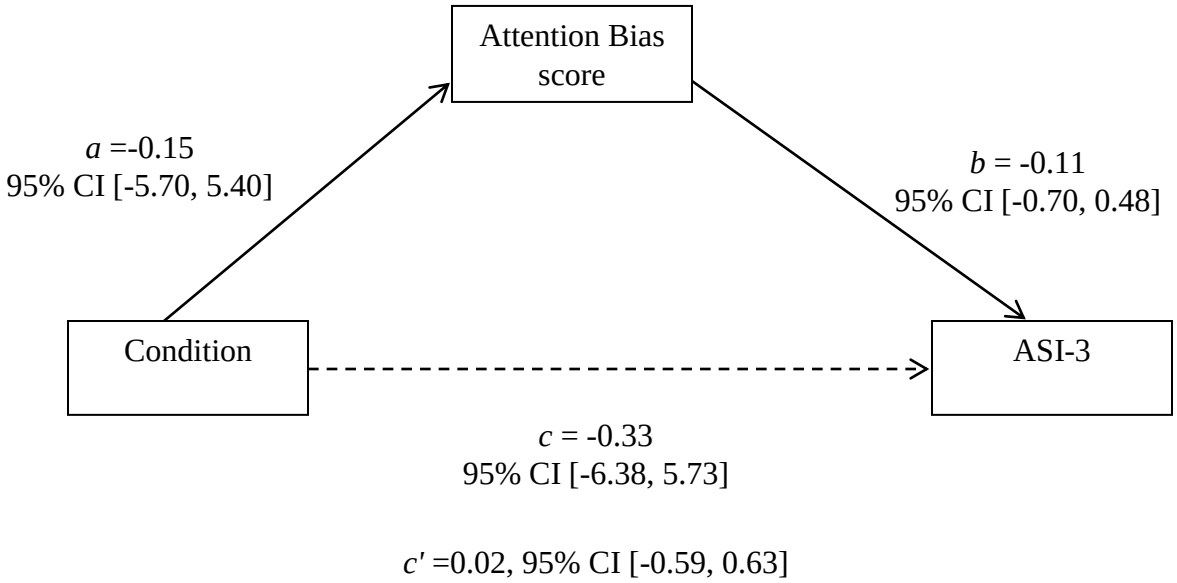

Figure 8. Study 2- Results of the analyses investigating Attention Bias score as a mediator of the effect of training on change in ASI-3 scores. ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). Attention Bias score was calculated by subtracting the mean reaction time when the dot is paired with a threat word from the mean reaction time when the dot is paired with a benign word. The fit indices indicated poor to excellent fit, χ^2 (0)= 0.00, *p*= 0.00; CFI= 0.00; TLI= 1.00; RMSEA= 0.00. Change in attention bias scores did not mediate the effect of training on change in ASI-3 scores.
**p*< .05 ***p*<.01.

Hypothesis 5: Temporal order of change in AS and negative interpretive biases

A cross-lag panel analysis was conducted to investigate the temporal order of change of AS and negative interpretive biases in the whole sample, as this was an exploratory hypothesis and changes in AS and negative interpretation biases were similar across conditions. ASI-3 Total scores and BBSIQ Panic-Neg scores were included in the analysis. Assessments were conducted at baseline, immediately after the first computer training session, and at each subsequent visit (i.e., Visits 2-5), for a total of six assessment points. Lag variables were created to determine the ability of the ASI-3 at time *t-1* to predict Panic-Neg at time *t*. The analyses were conducted again in the opposite direction (i.e., Panic-Neg at time *t-1* predicting the ASI-3 at time *t*). The results of the analyses are depicted in Figure 9. The model had adequate fit, χ^2 (55)= 106.65, p= 0.00; CFI= 0.91; TLI= 0.90; RMSEA= 0.14. First, ASI-3 scores at each time point predicted ASI-3 scores at the subsequent time point, b=0.73, SE= 0.03, p< .01. Identical results were obtained for Panic-Neg scores predicting Panic-Neg scores at the subsequent time point, b=0.73, SE= 0.03, p< .01. ASI-3 scores at Time 1 *did not* significantly predict Panic-Neg at Time 2 b=0.01, SE= 0.02, p=0.56. Alternately, Panic-Neg scores at Time 1 (i.e., baseline) significantly predicted ASI-3 scores at Time 2 (i.e., immediately after the first computer training session), b=1.90, SE= 0.33, p< .01, indicating that *Panic-Neg scores changed before ASI-3 scores*. The results of the paths between Time 2 and Time 6 were identical (i.e., Time 2 predicting Time 3 produced the same results as Time 3 predicting Time 4, etc.). ASI-3 scores significantly predicted Panic-Neg scores, b=1.90, SE= 0.33, p< .01, for each set of time points, and Panic-Neg scores significantly predicted ASI-3 scores, b=1.90, SE= 0.33, p< .01, for each set of time points.

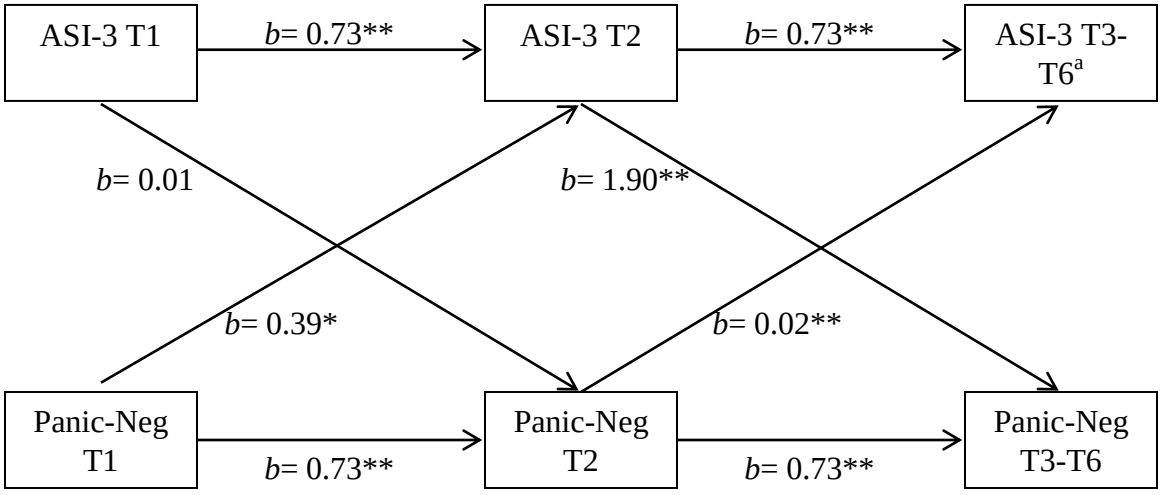

Figure 9. Study 2- Results of the cross-lag panel analyses investigating the temporal order of change of ASI-3 scores and BBSIQ Panic-Neg scores. ASI-3 = *Anxiety Sensitivity Index- 3* (Taylor et al., 2007). BBSIQ = *Brief Bodily Sensations Interpretation Questionnaire* (Clark et al., 1997); BBSIQ Panic-Neg= Panic negative Beliefs subscale; rating of the probability of negative explanations of ambiguous physical sensations. T1-T6= Time 1 to Time 6, respectively. The model had adequate fit, χ^2 (55)= 106.65, *p*= 0.00; CFI= 0.91; TLI= 0.90; RMSEA= 0.14. All pathways were significant, except ASI-3 at Time 1 did not significantly predict Panic-Neg scores at Time 2, *b*=0.01, SE= 0.02, *p*=0.56.

[a] The results of all of the paths between Time 2 and Time 6 were identical for each analysis (i.e., ASI-3 lag predicting Neg, and Neg lag predicting ASI-3). Therefore, the results have been depicted in a single image.

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

Discussion

The present study sought to examine the immediate and short-term effects of CBM for high AS on AS, negative interpretive biases, attentional biases, perceived control, psychopathology symptoms and reactions to physical sensations. Additionally, the present study investigated the cognitive mechanisms of changes in AS, and the temporal order of change in AS and negative interpretive biases.

Effect of CBM on AS, interpretive biases, attentional biases, and perceived control

It was hypothesized that participants in the CBM condition would display lower AS, weaker negative interpretive biases, weaker attentional biases, and lower perceived control compared to participants in the control condition. It was also hypothesized that only participants in the CBM condition would display changes in the aforementioned constructs. In general, AS decreased in all participants in the study, irrespective of training condition, which was not consistent with hypotheses. During the intervention period (i.e., the 2 weeks during which participants completed the CBM training), participants in the CBM condition displayed significantly larger reductions in AS compared to participants in the control condition. Conversely, during the follow-up period (i.e., 2 weeks between the last training session and the final assessment session), only participants who completed the sham training demonstrated significant reductions in AS. Taken together, these results are consistent with previous research that has demonstrated that AS changes in response to CBM for high AS (MacDonald et al., 2013; Steinman & Teachman, 2010). However, also in line with previous CBM research, participants who completed the sham training displayed changes in AS similar to those of participants in the CBM condition (MacDonald et al., 2013). This suggests that the sham training task used in the present study may have modified AS, which has also been noted by other researchers

(MacDonald et al., 2013; Salemink et al., 2008). Issues surrounding the sham training task will be discussed in detail in a forthcoming section.

The ASI-3 results must also be considered in light of several factors, the first being credibility and expectancy beliefs. In general, participants, irrespective of condition, did not find CBM credible as an intervention, and had minimal expectations for change in response to CBM. Although participants in the Beard et al. (2012) study reported, on average, that the intervention was credible and that they expected symptom change, scores could not be directly compared with the present study because the authors did not report the range of scores. Moreover, both credibility and expectancy beliefs were positively and significantly correlated with change in ASI-3 scores in the present study. Specifically, lower beliefs in the credibility of the intervention and lower expectations for change were associated with smaller change in ASI-3 scores over the course of the study. Although it is not possible to know if there would have been greater change in ASI-3 scores if participants had higher credibility and expectancy beliefs, these results make it challenging to understand the true effects of the CBM intervention, especially in light of the changes in the control condition. On the other hand, the results of a *posthoc* power analysis revealed that the study may have been only slightly underpowered, power= .77. This should be considered with caution, as the power analysis was conducted for repeated-measures ANOVA. Regardless, this adds to understanding of the results and appears to provide evidence that does not support CBM for high AS an intervention that results in meaningful change in AS.

The results of the negative interpretive biases analyses were also not consistent with hypotheses. Negative interpretation biases were assessed by three different subscales of the *Brief Bodily Sensations Interpretation Questionnaire* (BBSIQ; Clark et al., 1997). With regards to beliefs about negative and neutral explanations of ambiguous physical sensations, only

participants in the CBM condition displayed significant reductions in negative interpretive biases over time, as they rated *negative* explanations of ambiguous physical sensations *less* likely to be true and *neutral* explanations of ambiguous physical sensations as *more* likely to be true over the course of the study. For both measures, participants in the CBM condition displayed significant changes in the expected direction during the intervention period only, although participants in the control condition also rated neutral explanations as significantly more likely to be true during the intervention period. Of note, ratings of both negative and neutral beliefs were comparable across conditions, as there were no between-group differences at any point. As for the results of the third interpretation bias measure, participants in both conditions ranked the negative explanations of ambiguous physical sensations as *less likely* to come to mind over time. Although these changes were observed in both conditions during the intervention period, the CBM condition displayed a significantly larger change in the ranking scores compared to that produced by the control condition.

In general, the results demonstrated that negative interpretation biases associated with high AS changed. Specifically, changes were observed in the ranking of the negative explanations of hypothetical physical sensations. However, the results of the follow-up period suggest that the changes may not be stable, as CBM condition ranked negative explanations of physical sensations as significantly *more* likely to occur during the follow-up period. Moreover, there were no between-group differences. While this could be the result of a sham training condition that actually trained negative interpretive biases, the dose of training may also not have been sufficient to sustain meaningful change. This study administered four sessions of CBM training, which was considered the lowest number of sessions that would result in significant changes (Brosan et al., 2011). Although statistically and clinically significant change has been

achieved with as few as four sessions (e.g., Brosan et al., 2011; Micco et al., 2014), other studies administered eight sessions (e.g., Beard & Amir, 2008). Therefore, more training may be needed to detect meaningful differences between conditions.

The CBM and control conditions differed significantly on only one measure of interpretation biases; changes in rankings of negative explanations of physical sensations during the intervention period. This is pattern of results is similar to the results of MacDonald et al. (2013). It is unclear whether these results are related to insufficient dose of training, or whether the beliefs are less amenable to change in response to CBM. As was discussed in reference to Study 1 (Chapter 2, pp.59-60), the structure of the BBSIQ subscales may be a contributing factor. On the Beliefs subscales, participants are asked to consider the plausibility of each explanation of physical sensations independent of any other explanations. Participants must implicitly compare the explanation presented with other hypothetical explanations to determine their own rating. In contrast, the Ranking subscale presents alternative explanations, and participants are required to directly compare competing explanations without coming up with any on their own (Clark et al., 1997). It may be less cognitively taxing to *select* a positive/neutral explanation versus *develop* one spontaneously, which could thereby account for the changes in the Ranking subscale. Alternately, participants could rank items in a way that do not accurately represent their true beliefs when they are presented with limited options. Nonetheless, the interaction of the Time x Condition was largest, albeit nonsignificant, for the measure of beliefs about negative explanations of physical sensations, which suggests that beliefs are amenable to change in response to CBM. The results may have been complicated by the changes in beliefs in the control condition. When considered together, limited conclusions can be drawn about the efficacy of CBM training due to issues with the assessment measures.

Other measures of negative interpretation biases have also been used in studies of CBM for high AS and typically consist of an assessment task that is similar to the training task. Clerkin and colleagues (2015) used the *Word Sentence Association Paradigm* (WSAP; Beard & Amir, 2008). During this task, participants had to decide if a word and sentence were related or unrelated. Feedback was not presented; therefore, it was a pure assessment task. In the present study, the WSAP was also administered during the first and last visits as a manipulation check. All participants made significantly more benign interpretations at the final visit compared to the baseline assessment, which is consistent with the pattern of results of the BBSIQ subscales. Taken together, similar changes in interpretation biases were observed across both study conditions.

There were no significant changes or reductions in either attentional biases or perceived control, which was not consistent with hypotheses, but is consistent with the results of Study 1. It may first seem these results provide evidence against the bidirectional relationship between attentional and interpretive biases (e.g., Everaert et al., 2014; Hirsch et al., 2006). However, the present results must be considered in light of the limited changes in AS and negative interpretive biases. It is possible that the magnitude of change in negative interpretive biases was not sufficient to warrant a corresponding change in attentional biases. Alternately, there could have been a problem with the methodology of assessing attentional biases, as was previously discussed in Chapter 2 (pp. 110-112). The stimuli for the visual dot-probe task were adapted from previous research on attentional biases related to high AS and has used both the visual dot-probe and other attentional bias tasks, such as the emotional Stroop task (Hunt et al., 2006; Keogh et al., 2001; Taake et al., 2001). In all studies, participants with high versus low AS (or high versus low scores on the physical subscale of the ASI) demonstrated significantly different

patterns of attentional biases, as participants with high AS demonstrated biases *towards threat*. However, nonreplication of results is a major problem in the cognitive bias literature, specifically attentional bias research (Emmelkamp, 2012). Studies using identical assessment and training tasks have produced different results, which speaks to the unreliability of the findings (Emmelkamp, 2012). Factors that are believed to contribute to the lack of replication include the use of analogue versus clinical samples, and the method of delivery of the task (i.e., in the laboratory versus over the internet). Additionally, in the present study, participants in both conditions produced score slightly below the clinical range on the ASI-3 at the end of the study (CBM, *M= 22.52*; control, *M*= 22.15). Therefore, there may not have been sufficient change in AS to detect differences with this version of the visual dot-probe task. Moreover, as discussed in Chapter 2, using single word stimuli in the visual dot-probe task may decrease the ecological validity of the task, as participants could develop biased monitoring strategies, whereby they overly attend to one side of the computer screen, which would result in biased responding across all trials (Mogg & Bradley, 1999). Unfortunately, there is no way to predict for whom this type of attentional pattern develops, which makes it difficult to account for in analyses. Therefore, the issue of replication is a substantial one and the present study must be considered in light of these findings. Given the plethora of research supporting the relationship between interpretive and attentional biases, the present results should not be considered conclusive evidence against the relationship between these two constructs.

As for perceived control, past research has consistently demonstrated that low perceived control is associated with high AS in people with high AS (e.g., Viana & Gratz, 2012) and perceptions of control change in response to CBT for anxiety disorders (e.g., Gallagher et al., 2014). This is inconsistent with the results in this study. In fact, perceived control was *positively*

correlated with AS at all timepoints, although the correlations were only significant at baseline, $r = .44$, $p < .01$, and Visit 4, $r = .39$, $p < .01$. This indicates that high AS was associated with high perceptions of control, which is a surprising finding, although this is consistent with Study 1. Both studies examined only the total score of the ACQ-R as the measure of perceived control, as per the recommendations of Brown et al. (2004) and Rapee et al. (1996). The ACQ-R includes three subscales that assess perceptions of control over emotional states, control over threatening events, and control when experiencing stress, respectively. The emotional states and threatening events subscales have been negatively correlated with AS (e.g., White et al., 2006). *Posthoc* analyses revealed that both the emotional states and threatening states subscales were negatively correlated with AS at each time point, $r = -.20$ to $-.49$, $p = <.01$ to .23. Therefore, although the ACQ-R global scale is considered a comprehensive measure of perceived control, it may not be the most accurate way to assess perceived control as associated with AS. Also, as discussed in reference to Study 1 (pp. 112-113), it is possible that participants believed that they had control over their emotional states, as these participants were not treatment-seeking, and presumably, not experiencing distress and impairment as a result of their psychopathology symptoms. This would leave little room for improvement in perceptions of control. Therefore, the present results should not be taken as contradictory evidence for the well-documented relationship between AS and perceived control. Rather, it can be concluded that global perceived control did not change in response to CBM for high AS.

Effect of CBM on Psychopathology Symptoms

The second goal of the present study was to investigate the effect of CBM for high AS on psychopathology symptoms. It was hypothesized that participants in the CBM condition would report lower psychopathology symptoms compared to participants in the control condition, and

that reductions in symptoms would only occur in the CBM condition. Contrary to hypotheses, participants on average, irrespective of assigned training condition, showed reductions in panic symptoms, social anxiety symptoms, depressive symptoms, motivation to drink alcohol, general autonomic arousal symptoms and negative affect/distress during at least one time period in this study. During the intervention period, participants in the CBM condition reported significant reductions in all of the aforementioned symptoms, except motivation to consume alcohol, in which CBM participants demonstrated nonsignificant changes. Participants in the control condition also displayed significant reductions in several symptoms sets, including panic symptoms, motivation to consume alcohol, and negative affect/distress symptoms. The magnitude of change reported by the CBM and control condition was similar for all symptom sets, except depressive symptoms. During the intervention period, participants in the CBM condition showed significantly greater reductions in depressive symptoms compared to participants in the control condition. In contrast with these results, there was no effect of CBM training on GAD symptom or problems associated with alcohol use. Participants in the control condition demonstrated significant reductions in GAD symptoms during the intervention period. There were no significant changes in problems associated with alcohol use over the study, nor during the intervention period.

Overall, the hypotheses were only partially supported by the results of the intervention period, as some psychopathology symptoms changed in response to CBM for high AS. This is the first study to show that CBM for high AS may lead to limited changes in psychopathology symptoms associated with high AS, which provides some support the transdiagnosticity of both AS and CBM for AS. These changes occurred after very little intervention, as the CBM training was delivered in four sessions that lasted approximately 12-20 minutes each. However, there

were no significant differences between the CBM and control condition on almost any of the psychopathology measures. This is not surprising, given similar patterns in the AS and interpretation bias measures and the limitations of unintentional training in the control condition.

As for the follow-up period, the effect of the CBM intervention was maintained only on the measures of motivation to consume alcohol and negative affect/distress, as indicated by small and nonsignificant reductions in symptoms in the CBM condition. Alternately, depressive symptoms increased significantly in the CBM condition during the follow-up period. There are several possible reasons for the rebound effects of depressive symptoms. First, changes in depressive symptoms may not be a stable change. Second, there may be contributing factors outside of the study effects. For example, attending four research visits in 2 weeks during the intervention period may have decreased depressive symptoms by having participants be active more than they normally would have been. These effects would not have been present during the 2-week follow-up period, during which participants did not attend any study visits. Taken together, the follow-up results indicate that the durability of CBM effects is limited.

There was no observable pattern in the stability of the treatment effects, as improvements in psychopathology symptoms varied across symptom types (i.e., anxiety, depression, alcohol use, and general symptoms). Participants in both conditions reported clinically significant GAD symptoms at baseline, and the lack of changes in GAD symptoms in participants in the CBM condition was not consistent with the hypotheses and could be related to the measurement of GAD symptoms. The GAD measure in the present study, the GAD-Q-IV (Newman et al., 2002), specifically assesses symptoms of GAD, as per DSM-5 criteria (APA, 2013). Some GAD symptoms, such as frequency and severity of excessive worry, may have changed in response to treatment, but this would not have been captured by the GAD-Q-IV if overall symptoms did not

change. Examining the worry items of the GAD-Q-IV may have provided a more precise measure of change in excessive worry. However, Olthuis et al. (2014) also failed to find changes in excessive worry, as assessed via the *Penn State Worry Questionnaire* (Meyer et al., 1990) in response to telephone-delivered CBT for high AS. Taken together, it is possible that GAD symptoms may not change in response to treatments for high AS. More research is needed to understand both the effects on GAD symptoms, and why certain sets of symptoms associated with high AS change in response to CBM, while other sets of symptoms do not.

Effect of CBM on Reactions to Physical Sensations

The third goal of the present study was to investigate the effect of CBM for high AS on changes in reactions to *in vivo* physical sensations, which were assessed via response to BATs. It was hypothesized that participants in the CBM condition would report less fear and avoidance in response to the physical sensations compared to the control condition over the course of the study, and that only the CBM condition would report reductions in fear and avoidance. Given that research on CBM for high AS is characterized by null findings on BAT measures, the methodology of the BATs in the present study was designed to address the limitations of previous studies by using idiographic BATs that were selected specifically for each participant. Nonetheless, there were limited effects of CBM on reaction to physical sensations. For BAT 1, there was no effect of training observed on time spent engaging in BAT 1 or reported desire to stop completing BAT 1. Only participants in the control condition reported less fear in response to the physical sensations over the whole study. As for BAT 2, only participants in the control condition spent significantly more time engaging in BAT 2 over the course of the study. Participants in the control condition also demonstrated significantly less fear in response to the physical sensations during study and during the intervention period. Finally, while all

participants showed significantly less desire to avoid the sensations over the course of the study, those in the control condition demonstrated significantly less avoidance over the intervention period.

The results of the BATs are not consistent with hypotheses, as it was expected that reactions to physical sensations would change in response to CBM, and not in response to the sham training. Although participants in the CBM condition displayed reductions in AS and negative interpretation biases over the course of the study, corresponding changes in reactions to physical sensations were not detected. This was unexpected given that reactions to physical sensations are known to change in response to treatment for high AS, and these changes correspond to AS changes (Schmidt et al., 2007). Although selection of the BATs was individualized for each participant, the BATs still may not have induced enough sensations to detect training effects. Across conditions, 75% of the participants in the study were able to complete at least one BAT for the maximum time. This figure is consistent with previous research using nonidiographic BATs, with 66-81% of participants completing at least one BAT for the maximum time (Clerkin et al., 2015; MacDonald et al., 2013; Steinman & Teachman, 2010). Moreover, at baseline, about half of participants completed each BAT for the maximum time. The proportion of participants who completed each BAT for the maximum time was generally stable across all time points. Therefore, the BATs may not have been sufficiently difficult to assess changes in reactions to physical sensations. In light of the consistent null findings and problems with the BATs, it may be that the BATs administered in the present study are not an appropriate way to assess changes in reactions to physical sensations. These tasks are not strictly controlled, as the strength of the effect relies on the effort the participant puts into the activity, and there are many aspects of the tasks that cannot be controlled by the experimenter.

Moreover, it is possible that the tasks did not induce sufficient sensations or fear because of the lack of external validity. These activities were completed in a testing room with an experimenter who asked participants to complete the activity to induce the sensation. This is an artificial context, and may not create the same fear that would be present if the sensations were to occur naturally. When considered together, there are notable problems with the BATs as assessment tools. Other assessment methods are available. For example, a carbon dioxide (CO_2) challenge involves the inhalation of CO_2 enriched air, and is a common and safe method of inducing arousal-related physical sensations that mimic those of a panic attack (e.g., Perna et al.,1999). CO_2 challenges have advantages over BATs because the amount of CO_2 delivered, and the corresponding effect, is highly regulated. CO_2 challenges have been successfully used as a behavioural measure of reactions to physical sensations in many research studies, including Schmidt et al. (2007) and Farris and colleagues (2015). On the other hand, CO_2 challenges are associated with their own problems, including requiring strict inclusion/exclusion criteria, as was demonstrated in Study 1. Nonetheless, a CO_2 challenge has several advantages over BATs in regards to the assessment of reactions to physical sensations, and could be used to examine the efficacy of CBM.

When considering the results of the process, symptom, and behavioural measures together, it appears that the efficacy of CBM for AS is minimal and inconsistent, as most of the hypotheses were, at best, partially supported. Moreover, the limited effects found in the present study were not durable, as many of the effects were not maintained during the follow-up period. When considered alongside previous research, it is possible that CBM for high AS may not be an effective manner of modifying AS and related constructs. CBM for high AS is not achieving the same robust effects as CBM for specific symptoms sets, such as social anxiety disorder and

depression (e.g., Beard & Amir, 2008; Blackwell & Holmes, 2010). Even with the adaptations that specifically address AS, CBM did not target AS beliefs explicitly enough to produce reliable changes in AS and psychopathology associated with high AS. For example, other AS-specific treatments, such as Olthuis et al.'s (2014) CBT for high AS protocol, have high face validity, as AS is defined and discussed in unambiguous terms. This treatment is explicit in the targeting of AS, which may be important feature of an effective AS-specific treatment. However, the results of the present study are complicated by several limitations, mainly the control training task that produced similar effects as the CBM training task. Therefore, conclusions cannot be drawn about the efficacy of CBM for high AS based on the present study alone.

Cognitive Mediators and Order of Change

The present study also investigated the degree to which changes in negative interpretive biases, perceived control, and attentional biases mediated change in AS in response to CBM for high AS. It was hypothesized that all three constructs would mediate the effect of treatment on change in AS, and, similar to Study 1, none of the hypotheses were supported. However, the mediation results must be interpreted in light the lack of changes in attentional biases and perceived control. Given that there were no significant changes in either construct, it follows that neither one mediated the change in AS scores, in which there were significant reductions in both conditions. Therefore, this study provides inconclusive evidence about the mediating role of attentional biases and perceived control.

Changes in negative interpretive biases also did not mediate changes in AS in response to CBM. However, unlike the attentional biases and perceived control, change in negative interpretive biases, defined as beliefs about the likelihood of negative explanations of physical sensations being true, significantly predicted change in AS. Relatedly, the final analysis explored

the order of change of AS and negative interpretive biases. According to the results, negative interpretive biases change *before* AS beliefs. Moreover, the results demonstrated that negative interpretation biases changed after the first of four sessions of CBM, which is consistent with the results of MacDonald et al. (2013) and Steinman and Teachman (2010), wherein one session of CBM for AS was delivered. When considered with the results of the mediation analyses, these results provide some insight into the mechanisms of CBM. Teaching participants to make benign interpretations of physical sensations directly changes their interpretive style and their beliefs about negative consequences of physical sensations. Interpretive style, however, is targeted more explicitly, and changes after a single session. AS, which is a stable set of beliefs (McNally, 1994), also changes in response to CBM, but not immediately after a single session. These results are particularly interesting, as this is the first known study to directly investigate the temporal order of change of AS and negative interpretive biases and the first to demonstrate that the CBM modifies negative interpretive biases before other target variables.

The Control Training Task

Improvements in the control condition were found for almost every measure in the present study. As previously mentioned, participants in the control condition completed a sham training task that may have inadvertently modified their negative interpretive biases. The sham training task in this study was chosen as an improvement on the previous sham training tasks. Participants were presented with situations describing an ambiguous physical sensation, and two words that were related or unrelated to the content of the sentence (e.g., "Music" versus "Tennis" for the sentence "You are at a loud concert of your favourite band and your head is pounding."). Previous sham tasks have presented words that represent benign and threatening interpretations of the situation, and provided inconsistent feedback, with the goal of not altering participants'

negative interpretive biases by not reinforcing a specific interpretive style. However, that task appeared to modify biases, possibly by presenting participants with benign interpretations more often than they would have made them on their own (Salemink et al., 2008). Therefore, the use of emotionally neutral stimuli in the present study was designed to account for these issues. Nonetheless, there were still training effects associated with the sham training task.

There are several factors that may account for the training effects in the control condition. First, the changes in both conditions could be the result of a placebo effect, whereby participants in both conditions demonstrated change in response to demand characteristics rather than the intervention. Although this is a possibility, there are several methodological issues that could have resulted in the changes in the control condition. Repeated presentation of situations that describe ambiguous physical sensations may lead to changes in beliefs about these sensations. This is similar to *passive* CBM, in which the training task consists of repeated presentations of stimuli consistent with a specific interpretive style (Hoppitt et al., 2010). Although *active* CBM training, in which participants have to generate an appropriate answer, results in larger changes (Hoppitt et al., 2010), passive CBM training also modifies biases. When considered in light of the present results, it follows that repeatedly presenting the sentences describing ambiguous physical sensations may have altered negative interpretive biases in the control condition.

As another explanation, some researchers (e.g., Beard, Rifkin, Lee, & Bjorgvinsson, 2015) have suggested that repeatedly pairing neutral resolutions with descriptions of ambiguous but potentially threatening situations may lead a participant to distance him- or herself from the emotional content of these descriptions, which in turn may have the unintended effect of reducing anxiety. Another possibility to consider is that repeated exposure to descriptions of hypothetical situations describing potentially threatening situations could unintentionally

extinguish threat responses. In order to account for this possible effect, Salemink and colleagues (2014) conducted two studies using different control conditions in an investigation of CBM for anxiety disorders delivered via the internet. In both studies, participants were presented with ambiguous vignettes in which the last word was missing a letter. Participants were required to enter the letter, thereby completing the word and resolving the vignette in a positive or negative manner. The first study used a sham training task that reinforced negative interpretive biases in 50% of the training vignettes. In the second study, the sham training task consisted of completely neutral vignettes that were unambiguous and contained no emotional content. In both studies, the CBM condition made more positive interpretations than did the control condition after the training. However, all participants reported reductions in depression, trait anxiety and psychological distress. There were no significant differences between the conditions on any symptom measures (Salemink, Kindt, Prienties, van den Hout, 2014). These results suggest that effects demonstrated by participants in the control condition could be due to factors unrelated to the research, such as spontaneous remission or regression to the mean (Salemink et al., 2014), especially in the context of multiple assessments of the constructs of interest, which could have resulted in changes in those constructs. Another possibility is that these results could be due to the nonspecific effects of research, such as placebo effects, contact with the experimenter or demand characteristics (Salemink et al., 2014). A modified study design may have been able to account for any of these aforementioned explanations. Including an assessment-only control condition in which participants did not complete computerized training and completed all assessments could have helped elucidate whether the training effects observed in the control condition were truly the result of the sham training, or the therapeutic effects of repeated assessment/monitoring. Participants in the present study completed some measures as many as

six times (i.e., ASI-3 and BBSIQ), which could have influenced scores on those measures. Repeated administrations of the ASI are associated with reductions in ASI scores in the absence of any interventions (Broman-Fulks, Berman, Martin, Marsic & Harris, 2009), which suggests possible reactivity to the measures. Moreover, the BBSIQ includes vignettes that describe physical sensations and their consequences. By repeatedly completing this measure, all participants may have been exposed to a version of passive CBM training. If the BBSIQ had some treatment-related effect, participants in both conditions would have been exposed, and the biases of all participants would have been altered. This is consistent with the results of the present study. Inclusion of an assessment-only, no training control condition could clarify the factors that contribute to unexpected improvements in the so-called control conditions that are employed in CBM research. The problems with the existing "sham" training tasks make it impossible to test the true effects of CBM training, which is a major limitation in this field of research.

Methodological Strengths

This study was designed to extend previous research and address the limitations of studies on CBM for high AS. As such, the present study has several methodological strengths. This is the first known study to expand the research on CBM for high AS beyond two sessions of CBM training (Clerkin et al., 2015; MacDonald et al., 2013; Steinman & Teachman, 2010). Both immediate and short-term effects of CBM were examined to disentangle the effect of training from the stability of training effects. The study appeared to have adequate power to detect true effects, thereby limiting the possibility of Type II error. Finally, this was the first known study to investigate temporal precedence of change in response to CBM, which contributes to understanding mechanisms of change.

Limitations

This study also had several limitations, most of which have already been discussed. First and foremost, the sham training task unintentionally modified negative interpretive biases and associated psychopathology symptoms. Although this study was designed based on the most advanced knowledge available at the time, the CBM research field is fast-paced. The sham training task used in this study is no longer considered a true control task (Beard et al., 2015). Moreover, the dose of training, while more than double the amount of training in previous studies, may still have been insufficient to produce the hypothesized differences between the conditions. Coupled with the training effects of the control condition, interpretation of the present results is limited. For example, the cognitive mediation hypotheses were not supported. It is not clear whether this was due to the lack of changes in attentional biases and perceived control in response to CBM, or whether changes in theses constructs truly do not mediate changes in AS. The mechanism analyses were also limited by the fact that the potential mediators were assessed multiple times during the intervention. This was most evident for negative interpretation biases, which were assessed three times between the first and last computer training session, and six times over the course of the study. Although it is common to assess dependent variables multiple times during an intervention, consideration must be given to the effect of repeated assessments. The assessment itself could be considered an intervention (e.g., Broman-Fulks et al., 2009). The present study administered comprehensive assessment tools, and it is difficult to quantify their therapeutic effect. Reaction to physical sensations was the only construct that was measured *in vivo* in the present study. Despite attempts to personalize the task and select BATs that induced feared sensations in each and every participant, there was, once again a ceiling effect of the BATs. Seventy-five percent of the participants completed at

least one BAT for the maximum time. Given the consistency of this ceiling effects across studies, BATs may not an ideal way to assess reactions to real physical sensations.

Beliefs about the credibility of the intervention and expectancy for change may have negatively impacted the results, specifically for measures of AS, social anxiety symptoms, and motivation to consume alcohol. All participants received the same rationale for treatment, which accurately described the purpose and goal of CBM training (i.e., participants in the control condition received accurate information about CBM training task and then completed the control training task). Immediately after the first training session, participants were asked to complete measures of credibility and change expectancy. Although scores on both measures covered the maximum range in both conditions, the average scores were lower than benchmark scores established in published CBM studies, suggesting that participants, irrespective of condition, generally did not view their assigned computerized training intervention as credible and did not believe that it would result in symptom changes. Therefore, credibility and expectancy beliefs may have confounded the effect of CBM on AS and social anxiety symptoms, for which there were limited changes.

Finally, the similar changes observed in both the intervention and control conditions suggest that changes may be the result of a placebo effect, whereby the changes are the result of demand characteristics and not related to the CBM intervention. Other researchers have suggested that there may be publication biases in the CBM research field that skew the understanding of CBM effects. In a recent meta-analysis, Cristea and colleagues (2015) found that studies that provided compensation for participation reported larger CBM effects compared to studies that did not provide compensation. The authors concluded that some of the positive effects of CBM may be in response to factors unrelated to the intervention or their mechanisms.

Although the results of the present study could be attributed to placebo effects, these conclusions cannot be drawn in light of the other notable limitations.

Future Directions

There are many avenues for future research. First, researchers are advised to develop a new control training task. The problems with the current sham training task, and its past iterations, make it impossible to determine the true effects of CBM training. With regards to the training task from Beard and Amir (2008), the most likely design for a new sham training task would involve the presentation of different words and sentences, while maintaining the same structure as the CBM task. Unfortunately, as demonstrated by Salemink and colleagues (2104), a control task with neutral vignettes void of emotional content can lead to change in symptoms. One positive point, however, is that Salemink and colleagues administered the Mathews and Mackintosh (2000) CBM task. The use of completely neutral stimuli has not been examined in the Beard and Amir task administered in the present study, and is worthy of future investigation. Based on the Salemink et al. research, it is possible that using words as stimuli could induce training effects. Therefore, pictures could be substituted and presented in a similar format as the training task. For example, a small series of shapes could be presented, followed by a single shape. Participants would be asked to indicate whether the single shape appeared in the array. This task would have the benefit of controlling for time spent participating in a computer activity, while likely not eliciting any connections to AS-related interpretive biases. Another possibility is to remove the active requirement of the sham task. That is, present a neutral set of words or shapes on the computer screen, and not require participants to make a response. This would be a passive task, and would also control for the amount of time that the CBM participants spent in front of the computer. However, this task would require little cognitive effort from the

control participants, which could be a potential confound. Unfortunately, the problem with all of the aforementioned sham training tasks is that they are hypothetical. Extensive testing would be required, including comparing all the tasks to each other, to determine which one is associated with the smallest magnitude of change in interpretive biases, and therefore, would be the best control task. These tests would need to be highly controlled in order to limit the potential confounds and understand the true effects of each control task. This is a large undertaking, and should be a priority for future CBM research.

Relatedly, because of the problems with the control task, there are many questions that need to be revisited, particularly those from the present study. Use of an assessment-only control condition, could be useful replicating and understanding the results of the present study. This has the benefit of possibly determining whether the repeated and detailed assessments were actually the true source of change. It is possible that neither the CBM nor control training tasks modify negative interpretive biases, but rather the assessment tools are responsible for the change. Future research could extend research on changes in psychopathology symptoms in response to CBM for high AS by examining the effect of *more training* over a *longer period,* as other studies found changes in social anxiety-related symptoms and interpretation biases in undergraduate students with eight sessions of training over 4 weeks (e.g., Beard & Amir, 2008). Moreover, the mechanisms of change in AS in response to CBM are still not clear. The lack of significant changes in attentional biases and perceived control may have impacted the mediation analyses and increased the possibility of Type II error. Follow-up studies should continue to investigate the mediating effect of changes in attentional biases and perceived control on changes in AS, possibly with other measures of both constructs, as there were problems with the assessment tools for both attentional biases and perceived control. Relatedly, there may be other possible

cognitive mediators that could be considered, such as the other two fundamental fears/sensitivities, fear of negative evaluation and fear of illness/injury (Reiss, 1991). Credibility of the treatment and expectancy for change were low, and small methodological changes could lead to improvements in both sets of beliefs. For example, participants received a general treatment rationale. Providing a more specific and explicit rationale could increase participants' understanding of the intervention. Setting participants up for success by providing a more explicit rationale may contribute to the treatment effects by helping them understand how the computer training works. The rationale and description of CBM is generally accurate, but vague, and is an interesting contrast to other treatments such as CBT, in which the rationale is fully and repeatedly discussed (e.g., Beck, 2011). During preliminary investigations of the CBM, a vague rationale was important to understand the true effects of CBM training. At this point in the research, the goal is increase the efficacy of CBM, and providing an explicit, detailed rationale could support that goal.

Another avenue for future research pertains to the finding that information-processing biases change before beliefs in response to CBM. This is the first known study to demonstrate this, yet it is unclear if interpretive biases change before other cognitive processes in response to CBM for other types of biases/beliefs (e.g., CBM for social anxiety symptoms), or if this relationship is specific to CBM for high AS. Understanding the order of change will contribute to our understanding of the effects of CBM that are specific to CBM for high AS versus CBM designed to target specific symptom sets. Therefore, future research should continue to investigate the order of change of constructs in response to other types of CBM training. This will provide more information about the mechanisms of change, which can lead to refinement and improvement of CBM training.

Finally, researchers should explicitly investigate the role of placebo effects in CBM research. Understanding the role that demand characteristics and nonspecific research factors play on CBM effects will contribute to our understanding of CBM in general. This is important information for CBM researchers as the field progresses.

Conclusion

The present study demonstrates that CBM for high AS is limited in its ability to produce significant and stable changes in AS and negative interpretations biases. These findings replicate and extend past research on CBM for AS (MacDonald et al., 2013; Steinman & Teachman, 2010) by increasing the length of the follow-up period and by examining the effect of CBM on psychopathology symptoms. This study contributes to the CBM literature by being the first study to demonstrate that negative interpretive biases change in response to CBM *before* AS beliefs, which provides information about the specific constructs that are targeted by CBM. Despite these strengths, CBM for AS had limited effects across all study variables, which is consistent with aspects of past research. Therefore, CBM may not be an ideal intervention for AS and symptoms associated with AS. However, the present study has many notable limitations, including issues with sham training task, that make it difficult to draw specific conclusions about the efficacy of CBM for AS as a brief, transdiagnostic intervention. More research is needed to understand the true effects of CBM, and therefore, this avenue of research warrants continued investigation.

Chapter 4: General Discussion

The purpose of this dissertation was to advance the literature on AS by examining the transdiagnosticity, efficacy and cognitive mediators of two brief interventions for AS. The first study investigated the immediate and short-term efficacy of a single psychoeducation session followed by daily interoceptive exposure practice. Participants in the intervention condition appeared to demonstrate reductions in AS, one facet of interpretation bias, social anxiety symptoms, and motivations to consume alcohol. The second study examined the efficacy of a four session computerized CBM program. At the end of the intervention period, the CBM condition appeared to show reductions in AS, interpretive biases, and almost all facets of psychopathology. However, the changes in the CBM condition were comparable to those observed in the control condition, which calls into question the efficacy of CBM training.

The results of the both studies were generally not in line with hypotheses. Although these studies were developed based on previous research, the brief, transdiagnostic treatments were not as effective as anticipated. The general implications for these findings are unclear. However, it is noteworthy that both studies were plagued by significant limitations that truly hindered their ability to test the efficacy of each intervention. In Study 1, homework completion was minimal, and therefore, participants did not complete the treatment as intended. In Study 2, similar changes were observed across both study conditions. Nonetheless, the null findings raise questions about whether AS is an appropriate target for a transdiagnostic intervention.

In theory, AS is a perfect target for a transdiagnostic treatment. High AS is associated with symptoms of anxiety, mood, obsessive-compulsive, trauma- and stressor-related, and alcohol-use disorders (e.g., Naragon-Gainey, 2010; Gillihan et al., 2011). AS changes coincide with symptom reduction (e.g., Gallagher et al., 2013), which supports a bidirectional

relationship. In addition to being modified by disorder-specific treatments, AS also changes in response to AS-specific treatments (e.g., Watt, Stewart, Lefaivre, & Uman, 2006), which suggests that AS is a malleable construct that may be responsive to brief, targeted interventions. Considered together, the results of the present study are even more surprising. There were some AS changes, but few and inconsistent changes in psychopathology symptoms. What does this mean for AS and treatment research? The present dissertation could be considered evidence against the well-documented relationship between AS and psychopathology, but that would be short sighted and would dismiss the decades of research that preceded these studies. Nonetheless, some important considerations for the development and refinement of brief AS treatments can be highlighted.

Considerations for Transdiagnostic AS Treatments

First, these findings may speak to the nature of the relationship between AS and psychopathology symptoms. Although AS beliefs are malleable and can change with relatively little intervention, psychopathology symptoms may not be as responsive to these interventions. The AS-psychopathology symptom relationship is bidirectional, but it may not be linear. Small changes in AS do not necessarily equal small changes in symptoms. Significant intervention may be needed to modify AS to the point of creating symptom change. Treatments that have successfully modified AS and psychopathology symptoms tend to be comprehensive treatments. For example, Olthuis (2013) investigated the efficacy of eight sessions of CBT for AS delivered exclusively on the telephone. The treatment included psychoeducation, and descriptions of cognitive restructuring and interoceptive exposures, which were completed for homework between sessions. This comprehensive treatment lead to moderate changes in AS, which were associated with small to moderate changes in some psychopathology symptoms. Therefore, AS

treatments may be most effective as transdiagnostic interventions when the treatment is comprehensive.

This raises the question of what is a comprehensive treatment, for which several factors may be at play. For example, the amount of information/material that is covered could be one aspect of comprehensiveness. The variety of techniques or methods of change introduced over the course of treatment could be another, with more diverse methods representing a more comprehensive intervention. Including things such as psychoeducation, cognitive restructuring, and exposures increases the chance that at least one part of the treatment package will target some symptoms. The present interventions may not have been able to create meaningful change because they were not comprehensive. Each study included only one or two techniques as part of the intervention. In Study 1, the treatment was composed of psychoeducation and interoceptive exposures, while only interpretation bias retraining was included in Study 2. If, for example, one of these techniques did not induce change in the participant, there would have been little to fall back on in terms of other interventions.

Although it appears that a comprehensive treatment may be necessary to target both AS and psychopathology symptoms, treatments do not have to be long. A *brief* treatment could still be a *comprehensive* treatment, depending on the content of the treatment. Brief treatment has been shown to be successful in the treatment of serious mental illness. For example, six sessions of CBT over 8-12 weeks has been shown to lead to significant improvement in symptoms and insight in individuals with schizophrenia (Turkington, Kingdon, & Turner, 2002). This study demonstrates that a brief treatment does not necessarily have to be delivered over a short period of time. A treatment that is spread over a longer period of time could still be considered brief, and may still be associated with the same advantages of delivering a brief treatment quickly. For

example, the overall time commitment of patient and therapist would be low, which increases the likelihood of the patient completing treatment and allows the therapist to see more patients, which decreases wait lists (Crawley et al., 2013; Otto et al., 2012). Moreover, these types of treatments may have the advantage of allowing more time for consolidation of information between sessions and more time to practice skills. Alternately, the interventions in the present studies were temporally brief, both in the length of a session, and in the case of the CBM study, with little time between sessions.

Taken together, it is possible that the interventions in the present study were overly ambitious and may have been aiming for too much change with too little intervention. However, even in light of these results, AS is still a worthy target of brief transdiagnostic treatment research. By addressing some of the limitations outlined in each study, and possibly modifying the treatment protocols, these two interventions have the potential to be effective treatments.

Other Transdiagnostic Treatment Targets

On the other hand, AS is not the only transdiagnostic construct that could be the target of a brief, transdiagnostic intervention. There may be more efficient targets for transdiagnostic treatments that merit ongoing research, and emotion regulation is one such example. This is the process through which individuals modulate their emotions (Gross, 2002). Emotion regulation strategies are used to magnify or minimize the magnitude of positive and negative emotions, and this process tends to be automatic or explicit (Gross & Thompson, 2007). Strategies are generally classified as adaptive (e.g., reappraisal) due to negative correlations with psychopathology, while other strategies are considered maladaptive (e.g., suppression), as they may be implicated in the development and maintenance of psychopathology (Aldao & Nolen-Hoeksema, 2010). Emotion regulation strategies can be used at any point in the emotion generation process, including when

first encountering a stimulus, when directing attention towards or away from a stimulus, when interpreting the stimulus, or when generating an intrapersonal or interpersonal response (Fernandez, Jazaieri, & Gross, 2016).

Emotion regulation is considered a transdiagnostic process and is associated with many sets of psychopathology symptoms. Aldao and Nolen-Hoeksema (2010) investigated the relationship between psychopathology and a general cognitive emotion dysregulation factor in undergraduate students. The cognitive emotion regulation factor was composed of measurements of brooding, pondering, suppression (all positively loaded onto the latent factor) and reappraisal (negatively loaded onto the latent factor). General emotion dysregulation predicted greater depression, anxiety and disordered eating symptoms (Aldao & Nolen-Hoeksema, 2010). McLaughlin and colleagues (2011) found that emotion dysregulation significantly predicted anxiety, anger and disordered eating symptoms in adolescents. Emotion dysregulation was composed of assessments of emotional understanding, dysregulated expressions of sadness and anger, and rumination (McLaughlin, Hatzenbuehler, Mennin, & Nolen-Hoeksema, 2011).

These research studies provide some insight into the relationships between emotion dysregulation and psychopathology, although the relationship may be more complex and comprehensive than is demonstrated in these two studies. Emotion regulation is considered to be such a pervasive and impairing problem that it has recently been suggested to be part of the RDoc criteria (Fernandez et al., 2016). RDoc is a framework that conceptualizes mechanisms of underlying psychopathology into five domains and across seven levels of analyses. (Insel et al., 2010). The five core domains are negative valence systems, positive valence systems, cognitive systems, systems for social processes, and arousal and regulatory systems (Insel et al., 2010). RDoc was designed to be a living document that will be modified in accordance with new

research discoveries (Cuthbert & Insel, 2013). As such, Fernandez and colleagues (2016) believe that emotion regulation merits inclusion as a new domain criterion because it is transdiagnostic, cannot be reduced to another, more basic criterion, and it is based in empirical evidence. Relatedly, Hofmann, Sawyer, Fang and Asnaani (2012) posited a transdiagnostic model of emotion dysregulation that implicates emotion dysregulation as the central process in the development and maintenance of anxiety and mood disorders. Mood and anxiety symptoms are proposed to be the result of *dysregulation* of negative affect coupled with *deficiency* in positive affect. Based on this model, treatments for anxiety and mood disorders should include emotion regulations strategies (Hofmann et al., 2012).

Although some treatments, such as Dialectical Behaviour Therapy (Linehan, 2015), specifically target emotion dysregulation as part of a larger treatment protocol, very few treatments are designed to exclusively target emotion dysregulation. Berking and Lukas (2015) developed Affect Regulation Training (ART), a transdiagnostic intervention designed to target a range of emotion dysregulation challenges. ART integrates techniques from many other therapy approaches, including, but not limited to, CBT, DBT, mindfulness, acceptance and commitment therapy and emotion focused therapy. ART focuses on seven core skills that can be used to cope with a wide variety of affective states (i.e., muscle relaxation, nonjudgmental awareness, activating self-efficacy beliefs, self-support, analyzing cause of emotions, modify emotions; Berking & Lukas, 2015). Although ART was originally designed to be delivered over 12 1.5-hour sessions, an abbreviated version was developed and has been administered as an adjunctive treatment. ART was first delivered in five sessions to participants admitted to an inpatient psychiatric unit with principal diagnoses of depression, panic disorder, adjustment disorder, posttraumatic stress disorder, adjustment disorder, pain disorder and dysthymic disorder.

Participants were randomly invited to complete ART during the last week of their 6-week inpatient admission. Participants who received the specialized ART intervention demonstrated significantly more improvements in general emotion regulation skills, depression and positive affect compared to those who did not receive the intervention. Participants in the ART condition also displayed significantly less negative affect over the course of the study (Berking et al., 2008). Although these results were promising, the between-group effects were small to moderate across all dependent variables (η^2= .02-.04). In a follow-up study, participants with major depressive disorder who were admitted to an inpatient psychiatric unit were randomly assigned to receive ART and CBT or CBT only. Again, participants who completed the ART intervention displayed significantly lower depressive symptoms and negative affect at the end of treatment compared to participants who had received only CBT (Berking, Ebert, Cuijpers. & Hofmann, 2013). The between-group effect sizes were again small (depression measure, Cohen's *d*= 0.16; negative affect measure, Cohen's *d*= 0.20). While this study provides more evidence for the efficacy of ART and targeting emotion dysregulation as a treatment target, it does not demonstrate transdiagnosticity, as the sample all had principal diagnoses of major depressive disorder.

Nonetheless, when the two studies are considered together, there is very preliminary evidence for targeting emotion dysregulation in a transdiagnostic intervention. Moreover, the modified version of ART is relatively brief (i.e., approximately 7 hours over a week). The addition of this short intervention to a CBT protocol was superior to CBT alone. The question now, however, is about the independent effects of ART, as there are no known studies investigating its efficacy when delivered as a complete intervention. Given the proportion of CBT to ART in the previously mentioned studies and the small between-group effect sizes, it

would not be surprising if ART had a minimal effect on psychopathology symptoms over the course of treatment. However, the long-term benefits of learning emotion regulation skills could possibly have a more substantial impact on psychopathology symptoms than would be evident in immediate or short-term changes. According to the model proposed by Hofmann and colleagues (2012), learning to modulate emotions in a more adaptive manner could theoretically prohibit the development of anxiety and mood symptoms. Therefore, ART could have value as both a brief preventive and brief transdiagnostic intervention. However, based on the existing research, these conclusions are purely speculative. More research, specifically controlled research, is needed to fully understand the effects of ART.

Conclusion

The purpose of this dissertation was to investigate the efficacy, transdiagnosticity and mediators of two potential brief, transdiagnostic treatments for high AS. Although there were significant methodological limitations in both studies, these studies contributed to the literature by demonstrating that AS and some psychopathology symptoms change in response to psychoeducation/interoceptive exposures and CBM. Both studies may have been negatively impacted by employing a narrow perspective when designing the interventions. Although both interventions were based on sound empirical research, the broader perspective on factors that contribute to an effective AS treatment may have been missed. A more nuanced consideration of the role of brief and comprehensive treatments may have added to the conceptualization of the interventions and resulted in more effective interventions. The results of the present dissertation could be interpreted as support for the idea that AS is not the ideal target for a transdiagnostic treatment. There may be other transdiagnostic constructs that would be more efficient treatment targets. Emotion regulation is one possible example for which there is preliminary evidence and

is worthy of continued investigation. However, at this point, it would be premature to discount AS completely. There are numerous questions that remained to be answered, several avenues for future research and multiple ways to improve the research and intervention methodology. Continued research on brief, transdiagnostic interventions for AS is merited, and has the potential to make a significant impact on the treatment of psychopathology.

Appendices

Appendix A- Participant Recruitment Materials

Participants Needed!
Anxiety and Sensations Study
Do you experience these sensations?

Racing Heart
Sweating
Numbness
Choking
Breathlessness
Nausea
Dizziness
Shaking
Chest pain
Chills

If so, do you:

- Pay close attention to these sensations?
- Become scared when you notice these sensations?
- Worry that other people notice when you feel these sensations?
- Worry that these sensations could be harmful to your health?

If so and you are between the ages of 18-65, you may be eligible to participate in the Sensations Study at Ryerson University!

You will be compensated for your participation if you are eligible.

Please note: Participants must live in the Greater Toronto Area, as the study must be conducted in person at Ryerson University.

For more information on the Sensations Study please contact:
Phone: (416) 979-5000 ext. 2182
Email: caplab@psych.ryerson.ca

All queries are confidential. A phone screen (which participants will not be compensated for) is required to determine eligibility.

This study has been reviewed and approved by the Ryerson University Research Ethics Board.

Appendix B- Study 1 Medical and Health Exclusions

Participants were deemed ineligible if they endorsed any of the following criteria:

1. current pregnancy
2. Personal medical history of: brain tumour, cerebral aneurysm, cerebral hemorrhage, stroke, transient ischemic attack, heart attack, heart disease, coronary artery disease, congestive heart failure, mitral valve prolapse, diabetes, history of fainting (e.g., vasovagal syncope; unexplained fainting episodes), renal disease, heart murmur, cardiac arrhythmia, respiratory disease, lung disease, basilar artery migraine, asthma, epilepsy, hemiplegic migraine, seizures, liver disease, kidney disease, ophthalmoplegic migraine, hypertension, or cerebrovascular accident;
3. Family history (first degree relatives): cerebral aneurysm, cerebral hemorrhage, or hemiplegic migraine;
4. Endorsement of any two headache symptom questions that screen for complicated migraine headaches.
5. Use of psychotropic medications, not including occasional benzodiazepines use (i.e., less than twice a week, and not within 5 halflives of the challenge);
6. Use of a medication that could significantly affect heart rate (e.g., beta-blockers, calcium channel blockers, tricyclic antidepressants).
7. Anaphylactic allergy, or allergy to latex

ID number_____

Appendix C- Medical History Questionnaire

MHQ

1. Have you ever been diagnosed by a physician as having any of the following? If you are NOT SURE, please explain.

CONDITION	**NO**	**NOT SURE (IF NOT SURE, PLEASE EXPLAIN)**	**YES**
Head Injury			
Brain Tumor			
Cerebral Aneurysm			
Cerebral Hemorrhage			
Stroke			
Transient Ischemic Attack			
Heart Attack			
Heart Disease			
Coronary Artery Disease			
Congestive Heart Failure			
Mitral Valve Prolapse			
Diabetes			
Vasovagal syncope (fainting episodes)			

2. Have you ever been diagnosed by a physician as having any of the following? If you are NOT SURE, please explain.

CONDITION	NO	NOT SURE (IF NOT SURE, PLEASE EXPLAIN)	YES
Heart Murmur			
Cardiac Arrhythmia			
Respiratory Disease			
Lung Disease			
Basilar Artery Migraine			
Asthma			
Epilepsy			
Hemiplegic Migraine			
Seizures			
Liver Disease			
Kidney Disease			
Ophthalmoplegic Migraine			
Hypertension (High Blood Pressure)			
Cerebrovascular Accident			
Renal Problems (Kidney Problems)			

3. Has any family member (first degree relative) ever been diagnosed with any of the following?

CONDITION	NO	NOT SURE (IF NOT SURE, PLEASE EXPLAIN)	YES
Cerebral Aneurysm			
Cerebral Hemorrhage			
Hemiplegic Migraine			

4. Please check YES, NO, or NOT SURE for each of the questions below: If you are NOT SURE, please explain:

QUESTION	NO	NOT SURE (IF NOT SURE, PLEASE EXPLAIN)	YES
Are you currently pregnant?			
Do you have a history of fainting?			
Are you taking any medication that affects your heart rate? Examples include: beta-blockers, calcium channel blockers, and tricyclic antidepressants.			
Are you in poor physical health?			
Have you been told to limit physical activity?			
Have you ever been dizzy or passed out during or after exercise?			
Are there any restrictions on your daily behaviour due to a medical condition?			

5. Have you ever been diagnosed by a physician with any of the following? If YES, please explain the type.

CONDITION	NO	YES	IF YES, PLEASE EXPLAIN THE TYPE
Allergies			
Cancer			
Psychological Disorder			

6a. Have you ever been diagnosed by a physician as having a condition that has not been asked about on this questionnaire? **YES** **NO**

6b. If you answered NO to question 6a above, please skip to question 7 (next page). If you answered YES to question 6a above, please list the condition/s and explain below in the table:

CONDITION	PLEASE EXPLAIN

7a. Do you get headaches? **YES** **NO**

If you answered NO to question 7a above, please skip to question 8 (on page 6). If you answered YES to question 7a above, please answer the questions in the HEADACHE SYMPTOMS table below (question 7b).

7b. Please answer each question in the HEADACHE SYMPTOMS table below with respect to the headaches you have had. Please consider each question as it relates to symptoms you may have had during your headache, after your headache has passed, or before your headache has started.

HEADACHE SYMPTOMS

QUESTION	**NO**	**NOT SURE (IF NOT SURE, PLEASE EXPLAIN)**	**YES**
Did paralysis of one side of your body ever occur?			
Did **two** (or more) of the following occur?: feeling that the world was revolving or like you were revolving in space; tingling sensations on both sides of your body; double vision; ringing in your ears; paralysis of both sides of your body; difficulty speaking; visual symptoms in both eyes' visual fields near your nose and ears; decreased hearing; decreased level of consciousness; lack of coordination?			
Did paralysis of the nerves needed for eye movement occur, leading to a drooping eyelid, double vision, or excessive dilation of the pupil of your eye?			

8. Please list previous hospitalizations for past medical problems:

DIAGNOSIS	DATES	TREATMENT

9a. Are you currently taking prescription medications? **YES** **NO**

9b. If you answered YES to question 9a above, please list the prescription medications you are taking and the condition each is treating.

PRESCRIPTION MEDICATION	FOR WHAT CONDITION?

10. When did you have your most recent physical exam? MONTH and YEAR: _____

11. Did this most recent physical exam indicate that you are in good physical health? YES NO DON'T KNOW

(Please continue on to page7)

12a. Are you currently taking non-prescription medications? **YES** **NO**

12b. If you answered YES to question 12a above, please list the non-prescription medications you are taking and the condition each is treating or the purpose of the non-prescription medication.

NON-PRESCRIPTION MEDICATION	FOR WHAT CONDITION OR PURPOSE?

13a. Are you currently taking vitamins, minerals or herbal supplements? **YES** **NO**

13b. If you answered YES to question 13a above, please list the vitamins, minerals, or herbal supplements you are taking and the purpose of each. Herbal supplements include weight loss preparations such as ephedra (ma huang) and yohimbine.

VITAMIN, MINERAL, OR HERBAL SUPPLEMENT	FOR WHAT PURPOSE?

14a. Are you currently trying to become pregnant? **YES** **NO**
14b. Have you experienced a miscarriage or abortion in the past month? **YES** **NO**
14c. Please list the date of your most recent pregnancy: NEVER BEEN PREGNANT or DATE:_____

15a. Are you currently taking birth control pills or using other hormonal means of contraception? **YES** **NO**
15b. If YES, please specify what type of hormonal contraception: TYPE:_____

16a. Do you smoke cigarettes? **YES** **NO**

16b. If YES, please specify number of cigarettes per day: NUMBER OF CIGARETTES DAILY:_____

The next questions below (#17 & #18) are optional and you may choose NOT to answer either or both of them. These questions are for the purposes of data collection only.

17a. Do you drink alcohol? **YES** **NO**

17b. If YES, please specify number of drinks per week: NUMBER OF DRINKS PER WEEK:_____

18a. Do you use substances other than nicotine or alcohol? **YES** **NO**

18b. If YES, please specify the type of substance: TYPE OF SUBSTANCE _____

We greatly appreciate you giving us this information. All information will be kept confidential. It is important that this form be accurate. Please complete the following item.

"I have read the questions on this form carefully and have answered each as accurately as possible."

☐ Yes ☐ No

_____
Date

Appendix D- Study 1 Consent Form

Consent Form
Ryerson University

Title of Study: Anxiety and Information Study

You are being asked to participate in a research study. Before you give your consent to be a volunteer, it is important that you read the following information and ask as many questions as necessary to be sure you understand what you will be asked to do.

Investigators:
Emma MacDonald, M.A., PhD candidate, Department of Psychology, Ryerson University
Naomi Koerner, Ph.D., Associate Professor, Department of Psychology, Ryerson University
Martin M. Antony, Ph.D. Professor, Department of Psychology, Ryerson University
Kristin Vickers, Ph.D., Associate Professor, Department of Psychology, Ryerson University

Purpose of the Study: The purpose of this study is to evaluate different interventions designed to help people reduce their anxiety sensitivity, which is the extent to which individuals believe symptoms of anxiety are potentially harmful.

Description of the Study: The study will involve three visits to the Psychology Research and Training Centre at Ryerson University, located at 105 Bond Street. The total time commitment will be approximately 8.5 hours.

Visit 1 **(3 hours, 45 minutes).** First, you will be asked to complete a questionnaire that inquires about your physical health and preexisting medical conditions. You will then be asked to answer some questions about your emotional health. Next, you will be asked to complete a series of questionnaires that inquire about thoughts, emotions and reactions to certain situations. You will then be asked to complete a computerized assessment of your mental habits that involves responding with key presses when you see a dot on the screen.

The next task will involve breathing experiments. These experiments will make it harder to breathe for a short period of time, but the symptoms will go away quickly. Throughout the experiments, which will last approximately 25 minutes in total, you will wear a mouthpiece and a nose clip, and will breathe through a tube connected to the mouthpiece. You will breathe normal room air, except for during one of the two experiments during which you will receive one inhalation of room air that is mixed with larger than normal concentration of carbon dioxide (35% carbon dioxide mixed with 65% oxygen). In the other experiment, you will receive one inhalation of room air. These breathing experiments will each last only 30 seconds each. During each experiment, your heart rate, oxygen saturation, blood pressure and breathing will be measured by equipment attached to your arm, your ear, your hand and the mouthpiece. You will be asked to answer some questions about your experiences before and after these experiments.

Next, you will be randomly assigned to one of two types of education sessions. "Randomly assigned" means that the health education session that will be selected for you will be decided on by the flip of a coin.

Once you have participated in the study, we will tell you more about the session you were assigned to, and what we expect to be the differences between the two. After you are randomly assigned, you will meet with the experimenter who will review information with you about either health or stress. After the

education session, you will receive homework forms to monitor behaviours between this visit and your next visit. The experimenter will explain how to complete these forms, and you will have the opportunity to ask questions. You will then be asked to complete another set of questionnaires and another computerized assessment of your mental habits. You will receive $30 for this visit.

Visit 2 **(1 hour).** You will be asked to return to the lab two weeks after Visit 1. You will be asked to complete the questionnaires and computerized assessment of mental habits. You will also be asked to return your homework forms, and will receive new ones. You will receive $15 for this visit.

Visit 3 **(1 hour, 15 minutes).** You will be asked to return to the lab approximately 4 weeks after Visit 1. You will be asked to complete the questionnaires, computerized assessment of mental habits and the breathing experiments from Visit 1. You will also be asked to return your homework forms. You will receive $20 for this visit.

Visit 4 **(1 hour, 15 minutes).** You will be asked to return to the lab approximately 3 months after Visit 1. You will be asked to complete the questionnaires, computerized assessment of mental habits and the breathing experiments from Visit 1. You will receive $20 for this visit.

Visit 5 **(1 hour, 15 minutes).** You will be asked to return to the lab approximately 6 months after Visit 1. You will be asked to complete the questionnaires, computerized assessment of mental habits and the breathing experiments from Visit 1. You will receive $20 for this visit.

Potential Risks or Discomforts: There is minimal risk involved if you agree to take part in this study. You understand that you may experience some momentary negative emotions when answering questions about your thoughts, emotions and behaviours. You may have some difficulty breathing during the breathing experiments, but this experience will be temporary. You may also briefly experience some uncomfortable physical sensations and/or negative emotions during the breathing experiments. You have the right to refuse or discontinue participation at any time. If you decided to stop participating, you will still be entitled to compensation (as outlined above) for any activities that you have begun during a visit.

Potential Benefits of the Study to You or Others: Participating in this study may not benefit you directly, but this study may enable us to learn new information that may be beneficial to others who experience high levels of anxiety. You may derive some benefit from completing the questionnaires and computer tasks as it may increase your awareness of your anxiety-related thoughts, emotions and behaviour.

Confidentiality: Everything you disclose in this study will remain completely confidential; however, I am obligated to inform everyone that there are five cases in which I might need to break confidentiality:
(1) if you intend to harm yourself;
(2) if you intend to harm someone else;
(3) if there is reasonable suspicion that a child up to the age of 16 years is at risk of neglect or abuse, we are required by law to report this to the Children's Aid Society right away;
(4) if our files are subpoenaed by the courts (records can be opened by a specific court order)
(5) if a regulated health professional has engaged in inappropriate sexual behavior toward you or another person and you provide us with the name of this individual, we are obligated to report them to their regulatory body.

This informed consent agreement and all data that identifies you will be stored in a locked storage space in the Psychology Research and Training Centre. An ID number, not your name, will be used on all forms you complete and in all computer files that will contain the data you generate during the study. Only a

select group of people will have access to your data (containing your ID number, not name). These people include the investigators of the present study (Emma MacDonald, Dr. Naomi Koerner, Dr. Martin Antony, Dr. Kristin Vickers) and research assistants assisting with study.

You will read, and enter your responses to, the questionnaires on a computer using software called Qualtrics. Your data are securely and confidentially stored on a remote server and you will be identified by number only. Please note that because the data are securely stored on a USA based server (Qualtrics), it is subject to the Patriot Act. If you would like to know more about this, please visit the following link: http://epic.org/privacy/terrorism/hr3162.html. Under the Patriot Act, stored data may be intercepted in rare cases if United States officials have a reason to believe the data contain information related to suspected terrorism. However, your name is not stored with your questionnaire data. We will not ask for your name or other identifying information via Qualtrics. Please note that you also have the option to complete questionnaires on paper. All you have to do is tell the experimenter.

All of your data will be destroyed/deleted seven years after the publication of the results of this research. Your confidentiality will be protected to the full extent allowed by law. Only group findings will be reported in publications and presentations arising from this research.

Compensation for Participation: You will earn up to $105 for participating in this study. You are asked to arrange to transport yourself to the Psychology Research and Training Centre at Ryerson University (105 Bond Street). You will not be paid for the telephone screen that you took part in to determine eligibility.

Voluntary Nature of Participation: Participation in this study is voluntary. Your choice of whether to participate will not influence your future relations with Ryerson University or the Cognition and Psychopathology Lab. If you decide to participate, you are free to withdraw your consent and to stop your participation at any time without penalty or loss of benefits to which you are allowed. With regard to the breathing experiments specifically, you may stop your participation by signaling to the experimenter (for example, waving your hand) or by removing the mouthpiece. If you withdraw from the study, either by telling the researcher that you would like to withdraw from the study or by not showing up for the remaining visits, your data will be used in statistical analyses. However, you may also choose to withdraw consent to use your data. If you decide that you do not want us to keep or analyze data that you have provided during the course of your participation in this study, please feel free to notify us

At any point in the study, you may refuse to answer any question or stop participation altogether.

Questions about the Study: If you have any questions about the research, please ask now. If you have questions later about the research, you may contact Emma MacDonald, Department of Psychology, Ryerson University, 416-979-5000 ext. 2188. You may also contact Dr. Naomi Koerner, Department of Psychology, Ryerson University, 416-979-5000 ext. 2151.

If you have questions regarding your rights as a participant in this study, you may contact Dr. Lynn Lavallée at the Ryerson University Research Ethics Board.
Dr. Lynn Lavallée, Chair of the Ryerson Research Ethics Board
Office of the Vice President, Research and Innovation
Ryerson University, 350 Victoria Street, Room YDI 1154
Toronto, Ontario, Canada M5B 2K3
Phone: (416) 979-5000 Ext. 4791, Fax: (416) 979-5336
Email: rebchair@ryerson.ca
Website: http://www.ryerson.ca/research

Agreement:
Your signature below indicates: (1) that you have read the information in this agreement and have had a chance to ask any questions you have about the Anxiety and Information Study; (2) that you agree that information collected from you during the telephone screen for the Anxiety and Information Study can be retained and analyzed and (3) that you agree to be in the Anxiety and Information Study as described in this consent form and have been told that you can change your mind and withdraw your consent to participate at any time. You have been given a copy of this agreement. You have been told that by signing this consent agreement you are not giving up any of your legal rights.

_____
Name of Participant (please print)

_____ _____
Signature of Participant Date

_____ _____
Signature of Experimenter Who Obtained Informed Consent Date

Demographics Questionnaire

ID#: _____

Gender:

- ☐ Woman
- ☐ Man

Sex at birth:

- ☐ Female
- ☐ Male

Age*:* _____

Marital Status*:*

- ☐ Married/Common Law
- ☐ Single
- ☐ Divorced/Widowed

Race/Ethnicity*:*

- ☐ Aboriginal (e.g., Inuit, Métis, First Nations)
- ☐ Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
- ☐ Black (e.g., African, Haitian, Jamaican, Somali)
- ☐ East Asian (e.g., Chinese, Japanese, Korean)
- ☐ Latin American
- ☐ South Asian
- ☐ South East Asian
- ☐ White (Caucasian)
- ☐ Mixed (please specify) _____

☐ Other

Are you enrolled in an educational program? ☐ Yes ☐ No
If yes, please check one:

☐ College

☐ University

☐ Adult Education

Field of Study: _____

If no, please indicate highest level of education:

☐ Some high school

☐ High School Diploma

☐ College Diploma

☐ Undergraduate Degree

☐ Masters Degree

☐ Doctoral Degree

Employment Status:

☐ Not Working

☐ Working Part-Time

☐ Working Full-Time

If working part-time or full-time, indicate occupation: _____

Appendix F
Behavioural Approach Task Assessment Form

Exercise	**Sensations**	**Intensity of Sensation 0-100**	**Intensity of Fear/Distress 0-100**
Shake head from side to side			
Place head between legs			
Run in place			
Hold breath			
Gag response			
Spin			
Push up			
Breathe through straw			
Over Breathe			

Appendix G- Study 2 Consent Form

Consent Form
Ryerson University

Title of Study: Training Better Mental Habits

You are being asked to participate in a research study. Before you give your consent to be a volunteer, it is important that you read the following information and ask as many questions as necessary to be sure you understand what you will be asked to do.

Investigators:
Emma MacDonald, M.A., PhD candidate, Department of Psychology, Ryerson University
Naomi Koerner, Ph.D., Associate Professor, Department of Psychology, Ryerson University
Martin M. Antony, Ph.D. Professor, Department of Psychology, Ryerson University
Kristin Vickers, Ph.D., Associate Professor, Department of Psychology, Ryerson University

Purpose of the Study: The purpose of this study is to examine the immediate and short-term effects of a brief computerized task designed to develop more helpful anxiety-related mental habits.

Description of the Study: The study will involve five visits to the Psychology Research and Training Centre at Ryerson University, located at 105 Bond Street. The total time commitment will be approximately 6-6.5 hours.

Visit 1 **(3 hours).** First, you will be asked to answer some questions about your physical and emotional health. You will then be asked to complete questionnaires about your thoughts, emotions and reactions to certain situations. You will then be asked to complete two computerized assessments of your mental habits; one will involve deciding if words and sentences are related and the other will involve responding with key presses when you see a dot on the screen. You will then be asked to complete some very brief exercises that include things like breathing through a straw and spinning in a swivel chair. You will be asked a few questions about your experience during these exercises.

Next, you will be randomly assigned to one of two versions of a computerized training task: an "active task" or a "control task." "Randomly assigned" means that the task that will be selected for you will be decided on by the flip of a coin. You won't know in advance whether you are in the "active" condition or the "control" condition, but once you have participated in the study, we will tell you which one you were in.

After completing your assigned computerized training task, you will be asked to complete another set of computerized assessments of your mental habits and another set of questionnaires. You will receive $30 for this visit.

Visit 2 **(**30 minutes**).** You will be asked to return to the lab 3-4 days after Visit 1. You will be asked to complete two questionnaires and the same computerized training task from Visit 1. You will receive $5 for this visit.

Visit 3 (30 minutes)**.** You will be asked to return to the lab 7-8 days after Visit 1. You will be asked to complete two questionnaires and the same computerized training task from Visits 1 and 2. You will receive $5 for this visit.

Visit 4 (60-75 minutes)**.** You will be asked to return to the lab 12-14 days after Visit 1. You will be asked to complete the computerized training task from Visits 1, 2 and 3, as well as the questionnaires, computerized assessments of mental habits and brief exercises that you completed at Visit 1. You will receive $15 for this visit.

Visit 5 (60 minutes)**.** You will be asked to return to the lab approximately 4 weeks after Visit 1. You will be asked to complete the questionnaires, computerized assessments of mental habits and brief exercises that you completed at Visits 1 and 4. You will receive $15 for this visit.

Potential Risks or Discomforts: There is minimal risk involved if you agree to take part in this study. You understand that you may experience some momentary negative emotions when answering questions about your thoughts, emotions and behaviours. You may experience some uncomfortable physical sensations when completing the brief exercises. You have the right to refuse or discontinue participation at any time. If you decided to stop participating, you will still be entitled to compensation (as outlined above) for any activities that you have begun during a visit.

Potential Benefits of the Study To You or Others: Participating in this study may not benefit you directly, but this study may enable us to learn new information that may be beneficial to others who experience high levels of anxiety. You may derive some benefit from completing the questionnaires and computer tasks as it may increase your awareness of your anxiety-related thoughts, emotions and behaviour.

Confidentiality: Everything you disclose in this study will remain completely confidential; however, as part of this study, I am obligated to inform everyone that there are five cases in which I might need to break confidentiality:
(1) if you intend to harm yourself;
(2) if you intend to harm someone else;
(3) if there is reasonable suspicion that a child up to the age of 16 years is at risk of neglect or abuse, we are required by law to report this to the Children's Aid Society right away;
(4) if our files are subpoenaed by the courts (records can be opened by a specific court order)
(5) if a regulated health professional has engaged in inappropriate sexual behavior toward you or another person and you provide us with the name of this individual, we are obligated to report them to their regulatory body.

This informed consent agreement and all data that identifies you will be stored in a locked storage space in the Psychology Research and Training Centre. An ID number, not your name, will be used on all forms you complete and in all computer files that will contain the data you generate during the study.

You will read, and enter your responses to, the questionnaires on a computer using software called Qualtrics. Your data are securely and confidentially stored on a remote server and you will be identified by number only. Please note that because the data are securely stored on a USA based server (Qualtrics), it is subject to the Patriot Act. If you would like to know more about this, please visit the following link: http://epic.org/privacy/terrorism/hr3162.html. Under the Patriot Act, stored data may be intercepted in rare cases if United States officials have a reason to believe the data contain information related to suspected terrorism. However, your name is not stored with your questionnaire data. We will not ask for your name or other identifying information via Qualtrics. Please note that you also have the option to complete questionnaires on paper. All you have to do is tell the researcher, Emma MacDonald.

All of your data will be destroyed/deleted seven years after the publication of the results of this research. Your confidentiality will be protected to the full extent allowed by law. Only group findings will be reported in publications and presentations arising from this research.

Compensation for Participation: You will earn up to $70 for participating in this study. You are asked to arrange to transport yourself to the Psychology Research and Training Centre at Ryerson University. You will not be paid for the telephone screen that you took part in to determine eligibility.

Voluntary Nature of Participation: Participation in this study is voluntary. Your choice of whether to participate will not influence your future relations with Ryerson University or the Cognition and Psychopathology Lab. If you decide to participate, you are free to withdraw your consent and to stop your participation at any time without penalty or loss of benefits to which you are allowed. Your right to withdraw your consent also applies to our use of your data. If you decide that you do not want us to keep or analyze data that you have provided during the course of your participation in this study, please feel free to notify us. At any point in the study, you may refuse to answer any question or stop participation altogether.

Questions about the Study: If you have any questions about the research, please ask now. If you have questions later about the research, you may contact Emma MacDonald, Department of Psychology, Ryerson University, 416-979-5000 ext. 2188. You may also contact Dr. Naomi Koerner, Department of Psychology, Ryerson University, 416-979-5000 ext. 2151.

If you have questions regarding your rights as a participant in this study, you may contact Dr. Lynn Lavallée at the Ryerson University Research Ethics Board.

Dr. Lynn Lavallée, Chair of the Ryerson Research Ethics Board
Office of the Vice President, Research and Innovation
Ryerson University, 350 Victoria Street, Room YDI 1154
Toronto, Ontario, Canada M5B 2K3
Phone: (416) 979-5000 Ext. 4791, Fax: (416) 979-5336
Email: rebchair@ryerson.ca
Website: http://www.ryerson.ca/research

Agreement:
Your signature below indicates: (1) that you have read the information in this agreement and have had a chance to ask any questions you have about the Training Better Mental Habits study; (2) that you agree that information collected from you during the telephone screen for the Training Better Mental Habits study can be retained and analyzed and (3) that you agree to be in the Training Better Mental Habits Study as described in this consent form and have been told that you can change your mind and withdraw your consent to participate at any time. You have been given a copy of this agreement. You have been told that by signing this consent agreement you are not giving up any of your legal rights.

_____
Name of Participant (please print)

_____ _____
Signature of Participant Date

_____ _____
Signature of Experimenter Who Obtained Informed Consent Date

Interested in participating in other research studies?

If you would like to be contacted with the opportunity to participate in future research studies, please complete the following section:

_____
Name (please print)

_____
Phone number

Appendix H- Study 2 Debriefing Form

Training Better Mental Habits

Background of the Study: People who experience high levels of anxiety often have mental habits that fuel their anxiety. A mental habit can be thought of as a very well-practiced way of thinking that eventually happens automatically. One mental habit of interest to researchers is the tendency to interpret situations and experiences in a very negative way when there exists the possibility of seeing things in a more neutral way. For example, people who are highly sensitive to their anxiety tend to automatically interpret a racing heart or wobbling in the legs as signs that something very bad is happening (for example, a heart attack). This type of "mental habit" can heighten anxiety further and cause people a lot of distress. What is encouraging is that these mental habits are changeable, meaning that they can be trained to be more helpful.

In this study, we are looking at whether it is possible to train more helpful mental habits using a very simple computerized task similar to a computer game. The effects of such computer tasks are being studied widely at the moment for their potential as brief interventions for anxiety and depression. It is important for you to know that these computer tasks are just in the testing phase; they are not yet interventions because there is still a lot that needs to be known about how they work before they can be offered as interventions. So the computer "game" that you played was not a treatment for your anxiety. The specific purpose of this study is to test the short term effects of repeatedly practicing new mental habits using the computer game. This study will provide new information on how the computer task achieves its potentially positive effects on anxiety-related thoughts, emotions, and behaviours and the degree to which it reduces reactivity to uncomfortable, but benign, bodily sensations. It is hoped that this study will inform the development of full-scale treatments that can eventually be tested in clinical trials.

Contact Information: If you have any questions or concerns about this experiment or your participation in this study you may contact:

Emma MacDonald, M.A
Main Study Investigator
Ryerson University
105 Bond Street
Toronto, ON M5B 2K3
(416) 979-5000 x2188
caplab@psych.ryerson.ca

Naomi Koerner, Ph.D.
PhD Supervisor
Department of Psychology
Ryerson University
350 Victoria Street
Toronto, ON M5B 2K3
(416) 979-5000 x2151
naomi.koerner@psych.ryerson.ca

Lynn Lavallée, PhD
Chair, Research Ethics Board
Ryerson University
350 Victoria Street, POD470B
Toronto, ON M5B 2K3
(416) 979-5000 x4791
rebchair@ryerson.ca

If you would like any information about the results of the study once it is completed, please contact Emma MacDonald.

Resources: We provide everyone in this study with the same list of resources, in case they are interested in learning more about anxiety or methods of changing unhelpful patterns of thinking. Our list of resources has titles of books on anxiety management, as well as referral sources for cognitive-behavioural therapy (please turn over this page for the list).

In order to maintain the integrity of this research, please do not disclose the purpose of this experiment to others who may be interested in taking part in this study. When participants have too much prior knowledge about the purpose of an experiment, this can affect how they behave in the experiment and the data for that person may not be usable.

Thank you very much for participating in this study!

Self-Help Books

Antony, M. M., & Norton, P. J. (2009). *The anti-anxiety workbook: Proven strategies to overcome worry, panic, phobias and obsessions.* New York, NY: Guilford Press.

Greenberger, D., & Padeskey, C. (1995). *Mind over mood: Change how you feel by changing the way you think.* New York: Guilford Press.

Watt, M. C., & Stewart, S. H. (2008). *Overcoming the fear of fear: How to reduce anxiety sensitivity.* Oakland, CA: New Harbinger.

Other anxiety resources are available at:
www.martinantony.com/wordpress/wp-content/uploads/2013/08/Anxiety-and-CBT-Reading-List.pdf

Referrals in Toronto Area

OHIP-Covered and Sliding Scale Referrals

Adult Mental Health Program
Humber River Regional Hospital, Toronto
Contact: Heather Wheeler, Ph.D.
Tel: 416-658-2003

Mood and Anxiety Services
Centre for Addiction and Mental Health
Toronto
Tel: 416-535-8501, option 2

Ryerson University Centre for Student Development and Counseling *(Ryerson Students Only)*
350 Victoria St., Room JOR-07C, Lower Ground Floor, Jorgenson Hall, Toronto
Tel: 416-979-5195

Private Psychology Referrals

CBT Associates of Toronto
100 Adelaide St. W., Suite 805, Toronto, ON
Tel: 416-363-4228
Web: http://www.cbtassociates.net
Co-Directors: Eilenna Denisoff, Ph.D., and Peter Farvolden, Ph.D.
Email: eilenna.denisoff@cbtassociates.net or peter.farvolden@cbtassociates.net

David Moscovitch, Ph.D., C.Psych
The Clinic
101 Dupont St., Toronto, ON
Tel: 416-966-1692

EBT3 (Evidence-based Therapy, Training, and Testing)
2 Carlton Street, Suite 1803, Toronto, ON
Tel: 416-628-4336
Email: admin@ebt3.com
Web: http://www.ebt3/com

Brian Ridgley, Ph.D.
Ridgley, Thomas, and Associates
60 St. Clair Ave. E., Suite 900, Toronto, ON
Tel: 416-944-3747
Email: brianridgley@rogers.com

Hank Frazer, Ph.D., C.Psych
3852 Finch Ave., Unit 309, Scarborough, ON
Tel: 416-298-9143 or 416-298-1102

Neil Pilkington, Ph.D., C.Psych
2 Carlton St., Suite 1718, Toronto, ON
Tel: 416-977-5666
Email: dr.neil.pilkington@rogers.com

Heather Wheeler, Ph.D., C.Psych
1333 Sheppard Ave. E., Suite 225,
Toronto, ON Tel: 416-788-3038
Email: hwheeler@roger

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