THE IMPACT OF THE ATTENTION TRAINING TECHNIQUE ON ATTENTION CONTROL AND WORRY IN INDIVIDUALS HIGH IN THE TENDENCY TO ENGAGE IN EXCESSIVE WORRY

by

Kathleen Stewart

Bachelor of Science, McGill University, 2015

A thesis

presented to Ryerson University

in partial fulfillment of the

requirements of the degree of

Master of Arts

in the program of

Psychology

Toronto, Ontario, Canada, 2018

AUTHOR'S DECLARATION FOR ELECTRONIC SUBMISSION OF A THESIS

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I authorize Ryerson University to lend this thesis to other institutions or individuals for the purpose of scholarly research.

I further authorize Ryerson University to reproduce this thesis by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

I understand that my thesis may be made electronically available to the public

The Impact of the Attention Training Technique on Attention Control and Worry In Individuals High in the Tendency to Engage in Excessive Worry

Master of Arts, 2018

Kathleen E. Stewart

Psychology

Ryerson University

ABSTRACT

The present study examined whether the Attention Training Technique (ATT; Wells, 1990) is more efficacious at reducing worry and modifying GAD-related attention processes than a control intervention. Adults with Probable GAD ($N = 29$) monitored their worry for a week and were then randomly assigned to one of two audio recording interventions: ATT, or a control intervention that was not expected to train attention. Following one practice session at the laboratory, participants were instructed to listen to their assigned recording once per day for 7 consecutive days. Neither intervention showed a reduction in worry and most processes, although there was a significant reduction in attentional bias to threat from pre to postintervention that did not vary as a function of experimental condition. Findings suggest that overall, neither ATT nor the control intervention had a significant impact on worry and worry-related features. Explanations for the null findings are offered.

Acknowledgements

There are many people I would like to gratefully acknowledge for their continued support and contribution to my academic development. Thank you first and foremost to Dr. Naomi Koerner, my advisor, for setting an example of excellence in clinical research, for holding me to a high standard and challenging me, and for helping me to develop as a scientist.

Thank you to Dr. Martin Antony for your guidance through this process. Your expertise and feedback was invaluable to my growth, and I consider myself incredibly lucky to have had you on my committee. Thank you also Dr. Colleen Carney for graciously agreeing to be on my committee and for your feedback and valuable lessons on research design.

I would also like to thank a few others, without whom I would not have been able to see this project to fruition. Dr. Adrian Wells, thank you for sharing your materials with us for this study, and for consulting with us on the design of the control condition. Thank you to Dr. Frank Russo for allowing me to use your recording equipment, and to your patient lab manager Fran Copelli, for going above and beyond to help me navigate the equipment and troubleshoot every conceivable problem. Thank you to Andrew McConnell for your advice on all things sound engineering.

This experience would not have been the same without my labmates, whose mentorship was critical in helping me get my project up and running. Kathleen Tallon and Melina Ovanessian, thank you for answering my questions with patience, and for being a constant source of laughter and comradery. Bailee Malivoire, I am indescribably lucky to have you as a confidant. To my

cohort, your constant support has made these past two years unbelievable. Leah Sacks, thank you for being a trustworthy and reliable research assistant.

To my parents: without you none of this would be possible; thank you for all that you do.

Finally, thank you to the Canadian Institutes of Health Research and the Ontario Graduate Scholarship program for providing me with financial support during my Master's program.

Table of Contents

List of Appendices

The Impact of the Attention Training Technique On Attention Control and Worry In Individuals High in the Tendency to Engage in Excessive Worry

Worry has been defined as a chain of negative thoughts about potential negative future events where the outcome is uncertain (Sibrava & Borkovec, 2006). The core feature of generalized anxiety disorder (GAD) is worry that is distressing and excessive, meaning the individual worries when nothing is wrong, or in a disproportionate manner. The worry is also described as difficult to control. Although worry is a secondary feature of many anxiety disorders, the content of the worry is specific to the particular disorder (e.g., about having a panic attack in panic disorder), whereas in GAD, the worry is about a *variety of different situations.* Although everyone worries to some degree (Ruscio, Borkovec, & Ruscio, 2001), what separates transient and common worry from pathological worry, is the excessiveness and uncontrollability of the worry, occurring more days than not (American Psychiatric Association, 2013).

GAD is a chronic disorder with a global prevalence of 7.3% (Baxter, Scott & Whiteford, 2013). A naturalistic longitudinal study found that 42% of individuals with GAD receiving some form of medication treatment were still symptomatic at 12-year follow up. In addition, only 16% of primary care patients with GAD who received psychotherapy achieved full recovery at 2-year follow up (Rodriguez et al., 2005), suggesting that GAD has a chronic course. Cognitive behavioural therapy (CBT) is one of the most effective treatments for anxiety disorders, and is frequently used to treat excessive and uncontrollable worry. A meta-analysis of randomized controlled trials (RCT) comparing CBT to sham treatments controlling for contact with a therapist, rationale, structure, length, and discussion of psychological problems, found that CBT yielded significantly greater improvements in individuals with GAD (Hedges g=.44-.57;

Hoffman & Smits, 2008). Other meta-analyses have also found large effect sizes for CBT for GAD (Borkovec & Ruscio, 2001; Gould, Safren, Washington, & Otto, 2004; Mitte, 2005).

Despite being one of the most effective treatments available, only 39% to 57% of individuals with GAD who receive CBT reach remission, which leaves a substantial number of individuals without relief (Fisher, 2006; Hanrahan, Field, Jones, & Davey, 2013). Given that chronic worry is associated with heart disease (Martens, De Jonge, Na, Cohen, Lett, & Whooley, 2010), asthma (Culpepper, 2009), and lower quality of life (Barrera & Norton, 2009; Henning, Turk, Mennin, Fresco, & Heimberg, 2007; Stein & Heimberg, 2004), research into other treatments, administered either alone or in conjunction with CBT, to target worry is of upmost importance.

There is increasing interest in transdiagnostic approaches to treatment, which target underlying features and mechanisms that may cut across multiple disorders, as opposed to focusing on disorder specific elements. In the past few decades, the role of *attention* in the etiology and maintenance of anxiety disorders has become a key component of many prominent models of anxiety (e.g., Beck & Clark, 1997; Eysenck, 1992, 2007; Mathews & Mackintosh, 1998; Mogg & Bradley, 1998; Williams, Watts, MacLeod, & Mathews, 1988). Two models have specifically focused on the role of attentional processes related to *worry*, the cognitive component of anxiety (Hirsch & Mathews, 2012; Wells, 1995). These models may be applied transdiagnostically to any disorder with worry as a feature, and may be especially relevant for GAD.

Models from the attention literature will be defined, followed by findings regarding attentional impairment in individuals who suffer from chronic worry, culminating in the integration of the cognitive and clinical literature that provides a framework for treatment.

Attention

Attention is the process that allows us to focus on a specific aspect of our internal or external environment while ignoring competing information (Carrasco, 2011). One of the earliest psychological definitions came from William James (1890), who described it eloquently as "the taking possession by the mind, in clear and vivid form, one out of what seem several simultaneous possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal efficiently with others…" (p. 403). Given the vast amount of information in our world, attention must be selective; one cannot possibly attend to everything at once.

A fundamental tenet of many prominent models is that our attentional capacity is *limited* (Broadbent, 1958; Kinchla, 1980; 1992; Neisser, 1967; Treisman, 1960), which is supported by electrophysiological, neuroimaging and behavioural studies (Beck & Kastner, 2009; Desimone & Duncan, 1995; Reynolds & Chelazzi, 2004). Early attentional theories (e.g., Broadbent, 1958) implied that only small amounts of information make it through to semantic processing. These theories were supported by dichotic listening studies, where participants were played two different messages in each ear (e.g., Cherry, 1953; Moray, 1959). These studies found that when participants were asked to listen to a message coming into one ear, they had no memory of content played in the other ear. For example, participants had trouble even determining the language of the content played in the ear they were not attending to.

Although we have an incredible ability to focus our attention, it does not function like a spotlight, where all information outside our focus is completely and absolutely ignored (Desimone & Duncan, 1995). The phenomenon of the Cocktail Party Effect (Cherry, 1953; Moray, 1959), which refers to hearing someone say our name across the room while engaged in

conversation elsewhere, suggests we process more content in our environment than early attentional models suggested. The Attenuation model (Treisman,1960) proposed that unattended stimuli may still be processed if their threshold of activation is low enough, and if there are enough attentional resources available. The question then became, *what unattended information comes into focus?*

Models. The question of what information comes into focus over others is examined in the *biased competition* theory, developed by Desimone and Duncan (1995), which incorporates both top-down and bottom-up mechanisms (Posner & Peterson, 1990) to explain the dynamic processes of attention. Top-down attention is voluntary and goal driven (e.g., reading a book), whereas bottom-up attention is driven by the properties of the stimulus (e.g., how loud a sound is), which may cause attention to be captured. In this model, there is constant competition from different inputs at all stages of processing, and given that we cannot possibly attend to everything at once, our attention must be biased towards certain inputs over others. We may focus our attention on a specific aspect of our environment that is important to us at that moment (top-down); yet we also may shift our attention when another object becomes salient (bottom-up), such as novel stimuli (e.g., a bird flying towards our head), and stimuli that have learned importance (e.g., our name, or the word "help"), irrespective of our goals.

Drawing further on the idea of competitive bias, Knudsen (2007) developed a model of attention similar to Desimone and Duncan's (1995). Competition between different inputs, each of different strengths, occurs at multiple levels, from the most basic bottom-up level (e.g., between different sound frequencies) to higher order (e.g., between what is currently being held in our working memory, and the new signal being passed along). The "strength" of the signal is based on the inherent quality and salience of the stimulus as well as our *top down sensory*

control. To maintain attentional focus, our top-down sensory control system generates signals that both improve the quality of that information coming in and inhibit conflicting and distracting information. By modulating the sensitivity of neural circuits in an excitatory or inhibitory way, we are able to maintain attention to the information that is relevant to us at that moment. Certain aspects of our world evoke strong neural responses, specifically novel and infrequent stimuli or stimuli of learned or biological importance (e.g., the sound of a fire alarm, a lion running through the bush). If the signal is strong enough, salient stimuli will be passed along to working memory and will compete with the current information being held there. In Knudsen's model (2005), as in Desimone and Duncan's (1995), attention is dynamic and incorporates both top-down and bottom-up processes.

Attention control. A tenet of the previous models is that we are able to *control our attention*, to volitionally focus our attention on objects, events, or thoughts, in the face of distracting stimuli, and to flexibly switch our attention from one stimulus to another (Posner & Petersen, 1990). What we choose to pay attention to might change moment to moment. For example, driving is an activity that requires us to observe other cars, pedestrians, cyclists, street signs, and lights, while obeying traffic rules, often while listening to the radio or maintaining a conversation. Given that it is impossible to attend fully to each aspect of our environment at once, we assign more weight to certain bits of information over others at different times. In the pouring rain or other conditions of lower visibility, a person may devote more attention to the cars on the road and tune out from listening to the radio, returning attention back to the radio when visibility improves (Gopher, 1993). What we prioritize is essentially an "attentional strategy": the relative weight, or bias, assigned to certain tasks or pieces of information over others (Gopher, 1993; Logan, 1985).

The strategic control of attention has been incorporated into many models of human processing (Gopher & Sanders, 1984; Kahneman, 1973; Norman & Shallice, 1986; Posner & Petersen, 1990). Attentional control may also be referred to as "executive control" of attention (e.g., Posner & Peterson, 1990) or "working memory," described as a "domain-free" ability to control attention by Engle (2002; see also Conway, Jane, Bunting, Hambrick, Wilhelm, & Engle, 2005). Based on empirical evidence, Engle and Kane (2004) suggest the main difference in individuals with high or low working memory capacity is the ability of individuals with a high capacity to hold goal-relevant information in focus in the face of competing information (i.e., attention control; Kane, Bleckley, Conway, & Engle, 2001; Unsworth, Shrock, & Engle, 2004).

Although the terminology may vary slightly (Astle & Scerif, 2009), it is generally agreed that the ability to exert control over attention is beneficial in many ways. In dichotic listening tasks, individuals who have higher attentional control are better able to focus their attention to accurately follow task instructions and are less likely to become distracted by their name (Conway, Cowan, & Bunting, 2001). Behavioural measures of attention control have been shown consistently to distinguish between individuals who perform well or poorly on complicated tasks such as flying complex aircrafts (Gopher; 1982; Gopher & Kahneman, 1971; North & Gopher, 1976), and on complex mental arithmetic tasks (Beilock & Carr, 2005; Beilock & DeCaro, 2007; Kane et al., 2001), and attention control is negatively related to the rate of accidents among bus drivers (Kahneman, Ben-Ishai, & Lotan, 1973).

Attention control is frequently measured using complex tasks that require individuals to focus and shift attention to multiple sources of information, such as dual-task paradigms, in which individuals are responsible for performing two tasks at once. Random Interval Generation tasks (Vandierendonck, De Vooght, & Van der Goten, 1998) involve pressing a key in a random

fashion, which requires high levels of attention control to avoid reverting to a nonrandom sequence. As mentioned previously, the dichotic listening task is another behavioural measure of attentional control. The Attention Network Task (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002) measures RTs to respond to the direction of a central arrow surrounded by distracting "flanker" arrows pointing in the opposite direction, and thus assesses the ability of individuals to focus their attention in the face of competing information.

Self-report measures of attentional control, such as the Attentional Control Scale (ACS; Derryberry & Reed, 2002), are also employed. Although attention control may co-occur with a subjective feeling of volition, it can also occur *without* conscious awareness; thus self-report questionnaires cannot be used to *definitively* assess attention control capacity. Some studies have shown that self-report measures of attention control correlate with behavioural measures; for example, the Shifting subscale of the ACS correlates moderately with letter-number sequencing tasks, which measure working memory capacity (r=.34), and the Focusing subscale correlates well with antisaccade tasks that measure AC (r=.32), as well as the attention control component of the ANT (r=.16; Judah, Grant, Mills, & Lechner, 2014; Reinholdt-Dunne, Mogg, & Bradley, 2013). However, contradictory evidence has shown that self-control measures of executive function often *do not* correlate strongly with objective measures, and they tend instead to be associated with personality traits such neuroticism, low conscientiousness and anxiety (Buchanan, 2016). Nevertheless, self-report measures are useful in that they provide an indication of how much attentional control individuals *believe* they have, which may be of interest in GAD research, especially given that a subjective belief in one's lack of control over worry (a behaviour that consumes attentional resources) is a defining feature of the disorder.

Attentional Bias and Pathological Worry

There is strong evidence for attentional bias to threat-related stimuli in anxious individuals (see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007, for meta-analysis; and Cisler & Koster, 2011, for further review). Studies of individuals who engage in high levels of worry demonstrate fairly consistent threat biases; these individuals tend to allocate more attention to threatening stimuli compared to neutral stimuli than do low worriers (Bradley, Mogg, White, Groom, & DeBono, 1999; Goodwin, Eagleson, Mathews, Yiend, & Hirsch, 2016; Mogg, Millar, & Bradley, 2000). These biases are often measured with dot-probe paradigms (Macleod, Mathews, & Tata, 1986), where two cues are simultaneously presented on a screen, followed by a "dot-probe" appearing in one of the previous cue locations. Participants press a button to respond to the probe as quickly as they can.

Individuals with GAD, compared to healthy controls, are quicker to respond to probes appearing in the spatial location where a threat-related cue (word or image) previously appeared. This indicates an attentional bias to threat-related cues, as the participants were already focusing their attention at this location and thus were faster to respond to the probe (e.g., Bradley et al., 1999; Mogg et al., 2000; see Bar-Haim et al., 2007 for a comprehensive review). Dot-probe tasks are thought to tap into preconscious processing, suggesting these biases can occur without participants' awareness. Interestingly, behavioural measures of attentional biases serve as better predictors of stress than do self-report questionnaires of neuroticism and anxiety (Fox, Cahill, & Zougkou, 2010). A recent meta-analysis of 29 studies demonstrated strong evidence of attentional bias to threat among individuals with GAD compared to control groups, especially when threat stimuli were presented in words as opposed to images. This bias was evidenced across several domains of negative threat topics (Goodwin, Yiend, & Hirsch, 2017).

A positive relationship between training attention away from threat and reduced symptoms of anxiety and worry in individuals with clinical or subclinical GAD has been demonstrated (Hazen, Vasey, & Schmidt, 2009). In one study, participants were administered either five sessions of Attention Retraining for Threat Stimuli, which used a dot-probe task with probes always appearing in the location of the neutral word in the pair, or five sessions of a sham task where probes appeared equally following threat and neutral words. The experimental condition aimed to implicitly teach participants to direct their attention away from threat-related information. Individuals in the experimental condition showed a reduced threat bias pre to posttreatment, measured by a separate dot-probe task. They also experienced lower anxiety and worry, as measured by the State Trait Anxiety Inventory (Spielberger, 1983) and the Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990), respectively (pooled Cohen's d=1.53). The change in attention bias and the reduction in negative symptoms were positively correlated in the experimental condition r = .38; however, this correlation did not reach significance. Although this study demonstrated a co-occurring reduction in threat bias and negative symptoms, they were unable to determine the temporal nature of this relationship.

The temporal relationship between attention bias and worry was examined in two recent studies. One asked individuals who worry chronically to engage in either verbal-linguistic worry (the medium in which worry is experienced; see Borkovec & Inz, 1990) or image-based worry. Only verbal-linguistic worry was associated with a subsequent threat bias on a dot-probe task. This suggests that the verbal component of worry may increase attentional bias to threat, even when controlling for anxiety and propensity to worry (Williams, Mathews, & Hirsch, 2014). Conversely, Krebs, Hirsch and Mathews (2010) manipulated attention to threat in low worriers and found that training an attentional bias to threat stimuli versus neutral stimuli led to more

negative thought intrusions on a breathing focus task. It seems likely a bidirectional relationship between worry and attention bias exists, with each perpetuating one another.

Attention Control and Pathological Worry

As previously discussed, attention control is largely considered a positive cognitive ability, and may also be a protective factor in individuals with anxiety (Derryberry & Reed, 2002; Lonigan & Vasey, 2009; Peers & Lawrence, 2009). Individuals with high scores on the State Trait Anxiety Inventory who had poor self-reported attentional control showed a greater attentional bias to threat compared to those with high levels of anxiety but better self-reported attention control. This suggests that attention control may moderate the relationship between anxiety and attentional bias (although we do not know if this applies to worry specifically), and other research has suggested it may mediate the relationship as well. For example, Bishop and colleagues demonstrated that decreased activation of the dorsolateral prefrontal cortex, associated with attentional control capabilities, leads to decreased down-regulation of the amygdala during the presentation of threat in individuals who experience anxiety (Bishop, 2008, 2009; Bishop, Duncan, Brett, & Lawrence, 2004). This suggests that having less attentional control may make it difficult for individuals to inhibit low level threat processing, making them more vulnerable to threat bias.

Recent interest has arisen in targeting attention control in treatment directly. Following a daily 3-week "dual n-back" training task, where participants were trained to keep track of both visual and auditory stimuli, and to repeat back pieces of information previously presented, individuals high in trait anxiety performed better on a subsequent behavioural measure of attention control. They also reported less anxiety than they had preintervention (Sari, Koster, Pourtois, & Derakshan, 2016). A recent study comparing working memory training (25 sessions

of eight different WM tasks over 5 weeks) to CBT in adolescents with self-reported anxiety found that both conditions were associated with 1) improved attention control, as measured by digit recall and n-back tasks, 2) reduced attentional bias to threat stimuli, as measured by a dot-probe task, and 3) reduced self-reported anxiety (Hadwin & Richards, 2016).

The relationship between biases toward threatening information, deficits in attention control, and prolonged and excessive worry has been explained by two major models: Wells' metacognitive model (1995, 1999, 2004) and Hirsch and Mathews' cognitive model of pathological worry (2010). Each model proposes different pathways between attention control, bias, and worry, and has different implications for treatment. Although many models of attention and anxiety exist, most do not specifically apply to the cognitive component of worry and thus are outside the scope of this thesis (see Cisler & Koster, 2011 for review).

The Metacognitive Model of Psychological Disorder

Developed by Adrian Wells (1995, 1999, 2004), the metacognitive model of psychological disorder places the importance not on *what* individuals think about (i.e., the content) but rather *how* they think (i.e., the process). According to Wells, the metacognitive model is transdiagnostic in that it can be applied to any psychopathology that involves perseverative or repetitive negative thinking. To date, this model has mostly been applied to anxiety disorders, major depressive disorder, Obsessive Compulsive Disorder (OCD) and Posttraumatic Stress Disorder, although components of Wells' therapy have been applied to disorders such as schizophrenia. According to Wells, individuals with psychopathology have a maladaptive cognitive appraisal style, or way of thinking, which is termed the *Cognitive Attentional Syndrome* (CAS; Wells & Matthews, 1996; Wells, 2009). This negative and perseverative maladaptive style consists of worry, monitoring for threat, heightened self-focused

attention, and the use of maladaptive coping behaviours (e.g., avoidance). "Threat monitoring" is essentially the attentional bias to internal and external threat stimuli, including the physiological sensations of the body (e.g., pounding heart), whereas worry is a negative chain of thoughts triggered in response to an intrusive "what if" question (e.g., "what if I get fired?").

A major tenet of Wells' model is *self-focused attention*: an inward, self-focus on the thoughts, feelings, and physical sensations the individual experiences. Self-focused attention maintains psychopathology because the individual's attention is fixed rigidly on negative thoughts or physical sensations. Duval and Wicklund (1972) suggested that attention can be outwardly or inwardly directed, and that negative affect occurs when attention becomes fixed on the self. Fenigstein, Scheier and Buss (1972) suggested "self-consciousness," or focusing attention inwardly, is a disposition linked to both trait and state anxiety and worry, which was later supported by many studies (e.g., Boyce, 1981; Dickstein, Wang, & Whitaker, 1981; Wells, 1985). Ingram's (1990) model of self-focused attention suggested that self-focused attention is a common feature of many types of psychopathology and is heightened in individuals with anxiety, including those with GAD. He suggested that this self-focus of attention is dysfunctional because it is *inflexible* and *rigid* and is sustained even when the situation warrants shifting attention externally. Ingram (1990) also suggested that the focus of attention is specific to the disorder. For example, people with panic disorder may be extremely focused on internal body sensations, such as how fast their heart is beating, whereas individuals with GAD may be constantly focused on their chains of worry.

The metacognitive model of GAD (Wells, 1995, 1999). Perhaps no disorder exemplifies the maladaptive *CAS* as well as GAD, given that worry is a central component of the syndrome. Indeed, Wells has said that GAD is the "archetypal manifestation of the CAS" (Wells, 2009, p.

91). The maladaptive CAS arises because individuals with GAD hold certain erroneous beliefs about their cognitions. One set of beliefs are *positive* beliefs (e.g., "I need to worry to make sure I am prepared," or "if I don't stay alert, I might miss something dangerous"). These individuals also hold *negative* beliefs about their thoughts being uncontrollable, and often dangerous (e.g., "I can't stop worrying," "I'm going crazy"). Positive and negative beliefs perpetuate worry because individuals are convinced not only that worry is *useful*, but also that it is *out of their control*. Subjectively distressing thoughts, feelings of fear, and transient anxiety are experienced by everyone, yet if people believe these thought patterns are uncontrollable and dangerous, individuals then begin to worry about their worry, and the associated anxiety can become chronic. Although healthy individuals may hold positive beliefs about worry, they do not generally hold negative beliefs about worry and thus are less likely to worry about worrying.

In addition to erroneous beliefs, having heightened self-focused attention leads individuals to notice and pay attention to the physiological symptoms of anxiety, which may be taken as further indication that worry is in fact dangerous (e.g., "I could die from stress"). They also may believe they cannot possibly shift their attention away from their worry and back to the task at hand. The individuals' limited cognitive resources are directed inwards towards their worry chains instead of towards more adaptive activities such as challenging the beliefs that maintain worry, which would require individuals to externalize their attention. Since attention remains self-focused on worry, the belief that worry is uncontrollable is reinforced.

Two aspects of attention are emphasized in Wells' model: self-focus and top-down control. Control over attention is important because it is required to change the direction of attention, from an internal to external focus, which is necessary to interrupt the maladaptive CAS (e.g., to stop worry cycles) and to challenge beliefs. Conversely, a perceived lack of control over

cognition is a fundamental maintaining component of worry in GAD. In Wells' model, maladaptive behaviours (e.g., worry, attentional bias to threat) are a *consequence* of maladaptive metacognitive beliefs, but the behaviours must be interrupted in order to challenge these beliefs. The CAS behaviours are difficult to interrupt due to an inflexible and rigid self-focus coupled with limited attentional control required to shift this focus. Wells aims to target the inflexibility of these resources through his attention training technique (ATT).

Implications for treatment. Wells developed an intervention that is intended to interrupt the inflexible self-focused attention that he describes as the "key ingredient" (Wells, 2009, p. 57) in CAS behaviours. The ATT can be administered in adjunct to other therapeutic approaches and can be applied transdiagnostically. Theoretically, the intervention should help train individuals to have control over their attention, allowing them to turn their attention outward. Gaining control over attentional deployment, and having attention not solely focused on internal thoughts, should interrupt the maladaptive style of cognition (e.g., stop worrying), which would then give individuals the opportunity to challenge their beliefs (e.g., realize that worry is not uncontrollable). Wells' approach to treatment is top-down; he does not attempt to modify attentional biases to threat; rather he attempts to train or enhance the ability to control attention. His model implies that externalized attention and improved attention control should modify information processing such that attentional biases to threat and worry are attenuated as a result. The intervention will be described later in this thesis.

Tests of the model. Evidence for the Metacognitive Model, as it pertains to worry, will now be addressed. This brief review is a summary of Wells' (2005). In accordance with the model, individuals who are prone to pathological worry tend to endorse both positive and negative beliefs about worry (Cartwright-Hatton & Wells, 1997; Wells & Papageorgiou, 1998),

although positive beliefs about worry are also endorsed by individuals who do not worry pathologically (Tallis, Davey, & Capuzzo, 1994), and are thus not specific to GAD or pathological worry. Early studies showed that individuals with GAD according to the Diagnostic and Statistical Manual of Mental Disorders, 3rd edition, Revised (DSM-III-R), were significantly more likely to endorse negative beliefs about worry, and metaworry (worry about worry) compared to individuals with other anxiety disorders. It is important to note that most of the model testing was conducted using the DSM-III-R criteria for GAD, which focused more on autonomic symptoms than the current definition, which focuses more on the cognitive component of *worry*. Negative beliefs about worry also predict the development of the fourth edition of the DSM (DSM-IV) GAD 12 to 15 weeks later in individuals whose symptoms previously did not meet criteria (Nassif, 1999). Although the DSM-IV criteria include uncontrollability of worry as a criterion, the diagnosis also requires 3 out of 6 associated symptoms. This indicates that *negative beliefs* about worry may precede the development of GAD. Metaworry, as measured by the Anxious Thoughts Inventory (Wells, 1994) is a stronger predictor of pathological worry (measured by the PSWQ; Meyer et al., 1990) than actual worry itself. In sum, the body of evidence suggests that negative beliefs about worry, and metaworry are both important and empirically validated components of Wells' metacognitive model.

Wells conceptualizes worry as a maladaptive cognitive strategy that contributes to further anxiety. The tendency to use worry as a coping strategy is correlated with many negative emotional outcomes (Wells & Davies, 1994), and asking people to engage in brief periods of worry increases subsequent negative thought intrusions (Borkovec, Robinson, Pruzinsky, & DePree, 1983; York, Borkovec, Vasey, & Stern, 1987). More recently, Fergus and colleagues (2013) examined the relationship between the CAS, worry, and the symptoms of anxiety and

mood disorders. The authors used Wells' CAS-1 scale (Wells, 2009), which is a 16-item self-report measure that looks at metacognitive strategies and metacognitive knowledge. The CAS measure shared significant positive correlations with the PSWQ, as well as with other anxiety (panic, agoraphobia, social anxiety), obsessive-compulsive and depression scales. These results speak to the transdiagnostic application of Wells' theory; however, the strongest correlations were found for Major Depressive Disorder (MDD) and GAD (r=.47), suggesting the CAS may be particularly relevant for these disorders. Thus the ATT, which aims to interrupt the CAS, may also be particularly relevant for GAD.

Self-focused attention. A meta-analysis testing the relationship between self-focused attention and anxiety showed that self-focused attention has been observed in many anxiety disorders, especially GAD (d= 0.91; Mor & Winquist, 2002). For comparison, social anxiety and panic disorder were moderately positively correlated with self-focus, with a Cohen's d of 0.4 and 0.39 respectively. It appears that self-focused attention may be a major component of GAD; however, early studies linking self-focused attention and generalized anxiety are largely correlational and do not speak to causality. If self-focused attention perpetuates anxiety and worry, as proposed by Wells, modifying self-focused attention should in turn lead to decreases in anxiety, worry and other distressing symptoms. Perhaps the most promising support for the self-focused attention component of his model comes from the efficacy of his theoretically-based therapy, which aims to modify attention and is associated with a reduction in distressing symptoms. This therapy will be touched upon later.

A Cognitive Model of Pathological Worry

Close to two decades after Wells published his model, Hirsch and Mathews (2012) developed a cognitive model of pathological worry that also explains the relationship between

attentional bias to threat, attention control, and worry. They explain pathological worry as a consequence of impairments in both automatic and controlled processing; they posit that individuals who worry pathologically experience a bottom-up emotional processing bias in conjunction with an impaired top-down attentional control ability. According to their theory, the development of the disorder is bidirectional: with both bottom-up and top-down processes feeding into each other and further enhancing the maladaptive attentional style.

Emotional processing bias. The model posits that individuals who engage in pathological worry display a bias towards threat-related stimuli, which includes both external (e.g., threat stimuli in the environment) and internal experiences (e.g., distressing mental images, worry chains, and/or uncomfortable bodily sensations). This bias likely has both biological and environmental roots; some individuals may be predisposed to this cognitive style (such as those with a low expression allele of the serotonin transporter gene), which may interact with negative life events, reinforcing the maladaptive style (Fox, Zougkhou, Ridgewell, & Garner, 2011). The bias may also be learned and reinforced over time; despite our best intentions, patterns of thinking become habitual if we engage in them enough over time.

Support for emotional processing biases. Much of the research that supports low level processing biases was discussed in the previous section on attentional bias. As mentioned previously, training an attentional bias to threat leads to more subsequent negative intrusions (Krebs et al., 2010), whereas training that *reduces* attentional bias to threat is associated with decreased worry and anxiety symptoms (Amir, Beard, Burns, & Bomyea, 2009; Hazen, Vasey, & Schmidt, 2009). Conversely, inducing worry leads to an increased attentional bias to threat (Williams et al., 2014). These studies suggest that emotional processing biases have a causal role in worry, and that worry in turn further strengthens the bias.

Attentional control impairment. Hirsch and Mathews (2012) define attentional control as the ability to engage in inhibiting and shifting behaviours. Although preconscious biases may increase the likelihood of negative intrusions coming into consciousness, individuals who engage in pathological worry also have less attention control. They find it difficult to ignore these negative intrusions and to maintain focus on the task at hand. Much like the competitive bias models from the attention literature (Desimone & Duncan, 1995; Knudsen, 2007), Hirsh and Mathews (2012) suggest that mental representations compete for access to conscious awareness and the strongest will become the focus of our attention. In healthy individuals, the competition between the relatively weak bottom-up threat signals (due to a lack of preconscious bias) and the relatively strong inhibitory ability of the attention control mechanism, prevents threatening intrusions from distracting individuals from task-related focus. If an intrusion occurs, individuals' attention control capacity is usually sufficient for them to shift their focus back to the desired object of their attention.

In individuals prone to worry, bottom-up threat signals exert greater influence than they would in healthy individuals, due to the emotional processing bias, and thus it is much more likely threat representations will be activated. The balance between the threat representation and the current task at hand is skewed such that the attention control capacity is not sufficient enough to divert attention back to the task at hand. Paying attention to these negative intrusions further enhances the strength of the bottom-up signals, increasing the likelihood of them entering consciousness in the future. In accordance with Wells' model, Hirsch and Mathews acknowledge there may also be a motivational aspect to maintaining attention to worry; individuals may hold the belief that their worry is uncontrollable and thus they may not try to exert the effort to divert their attention, or they may believe worry is actually beneficial in some way (Wells 1995).

According to Hirsch and Mathews (2012), individuals who worry chronically suffer with regard to attentional control in two ways. First, these individuals have a generally limited attention control capacity, which predisposes them to worry. Second, the act of worry itself depletes control resources. The already limited attention capacities are further corrupted when actively engaging in worry, making it very difficult to break the cycle while engaging in worry. Worry uses the exact attention resources needed to be able to stop it. It is important to note that not all findings have supported differences in performance on attentional tasks between anxious and nonanxious individuals, which may be due to reasons such as difficulty of the task and motivation (Berggren & Derakshan, 2013). The following section reviews support for impairment.

Support for attentional control impairment. Support for the competition between the current goal-focused object of attention and an intrusive thought comes largely from the attention literature. Hirsch and Mathews' model is compatible with and draws on the competitive bias models discussed earlier (e.g., Desimone & Duncan, 1995; Knudson, 2007). Support for impaired top down control in worriers was discussed previously in the section on attentional control in pathological worry, but further support comes from a study by Hayes and colleagues (2008).

When asked to generate a random sequence of key presses while worrying, individuals high in pathological worry generated fewer random key presses compared to when they were thinking positively, indicating attention control is consumed by worry. Even when told to think positively, they still performed more poorly than did individuals not prone to worry, suggesting they also have preexisting limited attention control (Hayes, Hirsch & Mathews, 2008). This

preexisting depletion has been demonstrated in other studies where no threat is present (Ansari, Derakshan, & Richards, 2008; Bishop, 2009; Pacheco-Unguetti et al., 2010).

Summary of the model. In the cognitive model of pathological worry, there is a bidirectional relationship between worry and attentional bias, in that emotional processing biases leave individuals prone to negative intrusions, and worry itself further amplifies this bias to threat. Due to preexisting diminished attentional control resources (that suffer further when engaging in worry), individuals who suffer from pathological worry have difficulty shifting attention from worry back to the task at hand.

Implications for treatment. Hirsch and Mathews argue that the controlled direction of attention to worry content occurs only *after* the negative intrusion has arisen. Thus, they posit that training attention control resources is ineffective unless there is *also* training to modify the bias; otherwise, intrusions will still occur. Targeting negative beliefs about worry, or modifying attentional control, should only impact the *duration* of a worry episode and not the *frequency* of worry. They cite evidence suggesting that attempts to increase general attention control resources are often ineffective (Persson & Reuter-Lorenz, 2008). Further evidence comes from research that suggests that attention control does not predict bias to threat, nor does manipulating cognitive load decrease attention to threat (Goodwin et al., 2016). They specifically suggest that Wells' attention intervention is "limited by [its] reliance on enhancing top-down control over worry" (Hirsch & Mathews, 2012, p. 643). Thus they recommend using a combination of training techniques targeting both top-down and bottom-up resources.

It is important to note, however, that although tasks that aim to train attention biases are considered to work on automatic processes, it is possible they are modifying the ability of individuals to control their attention. Support for the role of attention control in attention bias

modification has come from Eldar and Bar-Haim (2010) and Koster, Baert, Bockstaele, and De Raedt (2010) who found, using event related potentials, that dot-probe attention bias modification training Impacts attention at later stages of processing, and not early orienting, although the findings are still too preliminary to draw final conclusions. Further evidence comes from functional magnetic resonance imagery (fMRI) studies of attention bias modification demonstrating that the activity of the prefrontal lobe, which reflects volitional attention, mediates the cognitive modification of attentional bias (Browning, Holmes, Murphy, Goodwin, & Harmer, 2010). At this point, the distinction between what aspect of attention is being trained by specific tasks is not completely clear, and it is possible that some of these tasks alter aspects of attention that they were not designed to (e.g., dot-probe tasks also training attention control, attention control training tasks altering attentional biases). Thus Hirsch and Mathews' assertion that Wells' ATT would not be effective in correcting attentional biases requires further testing.

Comparing the Models

Both models attempt to explain worry through a framework of attention impairment. The most prominent way that the models differ is in regard to their emphasis on the role of *attentional control*. Wells places the most importance on impaired attention control and rigid self-focused attention, whereas Hirsch and Mathews suggest emotional processing biases are largely responsible for worry. Wells believes that training attention control interrupts the CAS, which should decrease both attentional bias to threat ("threat monitoring") as well as worry, and in turn allow individuals to challenge their maladaptive beliefs. Hirsch and Mathews on the other hand theorize that training attention control would likely not alter attentional biases and thus would not sufficiently decrease worry. Specifically, they argue that without training threat bias, the individual would still experience frequent negative intrusions (i.e., worry), and because

attentional control resources are corrupted by worry, they would remain focused on that threat content. Thus they suggest that a combination of bottom-up training (to reduce negative intrusions) and top-down training (to limit worry episodes) may be the most effective treatment. It is also interesting that Hirsch and Mathews do not explicitly mention self-focused attention as an important feature. At this point, Wells' ATT and the evidence for its efficacy will be discussed.

Attention Training Technique

The ATT consists of three components that are practiced in a single exercise lasting roughly 12 minutes. In the first component, termed *selective attention*, individuals are instructed to focus their attention on a specific sound while ignoring competing sounds at different spatial locations in the environment. In the *rapid attention switching* section, individuals are instructed to shift their attention between individual sounds, starting at every 10 seconds and increasing to every 5 seconds. Finally, in the *divided attention* section, individuals are instructed to expand their attention to try to attend to multiple sounds at different locations simultaneously. The task becomes more challenging over time (dividing attention is much more difficult than selectively attending to one sound), which ensures the session remains resource demanding. Multiple task parameters can be modified: the sounds themselves, the number of sounds, and the spatial locations, which provides great flexibility in administration as well as in offsetting practice effects. This technique differs from attention bias modification tasks in that it is not repetitively training one to attend to certain kinds of stimuli over others (e.g., neutral or positive over negative). It instead trains individuals to direct their attention in a flexible and adaptive way, the effects of which may better generalize outside of the training sessions. The patient practices the sessions with a therapist as well as at home, making the intervention portable and cost-effective.

According to Wells, attention becomes inflexible because it is consumed with self-focused worry-based processing and threat-monitoring that is perseverative and appears uncontrollable to the individual. The aim of the technique is to *interrupt the CAS* by changing the direction of attention, which would allow individuals to break the perseverative cycle of worry so that they can challenge negative beliefs, and free up cognitive resources for other tasks (Wells, 2009). It is interesting that ATT is not intended to be practiced during periods of anxiety or worry, as Wells (2009) emphasized it is not supposed to be used as a distraction technique. Any worry that arises during the session is not intended to be "blocked out," rather it is treated as *noise* that the individual is aware of just like any other sound, no more or less important. He suggests that training during periods of anxiety may teach the individual to use distraction as a cognitive or emotional avoidance strategy, which can interfere with emotional processing and help to maintain erroneous negative beliefs about the dangers and consequences of certain thoughts. In addition, the individual may come to believe that it was the act of distraction that prevented catastrophe and then come to engage in more attentional avoidance, which is not the aim of the treatment (Wells, 2009). It is unclear how individuals transfer the skills gained from ATT to the periods of worry they experience in their everyday lives. It may occur from strengthening their general attentional control resources.

Evidence for the ATT. Although ATT has been recommended for use with individuals with GAD, the efficacy of this intervention has not been studied in this population, nor in individuals high in the tendency to worry across a variety of domains (whose symptoms may or may not meet diagnostic criteria for GAD). A recent systematic review (Knowles, Foden, El-Deredy, & Wells, 2016) summarizing the average effect of ATT suggests that one to eleven sessions of the intervention leads to symptom reduction in a variety of populations, including

unipolar depression (Papageorgiou & Wells, 2000), anxiety disorders such as panic disorder (Wells, 1990), DSM-IV hypochondriasis (Papageorgiou & Wells, 1998), and social anxiety disorder (Donald, Abbott, & Smith, 2014), as well as schizophrenia (Valmaggia, Bouman, & Schurrman, 2007). Early studies employed single case designs with a dose of between 6 to 11 sessions of treatment (Papageorgiou & Wells, 1998, 2000; Wells, 1990; Wells, White, & Carter, 1997). In these studies, comparing baseline to immediate posttreatment and follow up (6 to 12 months), ATT led to reductions in the frequency of panic attacks, urge to seek reassurance, bodily focused attention, illness-related beliefs, and rumination. Effect sizes were large, and ranged from 0.74-1.00. In addition, the effect sizes suggest that more sessions are not necessarily better, with little difference in efficacy between 6 to 11 practices (although in all the studies, participants listened to the ATT recording a minimum of 6 times). A case study of three patients with DSM-IV hypochondriasis showed reductions in health worry measured by a visual analogue scale. The measure of worry in the hypochondriasis case study *specifically* pertained to the individuals' *health,* which is different from the worry about a variety of topics typical of individuals with GAD. In addition, these case studies have shown decreases in maladaptive metacognitive beliefs, and improvements in anxiety and depression, as measured by the Beck Anxiety Inventory and the Beck Depression Inventory.

Randomized controlled trials that have mostly compared one or two 12-minute sessions of ATT to an active control (e.g., doing a task that uses attention resources) or to another treatment of the same duration (e.g., mindfulness-based progressive muscle relaxation) reveal moderate to large improvements in intrusive thoughts, rumination, and negative affect for those receiving ATT. In addition, ATT has yielded reductions in anxiety, measured by the State Trait Anxiety Inventory (Fergus, Wheless, & Wright, 2014). RCTs have also demonstrated decreases

in bodily focused and self-focused attention (the former is a component of the latter), and improvement in attentional flexibility and control. It is important to note that the vast majority of studies conducted examining the effects of ATT have been done by researchers affiliated with Adrian Wells or his metacognitive model of therapy. It is imperative that unaffiliated researchers continue to examine ATT.

In studies of the efficacy of ATT, self-focused attention is usually measured by a rating scale, called the Self-Attention Rating Scale (SARS) that is administered immediately following the session as part of the ATT protocol. The scale runs from -3 (entirely externally focused) to +3 (entirely self-focused) and a reduction of at least 2 points is seen directly after each session in most patients (Wells, 2010). Multiple case studies and an RCT have shown a change from internal to more external attention following each session of ATT using the scale (Papageorgiou & Wells, 1998; Sharpe, Perry, Rogers, Dear, Nicholas, & Refshauge, 2010; Wells, 1990). A single case experiment of 6 sessions of ATT in depressed patients (Papageorgiou & Wells, 2000) found that ATT led to less self-focused attention, measured by the "cognitive self-consciousness" subscale of the Meta-Cognitions Questionnaire (MCQ; Cartwright-Hatton & Wells, 1997), which includes statements such as "I pay close attention to the way my mind works."

A few studies have examined changes in attentional control or flexibility (the two terms are often used interchangeably but both refer to the ability to shift attention as opposed to being rigidly locked into focus). Nassif and Wells (2014) conducted an RCT in individuals experiencing intrusive thoughts, with two sessions of ATT at the lab, as well as one to three at home practice sessions. They measured attentional control using the attention flexibility subscale (**α**=.69) of the Detached Mindfulness Questionnaire (Nassif & Wells, 2007), which includes

questions such as “I can concentrate on my work even if I’m worried about something.” The authors found that attentional control improved following ATT compared to a distraction control task (ηp^2=.12). Another 2-session RCT, with at least two at home practice sessions, examined the ATT’s impact on traumatic stress symptoms (Callinan, Johnson, & Wells, 2015). The authors included a measure of attentional control called the Attentional Control Capacity for Emotional Representation Task (Johnson, 2009), which is a behavioural measure of ability to switch attention from the emotional expression of a face to a neutral shape embedded on the face. Improvements in attentional control were demonstrated following ATT compared to a filler task. A case study examining the effect of 9 sessions of ATT in schizophrenia (Levaux, Laroi, Offerlin-Meyer, Danion, & Van der Linden, 2012) found changes in what they refer to as both self-focused attention and attention control, assessed by an ecologically valid probe task that assesses mind wandering while reading (Kane, Brown, McVay, Silvia, Myin-Germeys, & Kwapil, 2007) and a cognitive digit ordination task (Rey, Marchand, Rappax, Richelle, & Schaechtlin, 1957), which is not cognitively demanding enough to consume all attentional resources, and thus leaves room for mind wandering. A case study of schizophrenia found that following 8 sessions of ATT, at 2 and 6-month follow up, the patient was better able to control his auditory intrusions (voices) and was no longer bothered by them (Valmaggia et al., 2007), suggesting improvement in attention control.

Studies examining the effects of ATT in depression have demonstrated reductions in rumination (Papageorgiou & Wells, 2000; Siegle, Ghinassi, & Thase, 2007; Siegle, Price, Jones, Ghinassi, Painter, & Thase, 2014), a type of perseverative mental activity that is similar to worry, which suggests this intervention might be promising for worry. Two studies found a reduction in intrusive thoughts compared to an active control group following 2 sessions of ATT with one to

three at home practice sessions (Callinan et al., 2015; Nassif & Wells, 2014). One study examining the impact of ATT on intrusive thoughts in participants with OCD found no decrease in the frequency of intrusive thoughts (Watson & Purdon, 2008). This may be due to the nature of the intrusive thoughts; intrusions in OCD tend to be experienced as less volitional and are briefer and often image based, whereas worry is experienced as more volitional and is more perseverative (e.g., long chains; Turner, Beidel, & Stanley, 1992; Wells & Morrison, 1994). It is also equally possible that this finding is in line with Hirsch and Mathews' (2012) hypothesis that attention control training is not capable of reducing the frequency of intrusions, only their duration.

More recently, an RCT examining the impact of the ATT in high trait anxious individuals, as measured by the State Trait Anxiety Inventory, showed that both the ATT and a mindfulness-based progressive muscle relaxation condition, compared to a thought wandering control condition, led to significant, medium-to-large reductions in cognitive anxiety, present-focused attention, and metacognitive beliefs (McEvoy, Graville, Hayes, Kane, & Foster, 2017). They also demonstrated a decrease in uncorrected errors made on a Stroop task that used threat words, which is thought to measure cognitive flexibility, or attention control. Importantly, the ATT was administered at only one time point and the outcome measures were administered immediately after listening to the recording. Therefore, further research is needed to examine the short-term impact in addition to immediate changes.

Most recently, Haukaas and colleagues (2018) compared 2 weeks of practice of the ATT to a mindfulness recording, in students who reported symptoms of anxiety and depression. Participants in both conditions showed significant reductions in anxiety and depression as well as increased mindfulness, self-compassion, and attention flexibility at postintervention and 6-month

follow up. Effect sizes were medium. It is important to note that in this study, although the recording was studied for a longer duration than in other RCTs, the ATT was integrated into a group format. Specifically, participants engaged in three group sessions, which included agenda-setting, practicing the technique, discussing the technique, unravelling any misunderstandings, and assigning the homework. Given that the group format included contact with a therapist and with other individuals, the authors acknowledged that nonspecific factors associated with treatment may be responsible for improvement in symptoms.

To summarize, it is promising that even just a few sessions of ATT have been associated with changes in self-focused attention, attentional control, perseverative thinking, and anxiety. Given the portability, brevity and feasibility of ATT, and given the theoretical basis for its use in the management of pathological worry, ATT should be tested in individuals who struggle with chronic worry.

Present Study: Research Questions and Hypotheses

Given the long history of the metacognitive theory of chronic worry and GAD, it is surprising there is such a lack of research on ATT in individuals who have GAD or who suffer from pathological worry, even though it has been recommended for use in these populations. The most relevant studies to date demonstrate improvements in anxiety or other cognitive processes that are similar to worry (such as rumination), yet the standalone use of this recording has not been examined in this population in both the immediate and short term.

Training the control of attention is meant to interrupt the maladaptive CAS; therefore, CAS behaviours such as worry should decrease (Wells, 2009, p. 57). The study measured the effect of ATT on worry, assessed using The Penn State Worry Questionnaire-Past Week (PSWQ-PW; Stöber & Bitttencourt, 1998) as well as by a daily diary, to see if ATT has

immediate and short-term implications for worry. Hirsch and Mathews (2012) have suggested training that targets only attention control will not reduce the *frequency* of intrusions, as the automatic bias will still exist, and will instead reduce only the *duration* of the intrusions, meaning worry levels may not substantially change. A worry diary was used to capture how frequently individuals worried as well as how much time they spent worrying during the day (duration), to help tease this apart.

There is evidence that both self-focused attention and attention control play important roles in the maintenance of worry, and modifying these processes may be a promising form of treatment. The present study aimed to measure whether the ATT improves *objective* attentional control in individuals who suffer from pathological worry, both in the *context of intrusive worry*, using a breathing-focused task (BFT) that measures intrusions following a period of worry, and generally using the ANT. The study also examined whether ATT is able to change self-focused attention using the "cognitive self-consciousness" subscale on the Metacognitions Questionnaire. Daily changes in self-focused attention were also measured by a daily diary to see if practicing ATT reduces the degree of internalized attention during the day.

It was also of interest whether there was a *subjective* experience of increased attentional control, both generally and with respect to worry specifically. Subjective impressions of better attentional control, while not a measure of true changes of control, give important information about whether people believe they can stop their worrying. One of the fundamental features of GAD is that individuals believe their worry is uncontrollable. Repeated experience interrupting the CAS should lead to the modification of beliefs about the controllability of worry. The study examined whether ATT leads to an improvement in subjective general attention control levels as measured by the Attention Control Scale, as well as a change in beliefs about the

uncontrollability and danger of worry, as measured by the "negative beliefs about the uncontrollability of thoughts and danger" subscale of the MCQ.

Although Hirsch and Mathews (2010) believe that training attention control should not impact attentional bias, Wells conceptualizes "threat monitoring," or attentional bias to threat, as a CAS activity similar to worry, and thus interrupting the CAS with ATT should in theory also modify attentional bias to threat. To test this possibility, a dot-probe measure of attention bias to threat was also included.

Lastly, it is of interest to examine whether mindfulness changes as a result of the ATT. Although mindfulness and the ATT differ theoretically in respect to the desired *direction* of attention (in mindfulness, the focus is often on the self, whereas in the ATT, attention is intended to shift externally away from the self; see Haukaas et al for review), both encourage flexible attention. Given that these two theoretical models propose opposite focuses of attention as mechanisms of change (Baer, 2009; Wells, 1995), yet both have been shown to reduce symptoms of psychopathology, it may be that the direction of attention is less important than attentional flexibility. In both practices, the individual is encouraged to treat thoughts as passing, and not to pay special attention towards them; therefore, it is possible that mindfulness would also increase as a result of the ATT.

The present study employed a between and within subjects design, comparing pre and postintervention scores between the ATT and an active control group. Participants came to the lab for three visits, each separated by a week. On the first visit, they completed baseline outcome measures, and then answered questions about their worry and attention every evening for the following week. On the second visit, they recompleted the baseline measures, and were then randomly assigned to engage in a week of listening to either the ATT recording or the active

control recording, while again answering daily questions about their worry and attention during the week. Lastly, they came back to the lab for a third visit to recomplete all outcome measures. Due to the introduction of daily worry and attention questions during the first week as a baseline measure, to control for the possibility that having participants reflect on their worry may have an unintended therapeutic benefit, participants completed the outcome measures twice, a week apart, before starting the ATT or control training. Following the intervention, participants were reassessed to capture change during the intervention period. Therefore, in this design, participants acted as their own control condition pre to postintervention, such that change within subjects from time 2 to 3 (worry monitoring+ intervention) was compared to change from time 1 to 2 (worry monitoring alone).

It was hypothesized that from baseline to postintervention, roughly seven daily sessions of ATT, compared to an active control, would: (1) result in a significant decrease in self-reported worrying by the end of the intervention period, as measured by the past-week version of the Penn State Worry Questionnaire and the worry diary, (2) lead to an improvement in attention control as indexed by performance on the Breathing Focus Task and the Attention Network Task, (3) lead to less pronounced cognitive self-consciousness (self-focused attention) on the Metacognitions Questionnaire, (4) increase subjective *general* attentional control as measured by the Attentional Control Scale, (5) decrease the belief about worry being uncontrollable and dangerous, measured by the Metacognitions Questionnaire, (6) result in a significant decrease in attentional bias to threat-related words on the dot-probe task, and 7) result in an increase in mindfulness, as measured by the Southampton Mindfulness Questionnaire.

Method

Power Analysis

An a priori power analysis was conducted using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) to estimate the sample size needed to demonstrate a statistically significant interaction between condition (ATT vs. control) and time (pre and postintervention). Previous RCTs examining the effect of ATT on a variety of outcome measures have found medium to large effects sizes (Knowles et al., 2016). Therefore, to find a medium effect for this interaction (*f*=.25, as seen in SPSS), with a power of .80, G*Power suggested that a sample size of 62 participants, or 31 participants per group, would be needed. With a more stringent power of .90, G*Power suggested a sample size of 78 participants, or 39 per group would be needed. Previous RCTs of the ATT in various populations have found medium to large effects with 42 to 103 participants (Knowles et al., 2016), or 21 to 52 participants per group. A study by Watkins and colleagues (2009), that had patients engage in an at home intervention for depression for a week, found large effect sizes for changes in rumination, a similar construct to worry, with a sample of 20 participants per group. Taken together, this information suggested that aiming for a total sample of 62 to 78 participants was justified.

Participants

Participants were recruited with flyers around the Toronto area and with online advertisements. One hundred and three participants initiated the phone screen. Thirty-seven participants were eligible. Two eligible participants did not enroll in the study. Thirty-five participants were enrolled to take part in the study and came to the first lab visit. Four individuals dropped out (two before commencement of the intervention period and two following commencement). A total of 30 participants completed the study. One participant was removed

from analysis due to misinterpreting the recording (i.e., hearing sounds that were not on the recording). The final sample for analysis included 29 participants (14 in the ATT condition and 15 in the control condition).

Potential participants were screened over the phone with the PSWQ (Meyer et al., 1990) as well as a GAD phone screen that our lab has employed in previous studies. The *Phone Screen* consists of the GAD module from the MINI International Neuropsychiatric Interview 7.0 (MINI; Sheehan, 2015), as well as more detailed questions employed in previous phone screens in our lab for assessing GAD (see screening measure, page 37). Questions from the MINI Screen were also asked at this time to assess for comorbidity, modified to reflect 5th edition of the DSM (DSM-5) criteria, and the Psychotic Disorders module of the MINI was also completed. In addition, potential participants were asked if they were currently engaging in any treatment for psychiatric concerns (psychotherapy or pharmacotherapy), and were assessed for current suicidality. Participants met criteria for eligibility if they 1) were between the ages of 18 to 65, 2) endorsed symptoms consistent with DSM-5 GAD (that is, excessive and uncontrollable worry in a number of domains, 3/6 associated symptoms, distress or impairment), 3) had a PSWQ score of 65 or higher and 4) had probable GAD as a primary concern over other concurrent symptoms. This was determined by asking participants which of their symptoms caused them the most distress and impairment in their life at the moment (e.g., "would you say that your worry and anxiety, or your low mood is causing you more distress right now?).

Some studies have found decreased performance on behavioural attention tasks such as the ANT above the age of 70 (Mahoney, Verghese, Goldin, Lipton, & Holtzer, 2008); however, these findings are controversial, given that other studies examining the use of the ANT in individuals aged 65-76 have found no difference in executive functioning compared to younger

adults (Ishigami & Klein, 2011). Age related differences in attention to emotionally valenced stimuli appear to be minimal (Murphy & Isaacowitz, 2008), although older adults do tend to prioritize accuracy over speed (Ishigami & Klein, 2011). To be conservative, a cut-off age of 65 was employed.

Participants were *ineligible* if they had a history of psychosis or mania, endorsed symptoms consistent with a diagnosis of alcohol or substance use disorder over the past 12 months, or reported clinically significant suicidal ideation, intent or plan. They were also ineligible if they were receiving psychotherapy or counselling for psychiatric problems, *unless* it was infrequent (i.e., less than once per month), or they had been in treatment for over 12 weeks and still met all other eligibility criteria. Based on past and ongoing recruitment in our lab, many interested potential participants were receiving some form of psychotherapy or counselling at the time of the screen; therefore, these inclusion criteria were justifiable to avoid excluding too many potential participants while still ensuring the individual's symptoms were stable and outside treatment would not likely interfere with the study.

Individuals were also ineligible if they were taking psychotropic medication and had changed the dose or type of medication in the past 12 weeks. If they had recently discontinued any psychotropic medication they were excluded, but were welcome to recomplete the eligibility screen after at least 1 month after the date of discontinuation, or 3 months for fluoxetine, due to its longer half-life (Gourion, Perrin, & Quintin, 2004). A meta-analysis of the effects of long term benzodiazepine use (one to 34 years of an average of 17.2 mg/day) on a variety of cognitive measures, including measures of attention, demonstrated that benzodiazepine use was correlated with significant impairment. Effect sizes were medium to large (d=-1.3 to -0.42; Barker, Greenwood, Jackson, & Crowe, 2004a). Short-term usage of benzodiazepines have also been

shown to influence responses on dot-probe tasks with emotional stimuli. For example, a one-time administration of benzodiazepine was associated with attentional direction away from fearful faces at short stimulus presentations (Pringle, Warren, Gottwald, Cowen, & Harmer, 2016), and a 7-week administration period was associated with increased vigilance towards happy faces compared to controls (Murphy, Downham, Cowen, & Harmer, 2008). Given these data, daily benzodiazepine use was an exclusion criterion. In addition, withdrawal from daily usage is also associated with reduced cognitive functioning for up to a year after cessation; therefore, participants were excluded unless they had refrained from daily usage for over a year (Barker, Greenwood, Jackson, & Crowe, 2004b; Tonne et al., 1995). Given the dearth of evidence on as-needed benzodiazepine usage on cognitive functioning, if the medication was taken only as-needed, participants were eligible but were asked to refrain from taking a benzodiazepine on the day of their lab visits. Since the distinction between daily usage and as-needed usage may be fuzzy in some cases, psychotropic medication usage was asked about and noted at each visit. At each visit, participants were asked about any benzodiazepine usage in between lab visits, as well as information on their alcohol, marijuana, nicotine, and caffeine usage, as well as how much sleep they got the night before (see Appendix A). These data were recorded to account for the possible influences of psychoactive substances and fatigue on performance.

Recruitment was more difficult than predicted, with only 35% of interested potential participants being eligible to take part. Reasons for ineligibility are as follows, from most to least common: concurrent symptoms of greater severity than probable GAD, PSWQ score too low, type of worry not consistent with GAD/not deemed excessive enough, conflicting therapy or medication use, and moderate suicide risk.

Demographics. The final sample was composed of 23 females (79.3%) and 6 males

(20.7%), with ages ranging from 18 to 65 years (*M* = 29.6 years; *SD* = 13.6 years). The sample consisted of those identifying as Caucasian (41.4%), East Asian (13.8%), mixed (10.3%), South Asian (10.3%), Other (option not listed) (6.9%), Latin American (6.9%), Black (3.4%), Southeast Asian (3.4%), or Arab/West Asian (3.4%). Most participants were enrolled in an educational program while taking part in the study (69%). Of those not currently enrolled, 44.4% had completed an undergraduate degree, 33.3% had completed a master's degree, 11.1% had completed high school, and 11.1% had completed some high school. Many participants were working (34.5%, part-time, and 17.2% full time), with 48.3% not currently working. The two conditions did not significantly differ on demographic variables. See Appendix B for sample demographics by condition.

Clinical characteristics. Participants in the final sample had a mean PSWQ score of 70.70 (*SD*=4.23, range= 65-79) at the time of the screen. On the Generalized Anxiety Disorder Questionnaire for the DSM-IV (GAD-Q-IV), a screening measure for GAD, 83% of participants exceeded a stringent cutoff of 7.67, and 93% exceeded the less stringent cutoff of 5.7. The mean GAD-Q-IV score was 10.18 (*SD*=2.25, range=4.66-12.75). This mean was comparable to prior studies that have used the 5.7 cutoff to suggest probable GAD (e.g., 9.32, in Salters-Pedneault, Roemer, Tull, Rucker & Mennin, 2006), as well as those diagnosed by a clinician with GAD (e.g., 10.32 in Luterek, Turk, Heimberg, Fresco, & Mennin, 2002). Therefore, the present sample was representative of those high in GAD symptoms. The mean CESD-R score was 26.38 out of a possible 60 (*SD*=12.96, range=0-44*)*. Based off scores on this measure, 13.7% of the sample endorsed having no clinically significant depression, while 86.2% endorsed having at least subclinical levels of depression. See Appendix C for clinical characteristics.

Psychotherapy and pharmacotherapy. Two participants in the sample were engaged in

therapy for high anxiety. Both were attending biweekly and had been in treatment for at minimum 4 months at the time of commencing the study. Four participants were currently taking medication at the time of starting the study. Two participants were taking an SSRI (buproprion, 300mg; escitalopram, 20 mg) one was taking a tricyclic antidepressant (amytriptyline, 30mg) and one was taking a benzodiazepine (lorazepam, 1 mg) as needed. All participants on antidepressant medication had been on the medication for at least a month without a change to dose. The individual taking the benzodiazepine agreed to try to refrain from taking one the day of the lab visits.

Psychoactive Substance and Sleep Questionnaire. The Psychoactive Substance and Sleep Questionnaire indicated that no participants consumed alcohol or marijuana before any of the lab visits. One participant had taken three benzodiazepines (lorazepam, 1mg) in the 2 weeks leading up to starting the study but not during the duration of the study. On average participants slept between 6.2 and 6.8 hours per night before lab visits, with the minimum amount of sleep at all three visits being 4 hours.

Measures

Screening measures.

Telephone screen. The phone screen for probable GAD included questions from the MINI 7.0 in addition to other targeted questions used in previous phone screens in our lab, to assess for 1) worry about a variety of topics that is future oriented, excessive, and difficult to control, and 2) amount of time spent worrying, associated symptoms, distress, impairment, intolerance of uncertainty, and suicide risk. The MINI screen was also used to assess for the presence of other DSM-5 disorders, and the Psychotic Disorders module of the MINI assessed for potential psychosis.

Penn State Worry Questionnaire. The PSWQ (Meyer et al., 1990) is a 16-item self-report measure of pathological worry. The PSWQ has good reliability and validity in both clinical and nonclinical samples (Brown, Antony, & Barlow, 1992; Davey, 1993; Meyer et al., 1990) and has high internal consistency (α = .86 to .95; Dear, et al., 2011; Molina & Borkovec, 1994). A cut off score of 65 is often used due to its ability to sensitively and specifically distinguish individuals with probable GAD from those without pathological worry as well as from those with social anxiety disorder (Fresco, Mennin, Heimberg, & Turk, 2003).

Symptom measures.

Generalized Anxiety Disorder Question-IV. The GAD-Q-IV (Newman et al., 2002) is a self-report measure of DSM-IV diagnostic criteria for GAD. It consists of nine items, with a total score ranging from 0 to 13. A cut score of 7.6 represents 85% sensitivity and 74% specificity in differentiating between people with and without GAD (Moore, Anderson, Barnes, Haigh, & Fresco, 2014). The GAD-Q-IV has high convergent validity with other measures of GAD symptoms, good discriminant validity with measures of depression (Robinson, Klenck, & Norton, 2010), and good test-retest reliability (Newman et al., 2002). The GAD-Q-IV was administered at visit 1 to validate the sample. Given that the core diagnostic criteria of GAD did not change from DSM-IV to DSM-5, this tool is suitable to assess for symptoms of potential DSM-5 GAD.

Center for Epidemiologic Studies Depression Scale—Revised. The CESD-R (Eaton, Muntaner, Smith, Tien, & Ybarra, 2004) is 20-item version of the *Center for Epidemiologic Studies Depression Scale* (Radloff, 1977) revised to reflect DSM-IV depression criteria. Given that the core diagnostic criteria of MDD did not change from DSM-IV to DSM-5, this tool is still suitable for use. Respondents rate the degree to which they experienced depressive symptoms

over the past week. Preliminary investigation suggests good psychometric properties (Eaton et al., 2004). Although the scale is not a diagnostic interview, it assesses for the presence of depressive symptoms; therefore, given the high comorbidity of GAD and MDD, the CESD-R was administered at visit 1 to provide information on the degree of depressive symptoms in the sample.

Primary outcome measures.

Penn State Worry Questionnaire-Past Week. The PSWQ-PW (Stöber & Bittencourt, 1998) is an adapted version of the Penn State Worry Questionnaire (Meyer et al., 1990) that assesses weekly changes in worry. The PSWQ-PW has high reliability and validity and good convergent validity with other measures of weekly worry (Stöber & Bittencourt, 1998), and is sensitive to treatment related changes in worry (Stöber & Bittencourt, 1998; Woelk & Schläfke, 2010). In the current study, Cronbach's alpha ranged from .77 to .93 across the three visits.

Breathing Focus Task. The breathing focus task (Hircsh, Hayes, & Mathews, 2009) is a modified version of a task that was originally developed by Borkovec and colleagues (1983), and later refined by Ruscio and Borkovec (2004). In this task, participants engage in a 5-minute preworry breathing focus task, followed by a 5-minute worry period, followed again by a 5-minute breathing focus task.

First breathing period. Participants are told to focus their attention on their breathing. A computer generated tone beeps at 20 to 30 second intervals (12 tones total across both breathing focus periods). At each beep, participants are instructed to indicate if they were focusing on their breathing or if they were engaged in a thought intrusion right before the beep. If they report a thought intrusion, they are asked whether the thought was positive, negative or neutral, and to provide a one or two-word description of what they were thinking about (e.g., "positive-dinner

tonight"). At the end of the 5 minutes, the experimenter asks the participant to elaborate on each thought intrusion reported during the breathing period. These longer descriptions are audio recorded for potential later coding.

The participant is then asked to: "estimate the percentage to which you were able to focus on your breathing (0%, not at all-100%, all of the time)," "rate how difficult you found focusing on your breathing (0, not at all difficult-100, extremely difficult)," and "estimate the percentage of time you worried during the last 5 minutes (0%, none of the time-100%, all of the time)."

Worry period. Following the first breathing focus period, the experimenter helps the participant choose a worry topic that is related to a potentially negative future event. Participants are then asked to worry silently about the topic for 5 minutes.

Second breathing period. Following the worry period, the second breathing focus period is completed, which is identical to the first, including the thought expansions and questions. Participants are also asked at this time to answer questions about the worry period, as in Hirsch et al. (2009) and Stokes and Hirsch (2009). Specifically, they are asked to: "estimate the percentage of time that you were able to spend worrying (0%, not at all-100%, all of the time)," "rate how difficult you found it to worry for 5 minutes (0%, not difficult at all-100%, extremely difficult)," and to "rate how stressed you were whilst worrying (0%, not stressed at all-100%, extremely stressed)." Questions about worry are asked retrospectively to not interrupt the impact of the worry period on the subsequent breathing focus period.

Secondary outcome measures.

Attentional Control Scale. The ACS (Derryberry & Reed, 2002) is a 20-item measure of self-reported attention control. The ACS assesses three related factors: ability to focus attention, ability to shift attention between tasks, and ability to flexibly control thought (Derryberry &

Reed, 2002). The ACS has good internal reliability (α = .88; Derryberry & Reed, 2002). Scores on the ACS correlate with the multiple behavioural measures of attentional control such as the random interval generation Task (*r* = .34; Tallon, 2014), antisaccade tasks (*r*=.32, Judah, et al., 2014), and the executive control component of the ANT (r=.16; Judah, et al., 2014; Reinholdt-Dunne et al., 2013). In the current study the Cronbach's alpha ranged from .82 to .89 for the total score, .82 to .85 for the focusing subscale, and .77 to .85 for the shifting subscale, across the three visits.

Metacognitions Questionnaire-30. The MCQ-30 (Wells & Cartwright-Hatton, 2004) is a self-report questionnaire with 30 items that assess metacognitive beliefs. The MCQ-30 has five subscales: cognitive confidence, positive beliefs about worry, cognitive self-consciousness, negative beliefs about the uncontrollability and dangerousness of thoughts, and beliefs about need to control thoughts. The MCQ-30 has good test-retest reliability, convergent validity, and internal consistency (Wells & Cartwright-Hatton, 2004). The "negative beliefs about the uncontrollability and dangerousness of thoughts" subscale of the MCQ-30 was used to assess changes in beliefs about worry, and the "cognitive self-consciousness" subscale was used to examine change in self-focused attention from baseline to postintervention. At the start of the questionnaire, participants were asked to reflect on the *past week* to maintain consistency with the PSWQ-PW, and to better capture change during the intervention period specifically. In the current study the Cronbach's alpha ranged from .71 to .81 for the cognitive self-consciousness subscale, and .81 to .87 for the negative beliefs about worry subscale, across the three visits.

Southampton Mindfulness Questionnaire. The Southampton Mindfulness Questionnaire (SMQ; Chadwick et al., 2008) is a 16-item self-report measure assessing mindful reactions to upsetting thoughts or images. The SMQ has good internal consistency, convergent validity with

other mindfulness measures, and can distinguish between people who meditate and those who do not (Chadwick et al., 2008). In the current study the Cronbach's alpha ranged from .87 to .88, across the three visits.

Attention Network Task. The ANT (Fan et al., 2002*)* is a test of three attention networks: alerting, orienting and executive control. At the centre of the screen a fixation cross appears for 400-1600 ms, followed by the presentation of an asterisk for 100 ms, serving as a cue. After the disappearance of the cue, a target arrow appears. Participants indicate the direction of the arrow by pressing the "f" key to indicate a left facing arrow and the "j" key to indicate a right facing arrow. The target is presented until response or until time out at 1700 ms.

There are four possible cue conditions. 1. No cue: on some trials, no cue appears. 2. Centre Cue: presentation of the cue at centre (in the location of the fixation cross). 3. Double cue: two cues presented simultaneously, one above and one below fixation. 4. Spatial Cue: the cue appears *either* above or below the central fixation. The no cue, centre cue and double cue conditions do not give a spatial indication of where the target will appear and thus only engage the alerting network. The spatial cue condition provides spatial information as to where the target arrow will appear and thus engages both the alerting and orienting network. On some trials the target is flanked on either side by two arrows each, or by dashed lines on either side. The participant is instructed to respond only to the central target. The flanker arrows are congruent on 1/3 of the trials (facing the same direction as the central target arrow), incongruent on 1/3 of the trials (facing the opposite direction as the central arrow) and neutral on a 1/3 of the trials (dashed lines). The executive control network is activated by tasks involving conflict (Bush, Lu, & Posner, 2000), thus the difference in RTs to respond to incongruent flanker trials compared to other trial types represents attention control. A larger number on the ANT suggests lower

attentional control, whereas a smaller number suggests greater attention control (see Data Screening and Preparation section for more detail on how these numbers are calculated).

Participants completed the task on a laptop computer running E-Prime stimulus presentation software (Psychology Software Tools, Inc., Pittsburgh, PA). Participants were instructed to respond as quickly and accurately as possible. A practice block was administered lasting roughly 2 minutes, and feedback was given regarding the accuracy of the response. Following the practice block, 3 experimental blocks were administered, each lasting roughly 5 minutes with the possibility of a short break between blocks. There were 96 trials per experimental block, with 288 total trials. Participants received no feedback during the experimental blocks. The test-retest reliability of the raw reaction times (RTs) is .87 (alerting=.52, orienting=.61, and executive control=.77). The executive control component of the ANT discriminates those with low and high working memory spans, measured by the Operation Span Task, which has individuals solve mental math problems while remembering unrelated words in their mind for later recall (Redick & Engle, 2006). The executive control component of the ANT has also been linked to activation of brain areas thought to be linked attention control, such as the anterior cingulate cortex as well as the lateral prefrontal cortex (Bush, Luu, & Posner, 2000; Fan, McCandliss, Fossella, Flombaum, Posner, & 2005).

Practice effects on the ANT were not expected to be a problem. Fan et al. (2002) found little effect of practice from one administration to the next, separated by a 10 minute Stroop task. Practice effects may be seen with multiple administrations of the ANT (Ishigami & Klein, 2010); however, given the tasks were separated by week intervals, it was deemed justifiable to readminister the task.

Dot-probe. A modified dot-probe task (Williams et al., 2014; originally MacLeod et al., 1986) was administered. Threat words were chosen based on prior piloting conducted by Tallis and colleagues (1992), where participants rated the negativity of words from six domains of worry common to GAD: relationships, lack of confidence, aimless future, work incompetence, financial, and social-political. Words from two other common domains of worry in GAD (physical and social) were piloted by Williams and colleagues (2014) and added to the group of original threat-related words. The most negatively rated words from the eight final categories were chosen. Nonthreat words were also piloted, and only neutrally rated words chosen. Words were paired so that two types of trials exist: threat/neutral pair (valenced) and neutral/neutral pair (nonvalenced). Forty valenced and 40 nonvalenced word pairs were developed, with both words in a pair being of equal length (William et al., 2014).

During the task, a fixation cross is presented in the middle of the screen for 1000 ms, followed by a word pair, with one word presented above the other (above and below the fixation cross). Word pairs are presented for 200 miliseconds, and then replaced with a probe (“.” or “..”) in one of the word locations. Participants are instructed to press the “c” key or the “m” key to indicate the “.” and “..” probe respectively, and are instructed to respond as quickly and accurately as possible. Each word in the valenced word pair is presented twice in the top location and twice in the bottom location. For each location, a probe appears following the threat word once and following the neutral word once. Therefore, there are four conditions: threat-top/probe-top, threat-top/probe-bottom, threat-bottom/probe top, threat bottom/probe bottom. For nonvalenced trials, the four conditions were as follows: word-top/probe-top, word-top/probe-bottom, word bottom/probe top, word bottom/probe-top. A larger positive number on the dot-probe indicates a greater bias to threat information while a negative number indicates the

participant was faster to respond to neutral information (see Data Screening and Preparation section for more detail on how these numbers are calculated).

Participants completed the task on a laptop computer running E-Prime (Psychology Software Tools, Inc., Pittsburgh, PA). They first completed five practice trials with household object words. They then completed the main task, which consists of 2 blocks, with 20 valenced word pairs and 20 nonvalenced word pairs appearing in random order across the four conditions. This gave rise to 160 trials per block (80 valenced and 80 nonvalenced word pairs) and 320 trials in total. An optional 2-minute break was given between the two blocks.

Dot-probe tasks are frequently administered multiple times (e.g., 12 times, twice weekly) to assess for changes in attentional bias during a particular intervention, and tend to be reliable over time (intraclass correlation=.88; see Price et al., 2015 for review). Thus administering the task three times, each a week apart, was deemed justifiable.

Worry diary. Participants in the ATT and active control conditions were asked to respond to daily questions about their worry and the focus of their attention between visit 1 and visit 2 (1-week preintervention period), and between visit 2 and visit 3 (1-week intervention period), for a total of 2 weeks. Having participants monitor their worry for a week before the intervention provided a stable comparison of preintervention worry, while monitoring during the intervention period allowed the assessment of change in worry during the intervention.

Participants were emailed the link to the questionnaire which could be completed on a smartphone or computer. Participants were encouraged to set an alarm on their phone to remind themselves to complete the diary and were emailed if they missed a day, to remind them to continue responding. Each day, participants answered questions about the frequency, duration, intensity, and uncontrollability of their worry that day, as well as how externally or internally

focused their attention was that day (see Appendix D). Worry diaries in previous studies have used different terminology to assess for these different aspects of worry (e.g., Dupuy, Beaudoin, Rhéeaume, & Ladouceur, & Dugas, 2001; Thielsch et al., 2015; Szabo & Lovibond, 2002; Versluis, Verkuil & Brosschot, 2016). The questions were based on previously used terminology (e.g., see Versluis et al., 2016) as well as a previous daily diaries employed in our lab's research.

Before answering the questions, participants were given a definition of worry, adapted from McGowan, Stevens, Behar, Judah, Mills, and Grant (2017; see Appendix D). Then participants were asked to "please indicate the number of worry episodes you had today" and "how long did you spend worrying today in minutes?" They were then asked to rate how intense their worry was that day on a 7-point Likert scale ranging from 0 (*not at all intense*) to 6 *(very intense*). Participants were also asked to rate their difficulty disengaging from episodes of worry that day on a 7-point Likert scale ranging from *not at all difficult* to *very difficult*. Finally, participants were asked to rate to what degree their attention was focused inwards on the self or outwards towards their external environment during the day, on a scale from 0 to 6, from *entirely externally focused* to *entirely internally focused.*

Manipulation measures.

Credibility and Expectancy Check. Participants completed a modified version of the Credibility Expectancy Questionnaire (CEQ; Devilly & Borkovec, 2000) immediately after completing the ATT and control condition recordings at the lab. The questionnaire examines the extent to which the participant thinks and believes ("feels") that the manipulation will be beneficial for their worry (See Appendix E), and was employed to help determine whether one condition appeared more credible than the other. The total scale standardized alpha of the CEQ

was between r =.84-.85, and the test-retest reliability after a week was r =.83 (Devilly & Brokovec, 2000).

Self-Attention Rating Scale. The Self-Attention Rating Scale (SARS) was developed by Wells (1990) to assess changes in self-focused attention. Participants were asked "at this moment in time how much is your attention focused on yourself or on your external environment? Please indicate by giving me a number on the scale." Participants responded by indicating a number from 0 to 6, from entirely externally focused to entirely self-focused, with 3 representing equal amounts. The SARS has no reportable psychometric information. The scale was administered immediately before and after each audio recording to see if participants experienced an immediate shift in attention. Wells suggests a lack of change in self-focused attention after a session indicates low level of effort or the use of counterproductive strategies, such as thought suppression or daydreaming, and suggests therapy should be readministered (Wells, 2009, p.61). However, for research purposes, the session was not readministered to maintain the standardization of the intervention across participants. Given that ATT has not been studied in a population of individuals who suffer from pathological worry, it is of interest to examine if there even is an immediate shift in attention in *this population* after listening to the recording.

Daydreaming question. At the end of each at home practice, participants were asked to estimate the percentage with which they focused on the recording (0%=not at all focused, 100%=completely focused).

Procedure

Following screening, participants were scheduled to come in for three lab visits, each separated by approximately a week. If participants were unable to return to the lab on the exact

same day a week apart, they were able to return up to 48 hours after their scheduled day (n = 1). See Appendix F for an outline of the procedure.

Visit 1: baseline. At the first visit, participants filled out the consent form, a demographic questionnaire, the GAD-Q-IV, MCQ-30, ACS, PSWQ-PW, SMQ, and the CESD-R. They also reported on their drug intake and sleep (see Appendix A). Following the questionnaire portion, they completed the dot-probe task, the ANT, and the breathing focus task. All questionnaires were completed on a laptop, using Qualtrics (2018), and the order of administration was counter-balanced. The order of the dot-probe and ANT tasks was also counterbalanced; however, the breathing focus task was administered last. This decision is due to the effect that engaging in a period of worry can have on performance on cognitive tasks (e.g., Hayes et al., 2008). Administering the breathing focus task last allowed us to avoid any unintended effects of worry on the ANT and dot-probe task.

Following this, participants were asked to respond to daily questions about their worry and attention for the following week on Qualtrics, using a link emailed to them. They were asked to start that evening. Participants were shown how to access the questions on Qualtrics before leaving the lab.

Visit 2: preintervention. Following the one-week baseline period, participants returned to the lab for Visit 2 and the MCQ-30, the ACS, the SMQ, and the PSWQ-PW were readministered. Participants were asked to again report on their drug intake and sleep. Following the questionnaires, the ANT, breathing focus task, and the dot-probe were readministered. The administration of all questionnaires was again counterbalanced, as well as the administration of the ANT and the dot-probe, with the breathing focus task administered last. Participants were then randomly assigned to one of the two conditions: attention training or control. All

participants filled out the SARS to measure their baseline focus of attention. They were then given the rationale (see Appendix G) which was the exact same for both conditions. The justification for keeping the rationale identical for both groups was to control for differential expectancy effects that could occur if one rationale is much stronger than the other. Given the control condition recording should not train attention, changes in attention control were not expected in this group. If changes in attention control were seen in the control condition as well as the ATT condition, it may indicate that the ATT recording is not specific at training control over attention, and other audio recordings may provide the same benefit.

Following presentation of the rationale, participants were left alone in the experiment room to listen to their assigned recording. In the ATT condition, the recording started with instructions telling them to treat worry as a "passing event in their mind and body" (see Appendix H). The control condition did not receive these instructions because the process of treating worry as unimportant, like any other thought or sound, is a *fundamental component* of ATT, and including these instructions in the control condition could inadvertently train attention and could have potentially added a therapeutic benefit. Instead, they received a very brief nondirective instruction at the start of the recording (see Appendix I). Following the instructions, the recording automatically played.

After listening to the recording, participants completed the SARS and the CEQ. Participants were asked to listen to the recording for their assigned condition once per day for the following week. Before leaving the lab, participants discussed with the researcher tools for remembering to listen to the recording (i.e., setting an alarm, planning ahead) as well as troubleshooting advice if there were any technical difficulties. Participants in both conditions

were instructed to complete the daily questions on their worry and attention for another week using Qualtrics.

Attention training technique. The ATT audio recording (Wells, 1990) included sounds and a voice guiding their attention to these sounds. These sounds (e.g., voice, birds chirping, church bell, insects, running water, traffic) played continuously during the recording. The participants were also guided to listen to sounds occurring outside the room. During the first 5 minutes, the recording guided participants to focus on one sound at a time while ignoring others. During the second 5 minutes, the recording guided participants to rapidly switch their focus from one sound to another, starting with every 10 seconds and increasing to every 5 seconds in the latter half. During the final 2 minutes the recording guided participants to expand their attention to absorb all the sounds they had heard. For a verbatim copy of the ATT script, see Appendix J.

Control condition. Participants listened to a similar recording as the ATT condition; however, in this condition, the voice did not guide the participants' attention to any particular sound and instead delivered neutral sentences (e.g., "there are a variety of sounds," or "the sounds continue to play"). The sounds were the same as the ATT recording with regards to the spatial location, continuity and discontinuity of the sounds, and use of high and low level stimuli. The same person's voice was used in the ATT and control recording to control for the effect of voice, and the speech was matched in word length and tone. In the control condition, the speech was nondirective (see Appendix K for the verbatim script). This condition controlled for the effect of listening to sounds, listening to a voice, and for attentional engagement. The recordings only differed regarding the guiding instructions to allow for determination of whether the therapeutic component of *training attention* had an effect on the outcome measures.

Homework. After finishing the recording and completing the self-attention rating, participants were emailed a link to open on Qualtrics, and were shown how to access the assigned recording at home. They were asked to listen to the recording once a day until the date of their next lab visit the following week. Although the original ATT protocol suggests participants listen to the recording twice a day, most RCTs have found medium to large effect sizes on outcome measures of self-focused attention, attention control, and intrusive thoughts after just one or two sessions of ATT in the lab, with no additional practice (Knowles et al., 2016). Most of the case studies and single case experimental designs have had participants engage in a total of six to eleven sessions of ATT (a session is defined as listening to one 12-minute recording; see Knowles et al., 2016, table 1), starting with one in-lab session followed by one to two times daily homework practice. Nassif and Wells (2014) have stated that the required dose of ATT is unknown. Given the participants in this study were also completing a worry diary each day, in an effort not to overburden participants and risk low adherence, they were asked to listen to the recording just once per day. With perfect adherence to the study protocol, this provided seven sessions of completed ATT.

When participants opened the recording on Qualtrics, they were given a brief rationale and instructions, again tailored to each condition (see Appendix L and M for computer instructions for the ATT and control conditions respectively). Participants were instructed not to be engaged in other activities (e.g., homework, cleaning) while listening to the recording. They were also instructed to not complete the recording during a period of high anxiety or distress (Wells, 2008, 2009). The homework began with the SARS to assess focus of attention before starting the session. The recording could not be fast-forwarded, meaning it had to be played for the entire length of time. At the end of the recording, participants were asked to fill out the

SARS, which was used as a manipulation check, as well as an indication of adherence (if participants exited out of the session, they were not able to answer the question). They were also asked to estimate the percentage to which they were able to focus on the recording.

Visit 3: postintervention. At the final visit, the MCQ-30, the ACS, and the PSWQ-PW was readministered. Participants were again asked to again report on their drug intake and sleep. Following the questionnaires, the ANT, breathing focus task, and the dot-probe were readministered. The administration of all questionnaires was again counterbalanced, as well as the administration of the ANT and dot-probe, with the breathing focus task being administered last. After completing the final breathing focus task, the participants were debriefed about the goals and hypotheses of the study. Those in the control condition were offered the opportunity to listen to the ATT recording in the lab.

Results

Data Analysis Plan

Scores from the questionnaires, the ANT, dot-probe task, and breathing focus task were analyzed using a 3x2 repeated measures Oneway Analysis of Variance (ANOVA), with time as a variable with three levels (visits 1, 2 and 3) and condition as a variable with two levels (ATT and Control). For the dot-probe task, due to a substantial loss of data at visit 1 resulting from a technical error, a 2x2 ANOVA (comparing visit 2 to visit 3) was also performed. For the ANOVA analyses, visit 1 will be referred to as 'baseline,' visit 2 will be referred to as 'preintervention', and visit 3 will be referred to as 'postintervention.'

Diary data were analyzed using hierarchical linear modeling (HLM; Raudenbush & Bryk, 2002) given the longitudinal structure of the data. HLM is able to handle the violation of independence seen with repeated observations, and accounts for clustering, or nesting of data.

Clustering of the diary data was expected, given that individuals' responses over time should be more similar than they would be to other people's responses. It was also expected that if the intervention was effective, then individuals within a condition would be more similar to each other than to those in the other condition. HLM also produces more accurate standard error estimates than a normal regression, which in turn allows for more accurate significance testing.

The proposed structure of the data included 2 levels, the first level representing the data across time points (i.e., an individual's responses over the course of the study), and the second level representing the participant's assigned condition (ATT vs. Control). First an unconditional means model was run with a random intercept. This model provides information on whether there is variation in outcome that is due to between-cluster variation (i.e., variation at level 2; Singer & Willett, 2003 pp. 92), and thus whether it is worth pursuing a multilevel approach to data analysis. Both intraclass correlations and the design effect were used to determine if multilevel modelling was appropriate. The intraclass correlation measures the proportion of variance in the outcome variable that is due to variation between clusters. There is no agreed upon cutoff for what an appropriate intraclass correlation should be for multilevel modelling, except that larger is better. The design effect measures how much nonindependence of observations would likely affect the standard errors in a model. A design effect of 2 or greater indicates that the standard error would be biased if clustering was not taken into account (Muthen & Satorra, 1995).

Following this, a piecewise analysis of the data was conducted with a random intercept and fixed slopes. A model with a random intercept allows the intercept (in this case, the value of the outcome variable at day 1) to be different for each condition while fixed slopes allows for comparison between the average slope of both conditions. A piecewise analysis was chosen

because no change was expected over the baseline/preintervention period, whereas change was expected over the intervention period. Therefore, without breaking the data into pieces, the model would try to fit a regression across the entire timeframe and would assume the rate of change is constant. Even if change occurred during the baseline period, it may not be as steep as during the intervention, further strengthening the importance of comparing separate pieces (baseline/preintervention vs. intervention).

Linear multilevel models were run separately for each outcome variable. Predictor variables included condition, time (piece 1: baseline, or visit 1 to visit 2 and piece 2: intervention period, or visit 2 to visit 3), and an interaction between condition and time. In addition, a main effects model was also run that included only condition and time as predictors. Lastly, a quadratic model was run for all diary variables, as it is plausible that change would not occur at a linear rate but instead at a quadratic rate (e.g., rapid improvement in worry at the beginning of the intervention and then plateauing, or alternatively, having a delayed occurrence and then improving rapidly later on). Given the novelty of this study, this "dosage" information was deemed useful for informing future studies on the ATT. Again, a quadratic model was run with the interaction term, followed by a main effects only model.

Data Screening and Preparation

Prior to analysis, data were screened for missing values, violations of assumptions of normality, and outliers.

Questionnaire data. Only one participant did not complete questionnaires (the ACS and PSWQ-PW) at preintervention (visit 2). They were not included in analysis for those variables. Missing values were very rare on questionnaire data (<1%) and were replaced by variable means, which is a method considered suitable when the rate of missing data is 5% or less (Schafer,

1999). No outliers, as defined by values outside a *z*-score of ± 3.29 (Tabachnick & Fidell, 2013), were identified on questionnaire data. In addition, examination of histograms and p-p plots, as well as kurtosis and skew estimates, suggested that data were normally distributed.

Behavioural data.

Dot-probe. Analyses were completed twice for the dot-probe data. First, analyses were run with a sample that consisted of individuals with data at all three visits ("full data sample"). Then, another analysis was run with individuals who had data at preintervention and postintervention ("missing data sample"). This decision was made due to the presence of a technical error that resulted in loss of data at baseline. Theoretically, outcomes at baseline and preintervention are not expected to differ significantly, given that individuals have not yet engaged in the intervention. Therefore, it is appropriate to compare just preintervention and postintervention, which represents change over the intervention period.

Thirteen participants were removed from dot-probe analysis in the full data sample. Two individuals were excluded due to technical failure of the task, and nine were excluded due to an error with the task resolution that led to inaccurate bias estimates. Two participants who had accuracy rates of <50% were excluded from analysis due to performing under chance level, leaving a final sample of 16. In the missing data sample, three participants' data were retained due to missing or invalid data occurring only at baseline, making the final sample 19.

Individual trials were examined for each participant. Based on guidelines suggested in previous studies (e.g., Hirsch et al., 2014), trials were excluded from analysis on which participants respond to the probe in under 200 ms, or over 2,000 ms. Responses under 200 ms are thought to represent "false alarms," while longer responses may indicate distraction. Only one participant had trials that were under 200ms (*n*=2), representing less than 1% of the trials,

and no trials were eliminated for being >2,000ms. Trials on which participants had incorrect responses were not included in RT analyses (4% of trials).

Latency data were created by calculating the mean RTs to respond to threat and neutral probes, on trials on which the participant responded correctly. Threat-top/probe-bottom and threat-bottom/probe-top scores were collapsed to represent "RT to probes at the neutral location," and threat-top/probe-top and threat-bottom/probe-bottom were collapsed to represent "RT to probes at the threat location." Only RTs for trials in which both threat and neutral words were presented at the same time were included in the present analyses (valenced trials, n=160). An Attention Bias Index (ABI) was calculated by subtracting the mean RTs for probes at the threat location from the mean RTs for probes at the neutral location (mean RT Neutral- mean RT threat). A larger positive number indicates a greater bias to threat information while a negative number indicates the participant was faster to respond to neutral information. Graphical examination and kurtosis and skew estimates showed that the residuals of the variables were normally distributed.

Attention Network Task. Six participants were excluded from the ANT analyses in the full data sample. One was excluded due to not responding at all during the entirety of the task at postintervention. Five participants who had accuracy rates of <50% were excluded from analysis due to performing under chance level. The final sample consisted of 23 participants.

Then, individual trials were examined for each participant. Based on guidelines suggested by the developer of the task (Fan, personal communication), trials were not included in analysis if participants responded in <200 ms (0% of trials) or three standard deviations above the mean of their average response time for correct trials (2% of trials). Incorrect trials were not included in RT analysis (4%). As suggested by Fan et al., (2002), the executive control effect on the ANT

was calculated by subtracting the RTs for congruent flanker trials (averaged across cue type) from the average RTs for incongruent flanker trials (averaged across cue type). A larger number suggests lower attentional control, whereas a smaller number suggests greater attentional control, evidenced by a smaller difference in responding to flanker types. Previous research has shown that neutral and congruent flanking conditions produce little difference, and thus only congruent RTs are generally used in analysis. All data were normally distributed based on graphical examination and kurtosis and skew estimates.

Breathing Focus Task. Two participants were excluded from analysis for missing data at postintervention due to a technical error when the computer froze during the task. The final sample consisted of 27 participants. Intrusions were calculated as the proportion of intrusions in the second breathing focus period (postworry period), relative to intrusions in the first (preworry period). This provided an intrusion quotient that was compared from baseline to posttreatment. Difficulty focusing on breathing (%), time spent worrying (%), and time spent focusing on breathing (%), were also compared between the second breathing focus period (postworry) and the first (preworry). A positive number indicates a greater value postworry compared to preworry, whereas a negative number indicates a greater value at the preworry period.

Diary data. Missing data was somewhat common for the diary data (17%); however, hierarchical linear modelling accounts for missing data using restricted maximum likelihood estimation. Due to the large range of variability in number of worry episodes and minutes of worry per day, slopes of individual responses were examined graphically across time and outliers were removed that would likely influence the estimation of the slope for that individual. This was done by graphing the data for each individual and assigning a line of best fit to the data before and after removing outliers. For example, if an individual worried between 20 to 30

minutes a day on average, and one day reported 200 minutes of worry, that outlier would greatly bias the slope for that individual. Thirty-seven data points were removed for number of worry episodes (11%) and 21 (6%) were removed from minutes of worry. In addition, the diary data were analyzed only if the items were completed the day of, as opposed to retrospectively the next day.

Manipulation Check

To account for potential differences between conditions due to factors external to the intervention itself, adherence and credibility/expectancy data were compared using t-tests. There was no significant difference in at home adherence between conditions, and the total mean practices was very high (M=6.88, SD=.87, range = 4 – 7). All participants listened to the recording for their assigned condition once at the lab. Eighty-three percent listened to the recording at least seven times during the week of practice. Credibility and expectancy outcomes were compared across the two conditions. In terms of the credibility of the recordings, the two conditions did not significantly differ in how logical using the recording appeared, or in confidence in recommending the recording to a friend. They did differ on how successful the participants believed the recording would be at reducing their worry, with participants in the ATT condition rating the recording as more *likely to be successful* (M=1.7, SE=0.80, p=.04), but they did not differ in amount of improvement (in %) they thought would occur. In terms of expectancy, there was no between-condition difference in the extent to which participants *believed* that the recording would lead to improvement. It is interesting to note that the mean ratings for the credibility questions fell below the midpoint (representing *somewhat*). It appears that on average, participants did not find either recording particularly credible. Conditions did not differ significantly in credibility of the recording when including the two individuals who

dropped out of the study after randomization. In addition, a *t*-test indicated that the two conditions did not differ in the percentage of time spent focusing on the recording (as opposed to daydreaming or worrying). On average, participants in the ATT condition focused on the recording 63.10% of the time (*SD*=20.46), and participants in the control condition focused 58.40% of the time (*SD*=23.35). See Appendix N for *t*-tests.

Wells has advised that a 2-point decrease in self-focused attention should occur after listening to the recording. On average, participants in the ATT condition rated themselves at 3.51 before listening to the recording and 3.17 after listening. Therefore, participants reduced their self-focused attention on average by 0.34 points. A repeated-measures ANOVA indicated that the two conditions did not differ in change in focus of attention pre to postintervention (see Appendix O).

Dropout. Four participants dropped out of the study. Two participants dropped out before the preintervention visit, and were not exposed to the recording for their condition (both participants stated the reason for drop out was due to inability to commit to taking part in the study due to time demands). Two participants dropped out following the preintervention visit, one in the ATT and one in the control condition. Both of these participants reported experiencing significant stressors that prevented them from continuing (e.g., a breakup). There was no significant difference in dropout rate between the conditions following exposure to the intervention. The two individuals who dropped out of the study following randomization were not included in the analysis given that there was no outcome data for these individuals. Due to the postintervention outcome data only being measured at one time-point (visit 3), it would be inappropriate to estimate an outcome for these individuals based on data that was acquired prior to commencing the intervention (baseline and preintervention).

Baseline Correlations

See Appendix P for baseline means and standard deviations. Baseline correlations (visit 1) were performed to examine relationships between variables of interest (see Appendix Q). Greater self-reported attention control (ACS) was associated with less worry (PSWQ) (r=-.48, p=.008) and greater self-reported mindfulness (SMQ) (r=.39, p=.04). Higher self-reported attentional control was not significantly associated with scores on the behavioural measure of attention control (ANT), although this relationship did approach significance (r=-.38, p=.07), such that greater self-reported attention control was associated with greater performance. Greater negative metacognitive beliefs about worry (MCQ-30) were significantly related to greater worry (r=.44, p=.02) and lower mindfulness (r=-.62, p=<.001). Negative metacognitive beliefs were also associated with poorer performance on the ANT (r=.42, p=.04). Greater attention control on the ANT was associated with less attentional bias to threat (dot-probe task, r=.57, p=.04). On the breathing focus task, difference in intrusions on the breathing task, time spent breathing, difficulty focusing on breathing, and time spent worrying, pre to post worry, were not correlated with the ACS, the MCQ, the SMQ, ANT or the performance on the dot probe.

Baseline Between-Condition Differences

The ATT and Control conditions were compared on baseline symptom and outcome measures using bootstrapped ANOVA. There were no significant differences between conditions at baseline on all self-report measures. For the ANT, there were no significant differences between conditions at baseline on RTs to respond to flanker type, difference in speed in responding to congruent vs. incongruent flankers, or in accuracy in responding to the flanker types. On the dot-probe task, there were no significant differences between conditions at baseline on accuracy, RT to respond to threat and neutral trials, and difference in speed of responding to

the two trial types (ABI). On the breathing focus task, there were no significant differences between conditions at baseline on positive, neutral or negative intrusions during the pre and postworry breathing periods. There was a significant difference at baseline between conditions in the *difference* between the number of intrusions experienced between pre and postworry periods (F=27.07, p=<.001), as well as the subjective amount of time spent focusing on breathing during the post worry breathing period (F=4.60, p=.04). Specifically, pairwise comparisons showed that at baseline, participants in the ATT condition had a greater difference in number of intrusions (specifically, they had more intrusions after the worry period than before), compared to the control condition (*Mean Difference; MD*=1.9). In addition, the ATT condition reported spending significantly less time focusing on their breathing at the baseline post worry period than did the control condition (*MD*=20%). The following results should be viewed in light of these baseline differences.

Hypothesis Testing

For all 3x2 repeated measures ANOVAs, see Appendix R, for the 2x2 ANOVA of dot-probe data see Appendix S, and for pairwise comparisons see Appendix T.

Primary outcomes.

PSWQ-PW. There was no main effect of condition, but there was a significant main effect of time. (F=6.54, p=.006, ηp^2=.20). Specifically, pairwise comparisons indicated that there was an improvement in worry from baseline to postintervention (*MD*=8.43, p=.002), but not significantly from baseline to preintervention, or pre to postintervention. There was no interaction between condition and time.

Breathing Focus task.

There was no main effect of time, but there was a significant main effect of condition on difference in number of intrusions experienced between the postworry breathing period and the preworry breathing period (F=12.88, p=.001, ηp^2=.34). Specifically, pairwise comparisons indicated that the ATT condition had a greater difference in number of intrusions (in this case, more intrusions after worrying than before worrying), than did the control condition did. There was also no main effect of time on the difference in number of *negative* intrusions between the two breathing periods, but there was again a significant main effect of condition (F=4.14, p=.05, η^2=.14). Specifically, pairwise comparisons indicated that the ATT condition had a greater difference in number of negative intrusions (in this case, more negative intrusions after worrying than before worrying). There were no interactions between condition and time for difference in number of total or negative intrusions.

Following the same pattern, although there was no main effect of time, there was a significant main effect of condition on subjective difference in amount of time spent breathing during the pre and postworry breathing periods (F=9.28, p=.005, ηp^2=.27). Pairwise comparisons indicated that participants in the ATT condition had a greater difference in the amount of subjective time spent breathing between pre to post worry breathing periods (in this case, they spent less time focusing on their breathing following worry than they had before worrying), than the control condition did. There was no significant interaction between condition and time in time spent breathing. There was also no significant main effects of time or condition or an interaction on subjective difficulty focusing on breathing or time spent worrying during the breathing periods.

Secondary outcomes.

Self-Report.

ACS. There was no main effect of condition or time, nor an interaction between condition and time for the ACS total score, or the focusing or shifting subscales. Therefore, participants did not improve in their subjective experience of being able to control their attention in either condition.

MCQ-30. There no main effect of condition or time, nor an interaction between condition and time for the cognitive self-consciousness subscale. Therefore, participants did not subjectively experience a change in focus of attention. There was also no main effect of condition for the negative beliefs about worry subscale, but there was a significant main effect of time ($F=3.33$, $p=.04$, $\eta p^2=.11$). Specifically, pairwise comparisons indicated that negative beliefs about worry being uncontrollable or dangerous improved from baseline to postintervention ($MD=1.86$, $p=.02$), but not between baseline and preintervention, or between pre to postintervention.

SMQ. There was no main effect of condition or time, nor an interaction between condition and time. Therefore, participants did not improve in their subjective experience of mindfulness.

Behavioural.

Attention Network Task. There was no main effect of condition, but there was a significant main effect of time ($F=10.84$, $p=<.001$, $\eta p^2=.34$), such that over time, the participants had less discrepancy in RT when responding to congruent and incongruent flanker trials, suggesting their ability to focus their attention on the central arrow while ignoring distracting information improved over time. Specifically, pairwise comparisons showed that individuals improved between baseline and postintervention ($MD=35.67$, $p<.001$), and from visit baseline to preintervention ($MD=23.62$, $p=.001$), but not from pre to postintervention. There was no

significant interaction between condition and time.

Dot-probe task. There was no main effect of condition, but there was a significant main effect of time (F=3.59, p=.04, ηp^2=.20). Specifically, pairwise comparisons indicated that there was a significant reduction in bias from pre to postintervention (MD=15.82, p=.02), but not between baseline to postintervention or from baseline to preintervention. There was no significant interaction between time and condition. To check for the possibility of this finding being due to practice effects, accuracy between pre and postintervention was compared. There was no significant improvement in accuracy on the task. In the missing data sample, comparing just pre and postintervention, there was no main effect of time (although this did approach significance, p=.06) or condition, nor an interaction between time and condition. See Table 7 for the 2x2 ANOVA.

Diary data.

Bootstrapped ANOVA showed that there were no significant differences between conditions at day 1 on number of worry episodes, minutes spent worrying, intensity and uncontrollability of worry, and the focus of attention. They also did not significantly differ in number of days they completed the daily diary entry. The mean number of completed diary entries out of a possible total of 14 was 12 (SD=2.02, min=6). The mean number of completed diary entries during the first week of the study was 6 (SD=1.21, min=3) and the mean number during the second was 6 (SD=1.13, min=3). PSWQ-PW scores correlated with average minutes worried over the past week (baseline: r=.57, p=.002; intervention period: r=.41, p=.03), as well as average intensity (baseline: r=.58, p=.001; intervention period: r=.54, p=.003) and uncontrollability (baseline: r=.67, p<.001; intervention period: r=.57, p=.001) over the past week, but not with number of worry episodes. For the correlation table, see Appendix U

For all simple slopes of the linear models, see Appendix V. For linear main effects models see Appendix W. For simple slopes of the quadratic model, see Appendix X For quadratic main effects models see Appendix Y.

Number of worry episodes. The unconditional random intercept only model indicated that the intraclass correlation was .46. This suggests that 46% of the variance in number of worry episodes is due to between cluster differences. In addition, the design effect was 6.98. Therefore, it was appropriate to run a multilevel model. The hypothesis that differences in change in number of worry episodes would be due to condition was not supported. The linear interaction model indicated that there was no significant interaction between time and condition. There was no change in residual variance, indicating that this model did not adequately explain variance due to clustering. The linear main effects model also demonstrated there was no main effect of condition or time for piece 1, but there was a main effect of time for piece 2 (intervention period). The quadratic models also indicated no significant interaction between time and condition, nor a main effect of time (either piece 1 or piece 2) or condition. The residual variance was decreased from 9.81 to 2.57.

Minutes of worry. In the intent to treat sample, the unconditional random intercept only model indicated that the intraclass correlation was .82. This indicates that 82% of the variability in minutes of worry was due to cluster effects. The design effect value was 11.66. Therefore, it was appropriate to run a multilevel model. The hypothesis that differences in change in minutes spent worrying would be due to condition was somewhat supported; however, not in the expected direction. The linear interaction model indicated that there was a significant interaction between condition and piece 2 (intervention period, γ =-6.23, t=-2.05, p=.04). Simple slopes analysis demonstrated that there was no significant change in minutes spent worrying during the

intervention period for the ATT condition; however, there was a significant reduction in minutes spent worrying for the control condition, such that for each day there was a .69-minute reduction in worry. Cohen's *d* was .07, suggesting that this effect is very small.

Graphical examination of this interaction led to further analyses (see Appendix Z). Although the control condition did decrease in worry during the intervention period, there was no significant difference between conditions on minutes worried on the final day of the study (day 14). In addition, there was no reduction in residual variance which suggests that the model is not adequately explaining variation due to clustering. Also, although nonsignificant, there was an increase in worry over the baseline period for the control condition.

The linear main effects model indicated there was no main effect of condition or time. The quadratic models also indicated no significant interaction between time and condition. There was a significant linear effect of change in worry during the intervention period (γ=-10.98, p=.04) in the main effects quadratic model, which is unsurprising given the results of the linear model. Residual variance *increased* (from 2215 to 2256) indicating that this quadratic model was not a good fit.

Intensity of worry. The unconditional random intercept only model indicated that the intraclass correlation was .15. This indicates that 15% of the variability in intensity of worry was due to cluster effects. The design effect value was 2.95. Therefore, it was appropriate to run a multilevel model. The hypothesis that this clustering effect would be due to condition was not supported. The linear interaction model indicated that there was no significant interaction between time and condition. There was no change in residual variance, indicating that this model did not adequately explain variance due to clustering. The main effects model indicated there was no main effect of time (either piece 1 or piece 2) or condition. The quadratic models

indicated no significant interaction between time and condition, nor a main effect of time (either piece 1 or piece 2) or condition. There was no change in residual variance, indicating that these models did not adequately explain variance due to clustering.

Uncontrollability of worry. The unconditional random intercept only model indicated that the intraclass correlation was .20. This indicates that 20% of the variability in uncontrollability of worry was due to cluster effects. The design effect value was 3.6. Therefore, it was appropriate to run a multilevel model. The hypothesis that this clustering effect would be due to condition was not supported. The linear model indicated that there was no significant interaction between time and condition. There was no change in residual variance, indicating that this model did not adequately explain variance due to clustering. The main effects model indicated there was no main effect of time (either piece 1 or piece 2) or condition. The quadratic models indicated no significant interaction between time and condition, nor a main effect of time (either piece 1 or piece 2) or condition. There was no change in residual variance, indicating that these models did not adequately explain variance due to clustering.

Focus of attention. The unconditional random intercept only model indicated that the intraclass correlation was .25. This indicates that 25% of the variability in focus of attention was due to cluster effects. The design effect value was 4.25. Therefore, it was appropriate to run a multilevel model. The hypothesis that this clustering effect would be due to condition was not supported. The linear model indicated that there was no significant interaction between time and condition. There was no change in residual variance, indicating that this model did not adequately explain variance due to clustering. The main effects model indicated there was no main effect of time (either piece 1 or piece 2) or condition. The quadratic models indicated no significant interaction between time and condition, nor a main effect of time (either piece 1 or

piece 2) or condition. There was no change in residual variance, indicating that these models did not adequately explain variance due to clustering.

Effect of Number of Practices

Given there was variability in the number of practices individuals engaged in, a regression was run with number of practices predicting change from pre to postintervention on outcome variables, in the ATT condition. There were no significant regressions, indicating that the number of times the individual listened to the recording did not influence outcomes. See Appendix AA for regressions.

Discussion

Purpose of the Study

The purpose of the present study was to examine the impact of the ATT, compared to a control condition, on worry and associated cognitive processes. The standalone use of the ATT has never been examined in a population that suffers from excessive and uncontrollable worry. The study aimed to examine whether a) one week of daily ATT practice would have an impact on worry and attentional control and b) whether other attention and worry-relevant cognitive processes would change over the course of the intervention.

Summary of Main Findings

None of the hypotheses were supported. There were no significant interactions between condition and time on any outcome measure, except for daily minutes of worry. Surprisingly, the control condition experienced a reduction in minutes of worry over the intervention period. This finding is unlikely to be meaningful, given that the control condition increased in minutes of worry during the baseline period (although this was nonsignificant), and thus the decrease seen during the intervention period may be nothing more than an artifact of regression to the mean.

Specifically, the control condition may have had more room for "improvement" during the intervention period given that at day 7 (the start of the intervention period) they had slightly higher levels of worry. Notably, the two conditions did not differ at the end of the study on minutes of worry, suggesting that the control condition did not experience a meaningful improvement in worry relative to the ATT condition. In addition, the effect size was very small (*d*=.07), and the daily reduction in worry was less than 1 minute per day. In addition, there was a main effect of time over the intervention period in number of worry episodes, suggesting that both conditions had a decrease in number of worry episodes. The reduction was very small however, representing a .11 decrease in worry per day. Given that there were no changes over the intervention period on other worry measures, this finding should be interpreted cautiously.

There was a significant main effect of time on worry and negative beliefs about worry. Both worry and negative beliefs about worry decreased over the duration of the study. It is important to note that these changes were only significant from baseline to postintervention, and there was no significant change from pre to postintervention (i.e., over the intervention period). This suggests that change on these measures was unrelated to the ATT or control recording and was likely an artifact of regression to the mean, or maturation over time. It is common in treatment studies for individuals to improve over time, which is often unrelated to the actual intervention and instead best accounted for by the trend for extreme scores to regress towards the mean over time (Hsu, 1995). It is also plausible that the act of taking part in a study on worry may have helped to decrease worry over the short-term, especially given that nonspecific factors (e.g., positive face to face contact, motivation to change, and hopefulness) have been shown to be related to symptom improvement (e.g., Cuijpers, 2016; Lambert & Barley, 2001; Lambert, Hansen & Finch, 2001; Marcus, OConnell, Norris, & Sawaqdeh, 2014). It is also possible that

these changes were due to worry monitoring. On the phone screen, participants would often report worrying to a very high degree during the day (e.g., 80% of the day), and worry monitoring may have helped some individuals to realize they worry less frequently, or for a shorter duration than they thought they did. This could further reduce worry and the belief that worry is uncontrollable. There is also research that suggests that monitoring can lead to change in the frequency of a behaviour (Korotisch, & Nelson-Gray, 1999; Nelson, Hayes, 1981), which can be problematic in a research assessment context. Given that there was no condition where participants did nothing, it is difficult to determine if the reduction in worry and negative beliefs is due to regression to the mean, worry monitoring, or other factors.

Another possible explanation for a lack of change in worry over the intervention period could be if the participants' worry was too high to benefit from an intervention this brief. To date, prior studies of the ATT have examined changes in anxiety as opposed to worry (the cognitive component of anxiety), and these changes have only been examined in those with high levels of self-reported anxiety and GAD symptoms. Although this was not a clinical sample, the degree of worry was very high, and the individuals were assessed using the GAD module of the MINI, a semistructured clinical interview. Therefore, the current sample may be more representative of those with GAD, and thus the individuals may have more severe psychopathology. Perhaps a longer duration, or an adjunctive treatment would be required to see change in worry in a GAD sample. Changes in other symptoms have been demonstrated (e.g., physiological sensations of anxiety, intrusive negative thoughts, rumination); however, perhaps chronic worry is more difficult to interrupt using this recording. This may not be the case though, because studies of other brief interventions, such as cognitive bias modification, have found

significant reductions in worry in individuals with generalized anxiety disorder with a similar dosage of sessions (e.g., 8; Amir et al., 2010; Hallion & Ruscio, 2011).

In addition, there was a main effect of time on two of the behavioural outcome measures. Specifically, attentional control, as measured by the ANT, improved between baseline and preintervention, and between baseline and postintervention; however, there was no change from pre to postintervention. This suggests that improvement in performance on the ANT was unrelated to the ATT or control recording, given that there was no change over the intervention period. Participants often reported verbally to the experimenters that at first, the task appeared overwhelming given the amount of instructions. It is quite possible that after having completed the task once, participants performed better at subsequent visits. Improvement was likely due to practice effects, with the participants becoming more comfortable with the task over time. This finding, as well as the lack of change in subjective attention control, and attention control as measured by the breathing focus task, is surprising, given that a proposed mechanism of change through which the ATT recording is proposed to work is attention control. The study was underpowered, however; therefore, these conclusions are tentative.

Interestingly, there was decrease in attentional bias to threat over the intervention period, and the effect size was large. This could suggest that both the ATT and control condition were equally effective at reducing bias to threat information, or that the study was too underpowered to detect an interaction. Regarding the first possibility, this result could suggest that the specific attention training instructions were not critical in helping individuals reduce their bias to attend to threat information. Perhaps the simple act of listening to a recording, or taking time out of one's day to sit quietly and focus on something other than worry is therapeutic, although it is difficult to imagine how this would decrease one's propensity to orient to threat information.

Another more probable explanation is that the control condition recording actually did modify attention in some way, even though it was not designed to do so. At debriefing, some participants in the control condition indicated verbally that they felt the control condition recording helped improve their focus. The change in bias is interesting given that there was no concurrent change in worry; perhaps even a statistically large reduction in attentional bias is not enough to lead to reduction in worry. Although the effect size was large, the change in RTs was only 15 seconds, which may not translate meaningfully for participants in real life (e.g., a 15 second reduction in bias to threat may not be enough to impact an individual's symptoms). Regardless, this finding contradicts many prior studies showing that attention bias modification programs lead to reductions in symptomatology such as worry and anxiety; however, those outcome measures are often administered immediately after training. In addition, some published (and some unpublished) studies have found insignificant effects of bias modification on anxiety (e.g., Mogg, Waters, & Bradley, 2017). Lastly, the dot-probe has been criticized for being an unreliable task (Eide, Kemp, Silberstein, Nathan, & Stough, 2002; Schmulke, 2005), further indicating that this finding should be interpreted with caution.

It is important to note that when a 2x2 ANOVA was conducted with the missing data sample for the dot-probe, comparing pre and postintervention, the effect of time became nonsignificant (although it did approach significance). This is surprising and suggests that the finding from the pairwise comparisons of the 3x2 ANOVA should be viewed conservatively, especially because no other outcome measures changed over pre to postintervention, suggesting neither the ATT nor the control intervention was effective. In addition, there were multiple analyses run throughout the study (e.g., 10 repeated measures ANOVAs). If one were to use a Bonferroni correction to protect against inflation of type I error from repeated hypothesis testing,

the effect of time on the dot-probe task would no longer remain significant. In addition, on first glance, it could be argued that the significant change from pre to postintervention was nothing more than a practice effect from repeating the task. This is unlikely however, because the attentional bias shifted from being oriented toward threat words toward more neutral words. Were participants to have improved performance, we would expect to see no bias toward any word, as this would lead to the most accurate responding. A bias towards neutral words is not an "improvement," and there was no significant improvement in accuracy from pre to postintervention, which suggests that this finding is not due to practice.

Lastly, there was a main effect of condition on the breathing focus task. The ATT group had greater difficulty focusing on breathing after worrying, and this was seen at baseline. Therefore, for this variable, randomization was unsuccessful. In addition, analyses revealed no change in the breathing focus outcomes over time.

It is important to note that these nonsignificant results may be largely attributable to an issue of sample size, as the present study was underpowered.

Credibility and expectancy. It is important to note that the credibility and expectancy of these recordings were quite low, and on average, participants did not find the recordings credible, nor did they expect to improve as a result of the interventions. Specifically, the mean ratings on all the items on the Credibility and Expectancy Questionnaire (see Appendix E) were below the halfway marker of "somewhat." There are two possible reasons for this. One is that the rationale for the recording may not have been clear enough, and participants may have been confused about what the recording was intended to do. The language of the rationale developed by Wells may have included too much jargon for participants to understand the purpose of the recording. For example, the notion of "internal control" may have been too vague, and not

directly tied to the concept of worry. Given that this study was experimental, the rationale was kept short and the experimenter did not go into further detail about potential benefits. Importantly, length of the rationale and the language used have been demonstrated to influence treatment outcomes (Horvath, 1990; Kazdin & Krouse, 1983). Perhaps explaining more explicitly and in lay language why the recording was proposed to help worry would have been beneficial. Second, it is possible that the recordings themselves did not appear credible, and that after listening, participants did not believe that they would experience any change in worry. This is not completely unsurprising given that the recordings are different from mindfulness or relaxation recordings participants may have been exposed to. For example, the sounds in the ATT and control recordings are not relaxing and may appear strange. This is the first study of the ATT that has included a measure of credibility and expectancy, so it is not possible to compare whether the contradictory findings in this study may be due to particularly low credibility of the intervention.

Credibility and expectancy have been demonstrated time and time again to be an important component of psychological treatment (Dew & Bickman, 2005; Lambert, & Barley, 2001; Joyce & Piper, 1998; Goossens et al., 2005; Meyer et al., 2002). Therefore, low credibility may explain why the ATT was not effective at changing worry. Interestingly, expectancy has been shown to increase improvement in therapy through the pathway of increased *adherence* (such that greater expectancy leads to greater adherence, which in turn leads to greater gains in treatment; e.g., Meyer et al., 2002). In the present study, the number of practices did *not* affect outcomes, although given that adherence was high, there may not have been enough variability to adequately determine this (and again, a lack of power makes it difficult to draw conclusions). Given that engagement was naturally high, expectancy may not have been as important;

however, the practice rate may not be this high outside of a research study. Participants were reminded by the experimenter to keep listening to the recording when they missed a practice, and were being paid for their participation. Therefore, credibility and expectancy would likely remain important outside of a research setting, especially if it were to increase adherence; if the intervention did not seem credible and one did not expect change, it is unlikely that one would continue to use the recording. It is also possible that participants played the recording but did not really listen or pay attention (i.e., they did not really adhere). It is important to consider that on average participants reported focusing their attention on the recording for 60.36% of the time they listened.

The current study was intended not only to examine the effects of the ATT as a potential intervention, but also as a proof of concept test of Adrian Wells' model of GAD, upon which the ATT was based on. If expectancy is required to see change, then is difficult to parse apart nonspecific factors common to all psychological interventions, and the actual theoretical mechanisms through which the recording is supposed to effect change.

Self-focused attention. Treatment recommendations for use of the ATT suggest that if one does not see a 2-point reduction in self-focused attention on the SARS, the rationale should be repeated and the recording should be reviewed again until a 2-point shift is observed. For the purpose of a research study, this would be problematic. Not only would this introduce variability into the design (e.g., some participants would receive additional training and an enhanced rationale), but it also would likely introduce demand characteristics. If a participant believes that he or she is supposed to be experiencing a change on a measure, and the experimenter keeps readministering that measure, it is likely that this would impact how the participant responds (Weber & Cook, 1972). In addition, a goal of the study was to see whether self-focused attention

does indeed shift, given that this is a potential mechanism through which the treatment is intended to work. It is interesting that there was little shift in self-focused attention in the ATT group, suggesting that the recording did not actively change people's focus of attention, even immediately after listening. This is in contrast to prior studies (Knowles et al. 2016). It is possible that participants had trouble with this question, given the wording. For example, externally focused is intended to represent an external focus of attention (i.e., on the environment, rather than on one's mind), whereas internally focused represents feeling focused on one's thoughts, emotions or physical sensations. However, some individuals reported that they thought that question meant whether they were worrying about external or internal topics that day (e.g., about the world, or about themselves). Therefore, this question may not have been valid in this sample.

Comparing models. One of the aims of the present study was to compare Wells' and Hirsch and Mathews' models of pathological worry: specifically, whether attention control or attention bias were associated with a change in worry. Given the results, it is not possible to do so at this time. Interestingly, while there was a change in attentional bias to threat, neither the ATT or control condition lead to reduction in worry. This contradicts Hirsch and Mathews' model because they posit that attentional bias to threat, or low level emotional processing, is responsible for maintaining worry. They state that without modifying these low level processes, a change in the frequency of worry would not be possible. The present study found that changing low level processes was not associated with a change in worry. Therefore, low level processes may not be as critical as had previously been suggested. This is in line with current research that suggests that attentional control is actually the mechanism of change in attentional bias modification programs (Browning, et al., 2010; Eldar & Bar-Haim, 2010; Koster et al., 2010),

and that a reduction in attentional bias may just be a byproduct of enhanced attentional control. Perhaps a lack of change in worry can be explained by the lack of change in attentional control, both subjectively and measured behaviourally.

Comparison to Previous Studies

The findings in this study differed from prior research examining the ATT. Again, although these findings may be due largely to an issue of power, other possibilities will still be reviewed. This study differed from past studies in a number of ways. First, the ATT was practiced multiple times, whereas most studies have one or two practices. Although there was one recent study that involved 2 weeks of practice of the ATT in a similar population (Haukaas et al., 2018), the ATT was not examined as a standalone intervention, and contact with the therapist or other factors of the study may have contributed to the significant results they found. Second, the outcome measures were not administered immediately after practice, unlike most prior RCTs. It is possible that the effects found in these studies are transient and do not last in the short term. In addition, the outcome measures of this study were different than in prior studies. For example, although changes in attention control were seen in past studies, this is the first study of the ATT that used the ANT and the breathing focus task.

Third, the control condition used in the present study was novel. Other RCTs have used attention control groups that use different modalities (e.g., reading and writing), or have compared the ATT to established interventions. Given the dearth of research on the effects of ATT in people high in worry, a control condition was an appropriate first step. The control recording was designed so that the only difference between the recordings would be the *attention training instructions*; however, it is possible that the control condition actually did impact attention. Perhaps by mentioning the sounds playing, attention was inherently focused on those

sounds. Although the control condition did not include rapid switching or directing attention to include all the sounds playing, it may have inadvertently included focusing. If this were true, and training attentional focus as an intervention was effective, then we would expect to see changes in outcome measures from pre to postintervention in both conditions, which was not the case. Therefore, it is possible that training attention in this way may not be an effective intervention. A final possibility is that the voice in the recording was not as effective or credible as in prior studies. The ATT recording used in this study included the same sounds as the prior recording, but the voice was rerecorded so that it would match the voice in the control condition. Therefore, it is possible that differences in results could be due to the difference in the voice in the recordings. This appears unlikely, and if it were the case, it would be problematic if the ATT only works when a specific kind of voice leads the training.

Strengths and Limitations

The present study had many strengths. First, the study used a within and between subjects design, which combines the benefits of both designs. By comparing individuals to their own baseline, a smaller sample size is required than if a third group was added (e.g., a worry monitoring only group). In addition, within group comparisons reduce error variance because the individuals being compared across time were the same; in this case, participants were compared to their own self before, during, and after completing the intervention. This is further strengthened by the use of multilevel modelling for the worry diary data. Individual regression lines were created for each individual and were then compared across the groups, allowing us to model change over time. The multiple time points (14) allows for a quadratic model to be fit to the data, which could unearth information about dosage of an intervention if change were to occur.

Another strength was that this study extended prior research by examining the effect of the ATT in a population that suffers from excessive and uncontrollable worry. The use of the ATT has barely been studied in this population, and this study extended previous research by examining not only the immediate effects of the recording but also the short term effects, over the duration of a week. In addition, the study included a control condition that would not only serve to test whether the ATT was effective, but would help serve as a test of Wells' model of GAD. By matching the ATT recording exactly, with the exception of the attention training instructions, this strengthens the conclusions that could be drawn if the ATT group improved. Many RCTs include control groups that differ in multiple ways from the intervention (e.g., modality), making it difficult to parse out the active ingredient of change. It is possible however that the recordings were actually too similar; regardless, neither led to improvement on any measure other than the dot-probe. It is also a strength that this study included the CEQ as a measure, given that prior studies have been limited by not including measures about client's beliefs about the intervention.

It is promising that the two recordings did not differ in perceived credibility, as this would have weakened the design of the study. If the hypotheses were supported with greater power, it is crucial that the credibility is comparable between the two conditions to be able to draw conclusions beyond the effect of expectancy. Therefore, the current findings are promising for future data collection. It would also be interesting if effects were seen despite low credibility, as this would indicate that the recording may actually be training attention beyond expectancy effects.

There are also a number of limitations of the current study. First, the study was underpowered, and thus the conclusions drawn are tentative. Second, as mentioned previously,

differences may not be detected given the similarity of the control condition to the ATT recording. Third, we do not truly know whether participants listened to the recording. Although we did collect information on whether the entire recording was completed, it is possible that participants walked away from the recording or did not really listen. This is a limitation of any at-home intervention, as one cannot ever know what happens beyond the walls of the laboratory, but every attempt was made to mitigate this as best as possible. Fourth, another potential limitation of the study was the diagnostic instruments used. Although every attempt was made to include participants that would likely have met criteria for GAD, not all individuals had probable GAD as measured by the GADQ-IV. It is possible that some of these individuals may have worry that was more normative (although Penn State Questionnaire Scores were all above 65, suggesting a degree of worry that was pathological) or may have been heightened by certain life stressors (e.g., students in very difficult programs under high stress). It is also possible, as previously discussed, that worry was too high to be impacted by a brief intervention. Yet, other brief interventions are associated with changes in worry (Amir et al., 2010; Hallion & Ruscio, 2011), and other studies of the ATT have shown changes in distressing symptoms after only one or two practices (see Knowles et al., 2016 for review).

Lastly, a limitation of the current study was that daily worry diary was administered at the end of the evening, and thus the measure did not take into account worry that was experienced during the night, when participants were attempting to sleep. Most of the participants in the study endorsed experiencing trouble sleeping due to worry, and some participants remarked that they felt the worry diary underestimated their worry, given that most of their worry occurred in the night, after they had completed the diary for that day. A diary in the morning that assessed sleep over the evening period would have helped to provide a more

accurate sense of people's worry. During the day, individuals may have been more distracted, by work or school, and their worry may be felt more uncontrollable and may have increased in duration while lying in bed. Nighttime worry has been shown to correlate with the PSWQ (Verkuil, Brosschot, & Thayer, 2007). Therefore, it is possible that daily worry was not measured as accurately as it could be. In addition, many participants expressed that they did not identify with the question asking about number of worry episodes, as they did not believe their worry occurred in an episodic manner. Interestingly, average number of worry episodes over the past week did not correlate with PSWQ-PW score, whereas minutes, intensity and uncontrollability did. Future diaries should take this feedback into account.

Future Directions

The present study should be extended to capture a larger sample, so that the power is adequate to detect an interaction effect. In addition, once an adequate sample is achieved, it would be interesting to run a linear and quadratic multilevel model with *random slopes,* for the diary data (at present, a random slopes model would not converge given the sample size). With random slopes, treatment responders and treatment non-responders could be better differentiated, because a single slope would not be forced across all the individuals in the intervention group, as it is with fixed slope designs. In addition, the intraclass correlations in the present study suggested that there was significant data that clustered between groups; however, condition did not account for this clustering. Therefore, there are likely other differences between participants that are accounting for this structure. For example, certain characteristics, such comorbidity or motivation to change may impact treatment response. In addition, a follow up study would benefit from integrating what was learned over the course of this study, largely from participant feedback. For example, including a worry diary in the morning to capture evening worry, and

modifying the diary questionnaire to better reflect the experience of the participants. In addition, monitoring expectancy over time, as opposed to at one time point may prove to be useful, as it is possible that expectancy does not remain constant.

Given the null results of the present study, if nonsignificant interactions are retained after collecting more data, a future study could examine the ATT in the same population, but with a control condition that is more differentiated from the ATT itself. Although the control condition should include a recording of roughly the same length to control for modality of attention and time, perhaps a recording that is more different from the ATT would be useful. It would also be pertinent to examine the short term effects of the ATT in populations for which prior significant results were found immediately after administration of the intervention, as it is possible that these results may not hold up over time. It is unlikely that people will benefit from an intervention with transient effects on symptomology and cognitive processes if they do not last even one day.

Conclusions

This is the first study to examine the standalone effect of the ATT, in a population of individuals who experience excessive and uncontrollable worry about a variety of topics, over the span of a week. The present study was underpowered and therefore significant interactions between group and time may have been undetected. At present, there is no indication that the ATT is effective at reducing worry, or changing other cognitive processes such as attention control, beliefs about worry, self-focused attention, or mindfulness. The ATT and control condition may both have led to a reduction in attentional bias. This is interesting given that this was not accompanied by a concurrent change in worry, measured by the Penn State Worry Questionnaire or by daily worry monitoring, suggesting a shift in attentional bias is not sufficient

to change worry. Further data collection is required to determine whether the ATT is effective at changing these symptoms and processes.

Appendix A. Psychoactive Substance and Sleep Questionnaire

Current Time:_____

1. Have you had any caffeine today? (i.e., coffee, tea, coke, energy drink)

YES NO

If YES, what beverage(s) did you drink and how much did you drink?

_____

2. Have you had any cigarettes today (including e-cigarettes)

YES NO

If YES, how many cigarettes?_____

If YES, When was your last cigarette?_____

3. Have you consumed any alcoholic beverages today?

YES NO

If YES, what did you drink, what size was the drink (e.g., bottle, pint, shot), and how many did you have?

_____

4. Have you consumed any marijuana today?

YES NO

If YES, roughly how much did you smoke (e.g., # joints, # bowls, or amount in grams)?

If YES, When was your last consumption of marijuana? _____

5. Have you taken any benzodiazepines in the past two weeks?

YES NO

If YES, which benzodiazepine and what dosage?_____

When did you last take the benzodiazepine?_____

6. How many hours of sleep did you get last night? _____

Appendix B. Sample Demographics by Condition

	ATT (*n*=14)	Control (*n*=15)
Mean Age in Years (SD)	28.36 (10.37)	30.8 (16.41)
Race/Ethnicity- Frequency (%)		
White	3 (21.4%)	9 (60%)
East Asian	1 (7.1%)	3 (20%)
Southeast Asian	1 (7.1%)	0 (0%)
South Asian	2 (14.3%)	1 (6.7%)
Black	1 (7.1%)	0 (0%)
Latin American	2 (14.3%)	0 (0%)
Arab/West Asian	1 (7.1%)	0 (0%)
Mixed	2 (14.3%)	1 (6.7%)
Other	1 (7.1%)	1 (6.7%)
Aboriginal	0 (0%)	0 (0%)
Gender-Frequency (%)		
Male	5 (35.7%)	1 (6.7%)
Female	9 (64.3%)	14 (93.3)%
Currently Enrolled in University	9 (64.3%)	11 (73.3%)
Yes	5 (35.7%)	4 (26.7%)
No		
Highest Education Level		
Some High School	0 (0%)	0 (0%)
High School	0 (0%)	1 (25%)
College Diploma	1 (20%)	0 (0%)
Undergraduate Degree	3 (60%)	1 (25%)
Master's Degree	1 (2%0	2 (50%)
Doctoral Degree	0 (0%)	0 (0%)
Employment		
Unemployed	8 (57.1%)	6 (40%)
Part-time Employed	3 (21.4%)	7 (46.7%)
Full-time Employed	3 (21.4%)	2 (13.3%)

Note. ATT=Attention training technique.

Appendix C. Sample Mean Clinical Characteristics Separated by Condition

	ATT (*n*=14)	Control (*n*=15)
PSWQ Screen (SD)	70.07 (3.97)	71.27 (4.51)
GADQ-IV (SD)	10.32 (2.16)	10.06 (2.41)
GAD-Q-IV Above 5.7-Frequency (%)	13 (93%)	14 (93%)
GAD-Q-IV Above 7.67 -Frequency (%)	12 (86%)	12 (80%)
CESD-R (SD)	26.07 (14.46)	26.67 (11.91)

Note. ATT=Attention training technique.

Appendix D. Daily Worry Diary Questions

The following questions will ask about your worry during the day. Worry is described as intrusive thoughts and images about potential future events or catastrophes.

1. Please indicate the number of worry episodes you had today?

_____

2. How long did you spend worrying today in minutes?

_____

3. How intense (e.g., strong, extreme, overwhelming) was your worry today?

0 1 2 3 4 5 6

Not intense at all Very intense

4. How difficult was it to stop worrying today?

0 1 2 3 4 5 6

Not difficult at all Very difficult

5. To what degree was your attention focused inwards on the self or outwards towards your external environment today?

0 1 2 3 4 5 6

Entirely externally focused Entirely internally focused

Appendix E. Credibility Expectancy Questionnaire

Recording Evaluation Form

We would like you to indicate below how much you believe, right now, that the recording you will be listening to will help to improve your worry. Belief usually has two aspects to it: (1) what one thinks will happen and (2) what one feels will happen. Sometimes these are similar; sometimes they are different. Please answer the questions below. In the first set, answer in terms of what you think. In the second set, answer in terms of what you really and truly feel.

Set I

1. At this point, how logical does it seem to you to use this recording daily?

1	2	3	4	5	6	7	8	9
not at all logical				somewhat logical				very logical

2. At this point, how successfully do you think this recording will be in reducing your worry?

1	2	3	4	5	6	7	8	9
not at all useful				somewhat useful				very useful

3. How confident would you be in recommending this recording to a friend who experiences similar problems?

1	2	3	4	5	6	7	8	9
none at all confident				Somewhat confident				very confident

4. By the end of the study, how much improvement in your worry do you think will occur?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Set II

For this set, close your eyes for a few moments, and try to identify what you really feel about the recording and its likely success. Then answer the following questions.

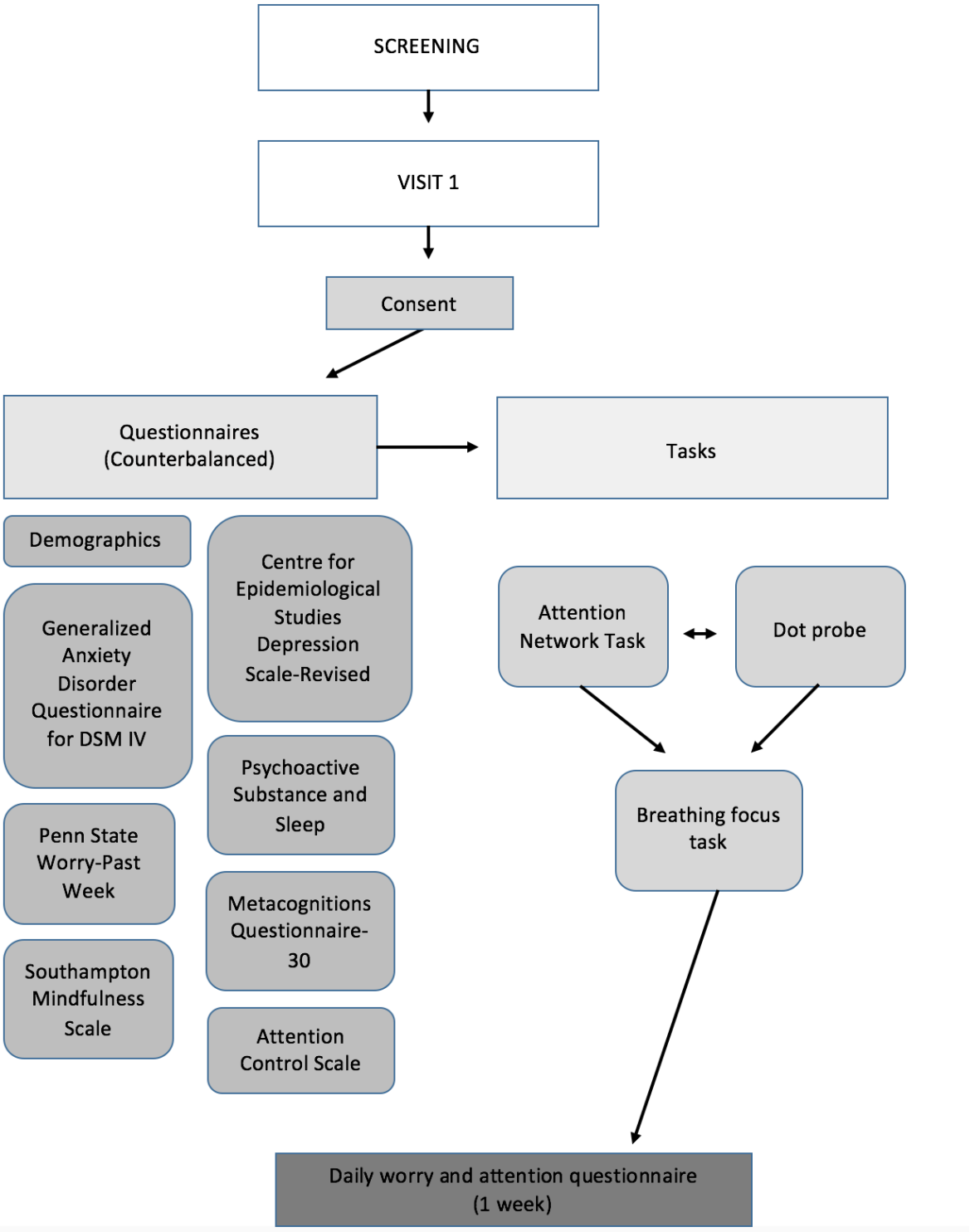
1. At this point, how much do you really feel that this recording will help you to improve your worry?

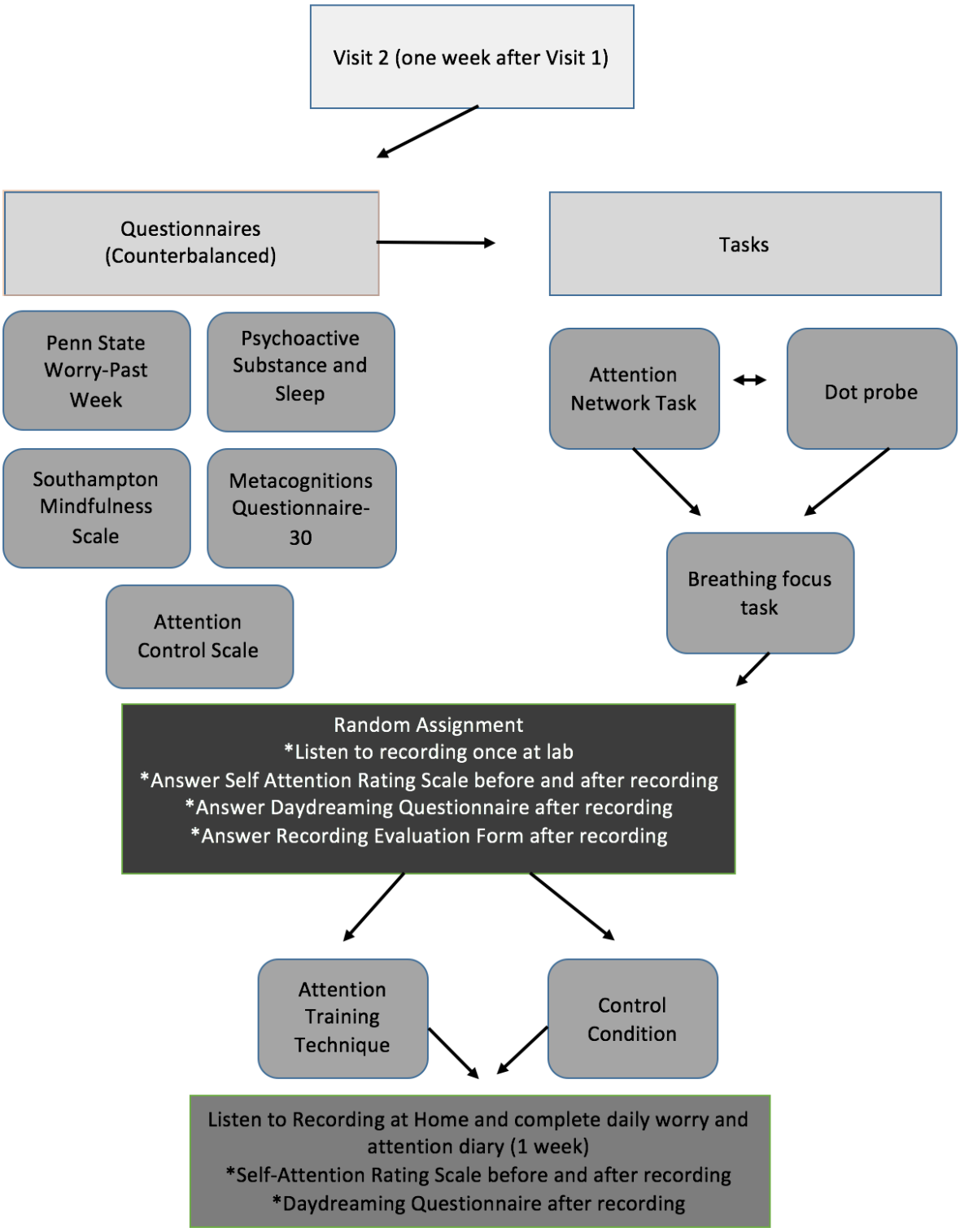
1	2	3	4	5	6	7	8	9
not at all				somewhat				very much

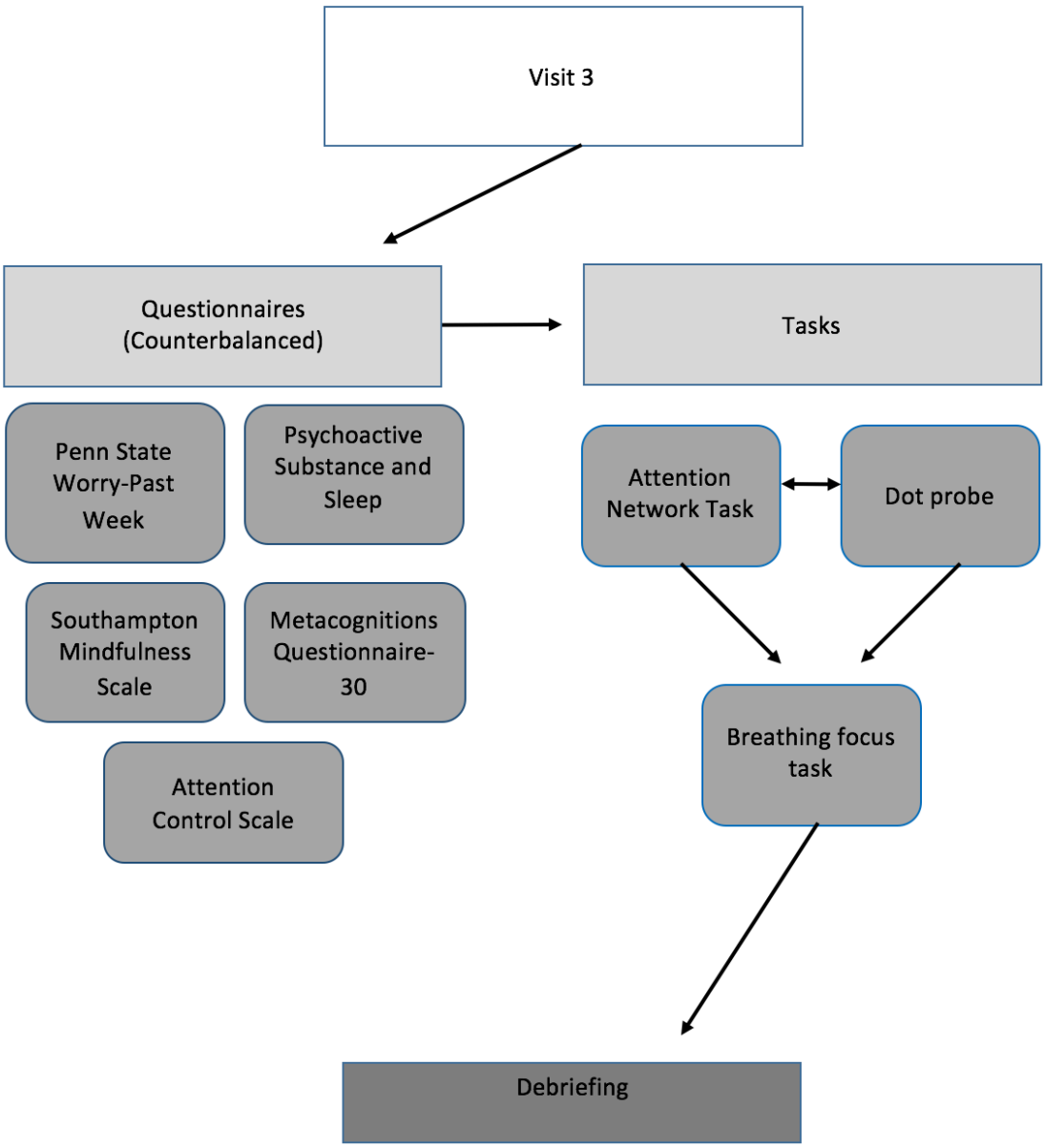
2. By the end of the study, how much improvement in your worry do you really feel will occur?

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Appendix F. Study Design




Visit 2 (one week after Visit 1)
Questionnaires (Counterbalanced)
Tasks
Penn State Worry-Past Week
Psychoactive Substance and Sleep
Southampton Mindfulness Scale
Metacognitions Questionnaire-30
Attention Control Scale
Attention Network Task
Dot probe
Breathing focus task
Random Assignment
*Listen to recording once at lab
*Answer Self Attention Rating Scale before and after recording
*Answer Daydreaming Questionnaire after recording
*Answer Recording Evaluation Form after recording
Attention Training Technique
Control Condition
Listen to Recording at Home and complete daily worry and attention diary (1 week)
*Self-Attention Rating Scale before and after recording
*Daydreaming Questionnaire after recording


Visit 3
Questionnaires (Counterbalanced)
Tasks
Penn State Worry-Past Week
Psychoactive Substance and Sleep
Attention Network Task
Dot probe
Southampton Mindfulness Scale
Metacognitions Questionnaire-30
Attention Control Scale
Breathing focus task
Debriefing

Appendix G. Rationale for the ATT and Control Condition

Worry is a chain of negative thoughts about potential negative future events where the outcome is uncertain. Worry becomes a persistent problem when people respond to it by changing their pattern of attention and thinking. Most people don't recognize that their attention has become locked onto dwelling on themselves, their thoughts, and their feelings. This process prolongs and increases the experience of worry. Unfortunately, people are usually unaware of this process and it can be difficult to interrupt.

You will listen to a recording that will make it easier for you to break free of old and unhelpful thinking patterns. Listening to this recording daily should help to strengthen and restore internal mental control mechanisms and help you to rediscover that you can make choices and exercise control over your attention. If we are flexible in the way we think, we can make choices over what to give attention to, and this helps us to eventually stop worrying. You should listen to this recording when you are not in a state of anxiety or worry, and be sure you are not using the recording to try and actively get rid of symptoms or thoughts.

Appendix H. Instructions for ATT

It is important to become more aware of the focus of your attention, and strengthen your control over it. You will listen to a recording that will make it easier for you to break free of old and unhelpful thinking patterns. The aim of the recording is not to distract you from upsetting thoughts or feelings. In fact, these are likely to occur as you practice. You must not try to stop them. The aim is to continue to follow the procedure while allowing the inner experiences to take care of themselves. You can simply think of these experiences as passing events in your mind and body.

Appendix I. Instructions for Control Condition

You are about to listen to a recording of sounds and a voice. Prepare yourself to listen. Make sure you are comfortable.

Appendix J. ATT Script

To begin with, focus on the sound of *my voice*. Pay close attention to *that sound*, no other sound matters. Try to give all of your attention to the sound of my voice and ignore all of the other sounds around you. You may hear them but try not to focus on them. Give all of your attention to my voice. Focus only on *that sound*; no other sound matters. No other sound is important. Now focus your attention on the sound of the clock. Give all of your attention to that one sound. No other sound matters. No other sound is important. Focus your attention on that one sound. If your attention begins to stray, refocus on the sound of the clock. Monitor that sound closely. No other sound matters. No other sound is important.

Now turn your attention and focus on the sound of the church bell. Give all of your attention to that one sound. Try not to be distracted. No other sound is important. Focus all of your attention on the sound of the bell. Turn your attention and focus on the sound of traffic. Give all of your attention to the sound of traffic. Don't allow yourself to be distracted, focus entirely on that one sound. No other sound is important. Focus on the sound of traffic. Now focus on the sound of bird song. Pay close attention to that one sound, no other sound matters. Try to give all of your attention to the sound of birds' song and ignore all the other sounds around you. You may hear them but try to give all of your attention to that one sound. Now focus on the sound of running water. Turn your attention to that one particular sound. Try to give it all of your attention. Closely monitor that one sound of running water. No other sound matters. Give this one sound all of your attention. Continue to monitor *this sound* and if you are distracted, return your attention to it as quickly as you can. Now focus on the sound of insects. Listen out closely for that particular sound. Closely monitor that sound. If your attention begins to stray or is

captured by another sound, refocus on the sound of insects. No other sound matters. Give all of your attention to that one sound.

Now turn your attention to sounds you can hear outside of this recording. Sounds that you might hear behind you. Focus on that area of space. Try to detect any sounds that might occur there. Give all your attention to that area of space. None of the sounds matter. Focus on the space behind you, try to determine any sounds that might occur there. Now focus your attention on your left hand side, away from the sounds on the recording. Focus on your left hand side and determine if any sounds occur there. Give all of your attention to that area of space. None of the other sounds matter. Turn your attention to your right hand side, focusing again *away* from the recording. Focus on that area of space. Try to determine if any sounds have occurred there. Give all of your attention to that one place. None of the sounds matter. Focus all of your attention on that one area.

I would now like you to rapidly shift your attentional focus between the different sounds and areas in the space, that you have identified. Begin by focusing on the sound of the clock. Pay close attention to that particular sound, no other sound matters. Give it all of your attention. Now turn your attention and focus on the sound of the traffic. Play close attention to that sound, none of the other sounds on the recording. Switch your attention and focus on the sound of running water. Give all of your attention to that one sound. And now focus on the sound of the church bell. Give all of your attention to that one particular sound. Turn your attention and focus on the sound of insects. Focus intensely on the sound of insects. Try not to be distracted. And now focus away from the recording, on the sounds behind you. Focus entirely on that area of space. And now focus on your left, and focus on your right. Focus on the sound of the clock. Now turn your attention to the bird song. Focus on the sound of running water. Focus on the church bell.

Focus on the sounds away from the recording on your left hand side. Now turn your attention to the running water. Focus on the sounds away from the recording, behind you. Now turn your attention to the church bell. Focus on the sound of the clock.

And now I would like you to make your attention as broad and as deep as possible. Try to focus on all of the sounds simultaneously. Expand your attention, try to absorb all the sounds and spatial locations you have identified at the same time. Count the number of sounds you can hear simultaneously. This concludes the exercise.

Appendix K. Control Condition Script

You are now listening to a recording of sounds. The sounds are now playing; the sounds will continue to play. There are many sounds playing on this recording. There are different types of sounds. Some of the sounds are loud and others are soft. Some sounds are clear. Other sounds are less clear. Some are loud. The sounds continue to play on this recording. There are insects, and there is also a clock, and there is also running water playing. Many sounds continue to play at once. Some sounds may be louder than others; others may be soft. There are birds chirping and there is a bell ringing. The sounds keep playing. Sometimes sounds may stop playing; sometimes they are all playing.

There are a variety of sounds. This is simply a recording of sounds. They continue to play. Sometimes a sound of traffic will play at points on this recording. Some sounds are not so easy to hear. This recording has sounds. The sounds are now playing. Some of them are loud. Some play consistently. Some sounds occur only occasionally. A bird squawks at times. Meanwhile, the church bell continues to ring. There are many sounds playing on this recording. There are birds chirping. A bell constantly rings. There is also a clock. There are many sounds playing on this recording. My voice is a sound on this recording. There is some traffic that is now playing. Not all sounds are always there. This is simply a recording of sounds. Some sounds are very clear; others are may be less clear. Some sounds are louder than others. Some sounds play constantly, while other sounds play only occasionally. My voice plays on occasion. Many sounds continue to play at once. There are many sounds playing on this recording. This is simply a recording of sounds. Sometimes it sounds like traffic drives by. There are bells, and there is also a clock, and there is also my voice playing. Some sounds are clear. Other sounds are less clear. Some are loud. The sounds will continue to keep playing on this recording. My voice is

also a sound. There are many sounds. A variety of sounds are playing. The sounds are now playing. Some of them are loud. Some play consistently. Some sounds occur only occasionally. There is occasionally a sound of running water.

The sounds continue to play. There may be a faint sound of insects at times. Other sounds are louder. There are many sounds playing. My voice is a sound. At times some sounds will stop while others play. There are many sounds playing on this recording. There are different types of sounds. Some of the sounds are loud and others are soft. Some are clear. There are bells, and there is also a clock, and there is also my voice playing. This is a recording of a variety of sounds. The sounds will continue to play. The sounds are now playing. Some of them are loud. Some play consistently.

Some sounds occur only occasionally. There may be a faint sound of insects at times. Other sounds are louder. There is occasionally a sound of running water. My voice is a sound. Birds are another sound. Some sounds are clear. Other sounds are less clear. Some are loud. The sounds continue to play on this recording. The sounds will continue to play. Not all sounds play at once. There are sounds playing. Sometimes there will be running water, or traffic, or insects. The sounds are playing. There are many sounds of different types and volumes. The sounds will continue to play. At times some sounds will stop playing. There are many sounds playing on this recording right now. A variety of sounds are playing including some insects, and a clock and bell. There are many sounds playing on this recording. At times some sounds will stop while others play. This is simply a recording of sounds. They continue to play. Some sounds may be louder than others; others may be soft. Running water is a sound that plays at times during this recording. The sounds keep playing. The sounds are different. Some sounds may be louder than others; others may be soft. At times some sounds are quiet. There are many different sounds.

There is sometimes a sound of traffic. You may hear some birds. There are sounds that play loud while others are softer. There are sounds playing. This is simply a recording that plays sounds. A variety of sounds are playing including birds, and a clock and bell. There are some sounds playing on this recording. The sounds will continue to play at different volumes. There are a variety of sounds right now. At times some sounds will stop while others play. There are birds chirping. There are insects and there is also running water. Some sounds will stop playing while others continue. Some sounds are louder than others. Some sounds play constantly, while other sounds play only occasionally. Traffic plays on occasion. There are many sounds playing on this recording. This concludes the exercise.

Appendix L. Homework Instructions for the ATT Condition

The researcher in this study has introduced you to this recording and has asked you to listen to it for homework. Listening to this recording requires consistent and regular listening in order to work effectively. The entire process takes around 14 minutes. It is best to listen once a day. Please dedicate this time to listening to the recording, and avoid engaging in any other activities at this time (e.g., homework, cleaning).

Please read these notes carefully before you listen to the recording, as they contain important information about the use of the recording. If you do want to know more about the recording and its scientific background, then you can follow up with the researcher at the end of the study.

A Few Important Tips Before You Begin

This recording is not a coping strategy. It should not be used to try to control anxiety or control unwanted thoughts or feelings. You should listen to the recording when you are not in a state of anxiety or worry, and be sure you are not using the recording to try to actively get rid of symptoms or thoughts. If you are suffering from ongoing low mood, then it is inevitable that you will listen to the recording when feeling this way. Discuss any questions or concerns you have about the recording with the researcher.

Listening to this recording daily should help to strengthen and restore internal mental control mechanisms and help you to rediscover that you can make choices and exercise control over your attention.

Getting Started

You can listen to your recording on a computer, either out of the speaker or you can listen with headphones and still try to listen for sounds outside of them. Please do not wear noise cancelling headphones, and if you chose to wear headphones, please ensure both the left and right ear work. Please ensure that you are able to hear the sound of the bell; if not, try listening with another method (e.g., try with headphones if not using them, or without headphones if using them).

Please ensure that the volume is not so loud that you cannot hear other sounds outside of the recording.

Some people find listening to this recording difficult. Like any exercise, it becomes easier with practice. You should try to listen with your eyes open.

Side Effects

It is unlikely that listening to this recording will produce any long term adverse side effects. None have been reported so far, but this is based on a relatively small sample of people. Some people have said that they feel more alert after listening to the recording and that they are more sensitive to sights and sounds. A small number of people become frustrated because this recording is very unfamiliar to them. If listening to the recording is too difficult or causes discomfort, then stop the recording and talk this over with the researcher.

Are you unable to hear everything?

The recording consists of some sounds that are continuous and some that come and go. Some of the sounds are very difficult to detect or are not always present when you are instructed to listen

for them. The recording is made this way. The point is that you do NOT need to detect all of them when instructed, but you should try to. This is an exercise in stopping any analyzing, giving up judgements, and rediscovering how the control of your attention is separate from your thoughts and separate from events in your body and the outside world.

Appendix M. Homework Instructions for the Control Condition

The researcher in this study has introduced you to this recording and has asked you to listen to it for homework. Listening to this recording requires consistent and regular listening in order to work effectively. The entire process takes around 14 minutes. It is best to listen once a day. Please dedicate this time to listening to the recording, and avoid engaging in any other activities at this time (e.g., homework, cleaning).

Please read these notes carefully before you listen to the recording, as they contain important information about the use of the recording. If you do want to know more about the recording and its scientific background, then you can follow up with the researcher at the end of the study.

A Few Important Tips Before You Begin

This recording is not a coping strategy. It should not be used to try to control anxiety or control unwanted thoughts or feelings. You should listen to the recording when you are not in a state of anxiety or worry, and be sure you are not using the recording to try to actively get rid of symptoms or thoughts. If you are suffering from ongoing low mood, then it is inevitable that you will listen to the recording when feeling this way. Discuss any questions or concerns you have about the recording with the researcher.

Listening to this recording daily should help to strengthen and restore internal mental control mechanisms and help you to rediscover that you can make choices and exercise control over your attention.

Getting Started

You can listen to your recording on a computer, either out of the speaker or you can listen with

headphones. Please do not wear noise cancelling headphones, and if you chose to wear headphones, please ensure both the left and right ear work. Please ensure that you are able to hear the sound of the bell; if not, try listening with another method (e.g., try with headphones if not using them, or without headphones if using them).

Please ensure that the volume is not so loud that you cannot hear other sounds outside of the recording.

Some people find listening to this recording difficult. Like any exercise, it becomes easier with practice. You should try to listen with your eyes open.

Side Effects

It is unlikely that listening to this recording will produce any long term adverse side effects. None have been reported so far, but this is based on a relatively small sample of people. Some people have said that they feel more alert after listening to the recording and that they are more sensitive to sights and sounds. A small number of people become frustrated because this recording is very unfamiliar to them. If listening to the recording is too difficult or causes discomfort, then stop the recording and talk this over with the researcher.

Appendix N. Between-Group Comparisons of Credibility, Expectancy, and Engagement in the Recording

	Mean Difference	Standard Error	*p*
Logic	0.85	0.75	.27
Success	1.72	0.79	.04*
Confidence in Recommending	1.21	0.93	.21
Expected degree of improvement	15.52	10.26	.14
Feeling	0.38	0.80	.64
Feeling about degree of improvement	3.57	9.96	.72
Focus on recording	4.66	3.07	.13

Note. Logic=How logical it appears to use the recording daily. Success=How successful the participant believes using the recording daily will be. Confidence in Recommending=How confident the participant would be in recommending the recording to a friend with similar concerns. Expected degree of improvement=% expected improvement in worry. Feeling=How much the participant believes the recording will improve their worry. Feeling about degree of improvement=% expected improvement in worry the individual *believes* they will experience. Focusing=% time focusing on the recording.
*p<.05

Appendix O. *Between and Within Subjects Interaction of Self-Focused Attention*

	Sum of Squares	df	*F*	*p*	ηp^2
Change in self-focused attention	0.39	1	0.23	.64	.01

Note. Change self-focused attention represents the average change seen immediately after listening to the recording, compared to before, between groups.

Appendix P. Means and Standard Deviations for Measures of Symptoms and Processes at Baseline, Preintervention, and Postintervention, Separated by Condition

	ATT (*n*=14)	Control (*n*=15)
	Mean (SD)	Mean (SD)
PSWQ-PW		
Baseline	73.50 (6.82)	70.80 (8.06)
Preintervention	71.36 (8.55)	67.36 (11.45)
Postintervention	65.64 (14.04)	62.80 (13.02)
BF Intrusions		
Baseline	1.92 (1.12)	-0.21 (0.89)
Preintervention	1.31 (1.65)	0.14 (0.77)
Postintervention	1.15 (2.38)	0.86 (1.7)
BF Intrusions Negative		
Baseline	1.77 (2.20)	0.57 (1.56)
Preintervention	1.54 (1.51)	0.57 (1.34)
Postintervention	1.69 (2.18)	0.71 (1.0)
BF Time Spent Breathing		
Baseline	-19.23 (14.12)	-7.86 (19)
Preintervention	-19.69 (17.50)	-8.07 (14.75)
Postintervention	-14.23 (20.60)	-1.30 (20.04)
BF Difficulty Breathing		
Baseline	9.23 (28.64)	13.57 (31.10)
Preintervention	13.85 (25.26)	10.00 (11.77)
Postintervention	10.00 (27.16)	4.14 (27.53)

	ATT (*n*=14)	Control (*n*=15)
	Mean (SD)	Mean (SD)
BF Time Worrying		
Baseline	22.31 (22.60)	11.64 (25.34)
Preintervention	17.54 (20.05)	15.14 (14.29)
Postintervention	32.54 (29.63)	20.43 (25.620)
ACS Total		
Baseline	44.07 (12)	44.00 (8.34)
Preintervention	42.71 (9.07)	44.29 (7.53)
Postintervention	44.92 (12.82)	45.53 (6.89)
ACS Focusing		
Baseline	15.50 (4.65)	15.47 (3.44)
Preintervention	13.64 (4.63)	15.71 (4.21)
Postintervention	16.57 (5.29)	16.50 (3.17)
ACS Shifting		
Baseline	10.86 (3.30)	10.87 (2.80)
Preintervention	10.64 (3.32)	10.64 (3.03)
Postintervention	10.29 (4.05)	11.07 (3.50)
MCQ-CSC		
Baseline	17.64 (3.34)	18.80 (3.32)
Preintervention	17.07 (2.23)	17.93 (3.71)
Postintervention	16.36 (3.84)	18.07 (3.50)
MCQ-NB		
Baseline	17.14 (4.00)	17.40 (4.40)
Preintervention	16.64 (3.84)	16.47 (4.47)
Postintervention	14.43 (4.31)	16.40 (3.60)

	ATT (*n*=14)	Control (*n*=15)
	Mean (SD)	Mean (SD)
SMQ		
Baseline	37.93 (13.97)	32.00 (11.24)
Preintervention	37.57 (15.00)	33.33 (9.05)
Postintervention	43.07 (14.58)	35.87 (10.91)
ANT		
Baseline	101.90 (41.04)	123.77 (48.20)
Preintervention	80.03 (33.83)	93.20 (33.78)
Postintervention	70.51 (25.69)	79.37 (69.13)
ABI		
Baseline	6.83 (23.16)	9.23 (28.64)
Preintervention	10.84 (14.00)	4.37 (17.88)
Postintervention	2.90 (10.76)	-10.77 (22.86)
Daily Diary-Number of Worry Episodes		
Baseline	3.74 (1.95)	4.19 (2.13)
Intervention	3.29 (1.87)	3.70 (2.55)
Daily Diary-Minutes of Worry		
Baseline	75.88 (74.13)	94.84 (137.45)
Intervention	69.00 (88.08)	89.53 (134.35)
Daily Diary- Intensity of Worry		
Baseline	3.46 (1.31)	3.40 (1.48)
Intervention	3.31 (1.34)	3.27 (1.53)

	ATT (*n*=14)	Control (*n*=15)
	Mean (SD)	Mean (SD)
Daily Diary- Uncontrollability of Worry		
Baseline	3.31 (1.60)	3.51(1.56)
Intervention	3.22 (1.68)	3/27 (1.70)
Daily Diary- Focus of Attention		
Baseline	3.66 (1.50)	3.50 (1.52)
Intervention	3.10 (1.67)	3.38 (1.20)

Note. ATT=Attention training technique. ACS Total=Attention Control Scale, Total Score; ACS Focusing=Attention Control Scale, Focusing Subscale; ACS Shifting=Attention Control Scale, Shifting Subscale; MCQ-CSC=Metacognitions Questionnaire-30, Cognitive Self Consciousness Subscale; MCQ-NB=Metacognitions Questionnaire-30, Negative Beliefs about Worry Subscale; PSWQ-PW=Penn State Worry Questionnaire Past Week; SMQ=Southampton Mindfulness Questionnaire; ANT=Attention Network Task (executive function score); ABI=Attention Bias Index on the dot-probe task. A smaller ANT number represents greater attentional control. A larger positive ABI indicates a greater bias to threat information. BF Intrusions=Breathing focus task, difference in total number of intrusions, pre to post worry period; BF Intrusions Negative=Breathing focus task, difference in number of negative intrusions, pre to post worry period. A positive number on these two indices indicates a greater number of intrusions following the worry period compared to before. BF Time Spent Breathing=Breathing focus task, difference in time spent breathing during breathing periods, pre to post worry, in percentage; BF Difficulty Breathing=Breathing focus task, difference in difficulty focusing on breathing during breathing periods, pre to post worry, in percentage; BF Time Worrying=Breathing focus task, difference in time spent worrying during breathing periods, pre to post worry, in percentage. A positive number on these indices indicates a greater % following the worry period compared to before.

Appendix Q. Correlations at Baseline in the Total Sample

	ACS-T	ACS-F	ACS-S	MCQ-CSC	MCQ-NB	PSWQ-PW	SMQ	ANT	ABI
ACS-T	--								
ACS-F	.82**	--							
ACS-S	.83**	.41*	--						
MCQ-CSC	-.12	-0.04	-.14	--		.			
MCQ-NB	-.23	-.20	-.09	.31	--				
PSWQ-PW	-.48**	-.41*	-.37*	03	.44*	--			
SMQ	.39*	.28	.31	-.29	-.62**	-.24	--		
ANT	-.38	-.29	-.29	.27	.42*	.24	-.36	--	
ABI	-.13	-.25	-.01	-.48	.18	.11	-.22	.57*	
BF Intrusions	.09	-.04	.14	-.12	.01	.07	.23	.01	.02
BF Neg Intrusions	-.18	-.38	.02	.19	-.13	.22	.02	.09	.10
BF Time Breathing	-.10	.09	-.19	.00	.12	.16	-.26	.10	-.28
BF Diff Breathing	.10	.22	-.12	-.35	-.14	-.19	.05	.01	.29
BF Time Worrying	-.15	-.14	-.13	.20	-.24	-.09	.15	.12	.45

Note. ACS_T=Attention Control Scale, Total Score; ACS_F=Attention Control Scale, Focusing Subscale; ACS_S=Attention Control Scale, Shifting Subscale; MCQ-CSC=Metacognitions Questionnaire-30, Cognitive Self Consciousness Subscale; MCQ-NB=Metacognitions Questionnaire-30, Negative Beliefs about Worry Subscale; PSWQ-PW=Penn State Worry Questionnaire Past Week; SMQ=Southampton Mindfulness Questionnaire; ANT=Attention Network Task

(executive function score); ABI=Attention Bias Index on the dot-probe task. A smaller ANT number represents greater attentional control. A larger positive ABI indicates a greater bias to threat information. BF Intrusions=Breathing focus task, difference in total number of intrusions, pre to post worry period; BF Neg Intrusions =Breathing focus task, difference in number of negative intrusions, pre to post worry period. A positive number on these two indices indicates a greater number of intrusions following the worry period compared to before. BF Time Breathing=Breathing focus task, difference in time spent breathing during breathing periods, pre to post worry, in percentage; BF Diff Breathing=Breathing focus task, difference in difficulty focusing on breathing during breathing periods, pre to post worry, in percentage; BF Time Worrying=Breathing focus task, difference in time spent worrying during breathing periods, pre to post worry, in percentage. A positive number on these indices indicates a greater % following the worry period compared to before.
** $p < .01$, * $p < .05$

Appendix R. 3x2 Repeated Measures ANOVAs for Outcome Variables

Comparisons	Sum of Squares	df	*F*	*p*	ηp^2
PSWQ-PW					
Time	1017.45	1.62	6.54	.006**	.20
Condition	201.20	1	1.06	.31	.04
Time X Condition Interaction	13.17	1.62	0.09	.88	.00
BF Intrusions					
Time	1.06	2	0.23	.80	.01
Condition	29.10	1	12.88	.001**	.34
Time X Condition Interaction	11.43	2	2.50	.10	.10
BF Intrusions Negative					
Time	0.33	2	0.11	.90	.00
Condition	22.19	1	4.14	.05*	.14
Time X Condition Interaction	0.23	2	0.08	.93	.00
BF Time Spent Breathing					
Time	638.91	1.63	0.99	.36	.04
Condition	2902.23	1	9.28	.005**	.27
Time X Condition Interaction	9.62	1.63	0.02	.97	.00
BF Difficulty Breathing					
Time	382.45	1.44	0.27	.69	.01
Condition	64.62	1	0.11	.75	.00
Time X Condition Interaction	393.35	1.44	0.28	.69	.01

Comparisons	Sum of Squares	df	*F*	*p*	η^2
BF Time Worrying					
Time	1740.79	1.44	1.95	.17	.07
Condition	1423.52	1	1.90	.18	.07
Time X Condition Interaction	370.37	1.44	0.41	.60	.02
ACS Total					
Time	40.81	1.35	0.71	.44	.03
Condition	0.45	1	0.002	.96	.00
Time X Condition Interaction	27.21	1.35	0.48	.55	.02
ACS Focusing					
Time	42.94	1.29	1.76	.32	.04
Condition	4.53	1	0.15	.70	.01
Time X Condition Interaction	27.13	1.30	1.11	.32	.04
ACS Shifting					
Time	0.02	2	0.01	1	.00
Condition	0.30	1	0.01	.92	.00
Time X Condition Interaction	4.17	2	0.89	.42	.03
MCQ-CSC					
Time	16.65	2	1.94	.15	.07
Condition	33.56	1	1.35	.26	.05
Time X Condition Interaction	2.68	2	0.33	.72	.01
MCQ-NB					
Time	50.82	2	3.33	.04*	.11
Condition	10.17	1	0.29	.60	.01
Time X Condition Interaction	18.68	2	1.23	.30	.04

Comparisons	Sum of Squares	df	F	p	η^2
SMQ					
Time	354	1.60	3.05	.07	.10
Condition	728.40	1	2.03	.17	.07
Time X Condition Interaction	32.07	1.59	0.28	.71	.01
ANT					
Time	2396.30	2	3.60	.04*	.20
Condition	439.33	1	0.84	.38	.06
Time X Condition Interaction	574.91	2	0.86	.43	.06
ABI					
Time	2396.30	1.94	3.59	.04*	.20
Condition	439.33	1	0.84	.38	.06
Time X Condition Interaction	574.91	1.94	0.86	.43	.06

Note. ACS Total=Attention Control Scale, Total Score; ACS Focusing=Attention Control Scale, Focusing Subscale; ACS Shifting=Attention Control Scale, Shifting Subscale; MCQ-CSC=Metacognitions Questionnaire-30, Cognitive Self Consciousness Subscale; MCQ-NB=Metacognitions Questionnaire-30, Negative Beliefs about Worry Subscale; PSWQ-PW=Penn State Worry Questionnaire Past Week; SMQ=Southampton Mindfulness Questionnaire; ANT=Attention Network Task (executive function score); ABI=Attention Bias Index on the dot-probe task. A smaller ANT number represents greater attentional control. A larger positive ABI indicates a greater bias to threat information. BF Intrusions=Breathing focus task, difference in total number of intrusions, pre to post worry period; BF Intrusions Negative=Breathing focus task, difference in number of negative intrusions, pre to post worry period. A positive number on these two indices indicates a greater number of intrusions following the worry period compared to before. BF Time Spent Breathing=Breathing focus task, difference in time spent breathing during breathing periods, pre to post worry, in percentage; BF Difficulty Breathing=Breathing focus task, difference in difficulty focusing on breathing during breathing periods, pre to post worry, in percentage; BF Time Worrying=Breathing focus task, difference in time spent worrying during breathing periods, pre to post worry, in percentage. A positive number on these indices indicates a greater % following the worry period compared to before.

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

Appendix S. 2x2 Repeated Measures ANOVA of Attention Bias Index

	Sum of Squares	df	*F*	*p*	ηp^2
ABI					
Time	1716.28	1	4.15	.06	.24
Condition	493.88	1	1.69	.22	.12
Time*Condition	9.14	1	0.022	.88	.002

Note. ANOVA=Analysis of variance. ABI=Attention Bias Index on the dot-probe task. A larger positive ABI indicates a greater bias to threat information.

Appendix T. Pairwise Comparisons from Repeated Measures ANOVAs.

		Mean Difference	Standard Error	*p*
PSWQ-PW				
Pre-Baseline		-3.11	1.76	.09
Post-Baseline		-8.43	2.42	.002**
Post-Pre		-5.32	2.78	.07
BF Intrusions				
ATT	Control	1.20	0.33	.001**
BF Intrusions Negative				
ATT	Control	1.05	0.52	.05*
BF Time Spent Breathing				
ATT	Control	-11.98	3.93	.01**
MCQ-NB				
Pre-Baseline		-0.72	0.66	.29
Post-Baseline		-1.86	0.75	.02**
Post-Pre		-1.14	0.76	.15

	Mean Difference	Standard Error	*p*
ANT			
Pre-Baseline	-23.62	4.11	<.001***
Post-Baseline	-35.37	9.13	.001***
Post-Pre	-11.75	8.92	.20
ABI			
Pre-Baseline	1.83	6.74	.79
Post-Baseline	-13.99	6.76	.06
Post-Pre	-15.82	5.84	.02**

Note. ANOVA=Analysis of variance. Mean differences represent the difference between the two conditions listed. Pre=preintervention (Visit 2). Post=Postintervention (Visit 3). MCQ-NB=Metacognitions Questionnaire-30, Negative Beliefs about Worry Subscale; PSWQ-PW=Penn State Worry Questionnaire Past Week; ANT=Attention Network Task (executive function score); ABI=Attention Bias Index on the dot-probe task. A smaller ANT number represents greater attentional control. A larger positive ABI indicates a greater bias to threat information. BF Intrusions=Breathing focus task, difference in total number of intrusions, pre to post worry period; BF Intrusions Negative=Breathing focus task, difference in number of negative intrusions, pre to post worry period. A positive number on these two indices indicates a greater number of intrusions following the worry period compared to before. BF Time Spent Breathing=Breathing focus task, difference in time spent breathing during breathing periods, pre to post worry, in percentage. A positive number on this index indicates a greater % following the worry period compared to before.

*p=<.05; **p=<.01; ***p=<.001

Appendix U. Correlations Between Worry Measures

	Number	Minutes	Intensity	Uncontrollability
Baseline				
PSWQ-PW	.29	.57**	.58**	.67**
Number	--	.22	.31	.45*
Minutes	--	--	.28	.44*
Intensity	--	--	--	.82**
Intervention				
PSWQ-PW	.14	.41*	.54**	.57**
Number	--	.29	.47*	.50**
Minutes	--	--	.46*	.33
Intensity	--	--	--	.90**

Note. PSWQ-PW=Penn State Worry Questionnaire Past Week. Number=Average number of worry episodes. Minutes=Average minutes of worry. Intensity=Average intensity of worry. Uncontrollability=Average uncontrollability of worry.
*p=<.05; **p=<.01

Appendix V. Multilevel Linear Models- Simple Slopes

	Estimate	SE	*t*	*p*
Number of Worry Episodes				
ATT				
Intercept	3.87	0.51	7.56	<.001
Condition	0.39	0.74	0.53	.60
Week 1- Control	-0.04	0.07	-0.51	.61
Week 2- Control	-0.07	0.07	-0.96	.34
Week 1 X Condition Interaction	0.05	0.11	0.46	.65
Week 2 X Condition Interaction	-0.08	0.11	-0.77	.45
Control				
Intercept	4.27	0.53	8.06	<.001
Condition	-0.39	0.74	-0.53	.60
Week 1- Control	0.01	0.08	0.16	.88
Week 2- Control	-0.15	0.08	-1.95	.05*
Week 1 X Condition Interaction	-0.05	0.11	-0.46	.65
Week 2 X Condition Interaction	0.08	0.11	0.77	.45

	Estimate	SE	*t*	*p*
Minutes of Worry				
ATT				
Intercept	77.62	28.52	2.72	.01
Condition	9.38	40.44	0.23	.82
Week 1	-0.69	2.04	-0.34	.74
Week 2	0.38	2.12	0.18	.86
Week 1 X Condition Interaction	3.95	3.00	1.33	.18
Week 2 X Condition Interaction	6.23	3.04	-2.05	.04*
Control				
Intercept	87.00	28.67	3.03	.005
Condition	-9.38	40.44	-0.23	.82
Week 1	3.26	2.15	1.52	.13
Week 2	-5.85	2.18	-2.68	.008
Week 1 X Condition Interaction	-3.95	2.97	-1.33	.18
Week 2 X Condition Interaction	6.22	3.04	2.05	.04*

	Estimate	SE	*t*	*p*
Intensity of Worry				
ATT				
Intercept	3.44	0.28	12.18	<.001
Condition	0.07	0.41	0.17	.87
Week 1	-0.01	0.05	-0.15	.88
Week 2	0.0	0.06	0.17	.87
Week 1 X Condition Interaction	0.0	0.08	0.15	.88
Week 2 X Condition Interaction	0.08	0.08	-0.93	.35
Control				
Intercept	3.51	0.29	12.02	<.001
Condition	-0.07	0.41	-0.17	.87
Week 1	0.00	0.06	0.06	.95
Week 2	-0.07	0.06	-1.15	.25
Week 1 X Condition Interaction	-0.01	0.08	-0.15	.88
Week 2 X Condition Interaction	0.08	0.08	0.93	.35

	Estimate	SE	*t*	*p*
Uncontrollability of Worry				
ATT				
Intercept	3.61	0.34	10.70	<.001
Condition	-0.14	0.48	-0.29	.77
Week 1	-0.08	0.06	-1.38	.17
Week 2	0.08	0.06	1.26	.21
Week 1 X Condition Interaction	0.11	0.09	1.25	.21
Week 2 X Condition Interaction	-0.15	0.09	-1.66	.10
Control				
Intercept	3.47	0.35	9.98	<.001
Condition	0.14	0.48	0.29	.77
Week 1	0.03	0.06	0.41	.68
Week 2	-0.07	0.06	-1.09	.28
Week 1 X Condition Interaction	-0.11	0.09	-1.25	.21
Week 2 X Condition Interaction	0.15	0.09	1.66	.10

	Estimate	SE	*t*	*p*
Focus of Attention				
ATT				
Intercept	3.88	0.31	12.54	<.001
Condition	-0.47	0.44	-1.06	.29
Week 1	-0.08	0.05	-1.53	.13
Week 2	-0.01	0.05	-0.23	.82
Week 1 X Condition Interaction	0.10	0.08	1.38	.17
Week 2 X Condition Interaction	-0.02	0.08	-0.31	.76
Control				
Intercept	3.41	0.32	10.74	<.001
Condition	0.47	0.44	1.06	.29
Week 1	0.02	0.05	0.44	.66
Week 2	-0.04	0.05	-0.66	.51
Week 1 X Condition Interaction	-0.10	0.08	-1.38	.17
Week 2 X Condition Interaction	0.02	0.08	0.31	.76

Note. ATT=Attention training technique. Intercept represents the mean value of the outcome variable at day 1. Condition represents the change in the outcome mean as condition changes. Week 1 represents the slope of the outcome measure over the baseline period. Week 2 represents the slope of the outcome measure over the intervention period. Condition*Week 1 and Condition*Week 2 represent the interaction of those terms.
*p=<.05

Appendix W. Multilevel Main Effects Linear Models

	Estimate	SE	*t*	*p*
Number of Worry Episodes				
Intercept	4.31	0.48	9.03	<.001
Condition	-0.48	0.61	-0.78	.44
Week 1	-0.01	0.05	-0.28	.78
Week 2	-0.11	0.05	-2.04	**.04**
Minutes of Worry				
Intercept	91.00	28.00	3.25	.003
Condition	-16.94	38.67	-0.44	.67
Week 1	1.19	1.50	0.80	.43
Week 2	-2.65	1.52	-1.74	.08
Intensity of Worry				
Intercept	3.46	0.24	14.42	<.001
Condition	0.02	0.26	0.08	.94
Week 1	-0.00	0.04	-0.06	.96
Week 2	-0.03	0.04	-0.70	.48
Uncontrollability of Worry				
Intercept	3.60	0.29	12.28	.<001
Condition	-0.12	0.33	-0.37	.72
Week 1	-0.03	0.04	-0.70	.48

Week 2	0.00	0.05	0.12	.90
Focus of Attention				
Intercept	3.65	0.28	13.22	<.001
Condition	-0.00	0.33	-0.00	1.00
Week 1	-0.03	0.04	-0.80	.42
Week 2	-0.02	0.04	-0.59	.56

Note. ATT=Attention training technique. Intercept represents the mean value of the outcome variable at day 1 for the control condition. Condition represents the change in the outcome mean as condition changes (from control to ATT). Week 1 represents the slope of the outcome measure over the baseline period for the control condition. Week 2 represents the slope of the outcome measure over the intervention period for the control condition.

Appendix X. Multilevel Quadratic Models-Simple Slopes

	Estimate	SE	*t*	*p*
Number of Worry Episodes				
ATT				
Intercept	3.76	0.52	7.25	<.001
Condition	0.48	0.75	0.64	.52
Week 1	0.02	0.08	0.28	.78
Week 2	-0.43	0.25	-1.68	.10
Week 2^2	0.05	0.04	1.50	.14
Week 1 X Condition Interaction	0.00	0.12	0.04	.97
Week 2 X Condition Interaction	0.20	0.37	0.54	.59
Week 2^2 X Condition Interaction	-0.04	0.05	-0.81	.42
Control				
Intercept	4.24	0.54	7.88	<.001
Condition	-0.48	0.75	-0.64	.52
Week 1	0.03	0.10	0.30	.77
Week 2	-0.23	0.26	-0.87	.38
Week 2^2	0.01	0.04	0.32	.75
Week 1 X Condition Interaction	-0.00	0.12	-0.04	.97
Week 2 X Condition Interaction	-0.20	0.37	-0.54	.59
Week 2^2 X Condition Interaction	0.04	0.05	0.81	.42

	Estimate	SE	*t*	*p*
Minutes of Worry				
ATT				
Intercept	73.27	28.60	2.56	.02
Condition	12.15	40.55	0.30	.77
Week 1	1.52	2.36	0.65	.52
Week 2	-13.05	7.51	-1.74	.08
Week 2^2	2.04	1.10	1.86	.06
Week 1 X Condition Interaction	2.53	3.44	0.74	.46
Week 2 X Condition Interaction	2.82	10.62	0.27	.79
Week 2^2 X Condition Interaction	-1.40	1.53	-0.91	.36
Control				
Intercept	85.42	28.77	2.97	.006
Condition	-12.15	40.44	-0.30	.77
Week 1	4.05	2.51	1.62	.11
Week 2	-10.23	7.51	-1.36	.17
Week 2^2	0.65	1.06	0.61	.54
Week 1 X Condition Interaction	-2.6	3.44	-0.74	.46
Week 2 X Condition Interaction	-2.82	10.62	-0.27	.79
Week 2^2 X Condition Interaction	1.40	1.53	0.91	.36

	Estimate	SE	*t*	*p*
Intensity of Worry				
ATT				
Intercept	3.62	0.29	11.59	<.001
Condition	0.25	0.42	0.59	.56
Week 1	0.03	0.06	0.49	.63
Week 2	-0.22	0.20	-1.11	.27
Week 2^2	0.04	0.03	1.21	.23
Week 1 X Condition Interaction	-0.08	0.09	-0.84	.40
Week 2 X Condition Interaction	0.43	0.29	1.52	.13
Week 2^2 X Condition Interaction	-0.08	0.04	-1.87	.06
Control				
Intercept	3.61	0.30	12.01	<.001
Condition	-0.25	0.42	-0.59	.56
Week 1	-0.05	0.07	-0.69	.49
Week 2	0.21	0.20	1.04	.23
Week 2^2	-0.04	0.03	-1.44	.15
Week 1 X Condition Interaction	0.08	0.10	0.84	.40
Week 2 X Condition Interaction	-0.43	0.29	-1.53	.13
Week 2^2 X Condition Interaction	0.08	0.04	1.87	.06

	Estimate	SE	*t*	*p*
Uncontrollability of Worry				
ATT				
Intercept	3.60	0.35	10.34	<.001
Condition	-0.06	0.50	-0.13	.90
Week 1	-0.07	0.07	-0.93	.35
Week 2	-0.03	0.23	-.012	.91
Week 2^2	0.02	0.03	0.49	.63
Week 1 X Condition Interaction	0.07	0.10	0.71	.48
Week 2 X Condition Interaction	0.06	0.32	0.20	.84
Week 2^2 X Condition Interaction	-0.03	0.05	-0.70	.49
Control				
Intercept	3.51	0.36	9.82	<.001
Condition	0.06	0.50	0.13	.90
Week 1	0.01	0.07	0.09	.93
Week 2	0.04	0.22	0.17	.87
Week 2^2	-0.02	0.03	-0.50	.62
Week 1 X Condition Interaction	-0.07	0.10	-0.71	.48
Week 2 X Condition Interaction	-0.06	0.32	-0.20	.84
Week 2^2 X Condition Interaction	0.03	0.05	0.70	.49

	Estimate	SE	*t*	*p*
Focus of Attention				
ATT				
Intercept	3.80	0.32	12.02	<.001
Condition	-0.40	0.45	-0.89	.34
Week 1	-0.04	0.06	-0.60	.55
Week 2	-0.27	0.20	-1.40	.16
Week 2^2	0.04	0.03	1.39	.17
Week 1 X Condition Interaction	0.07	0.09	0.78	.43
Week 2 X Condition Interaction	0.19	0.27	0.69	.49
Week 2^2 X Condition Interaction	-0.03	0.04	-0.83	.41
Control				
Intercept	3.39	0.32	10.45	<.001
Condition	0.40	0.45	0.89	.34
Week 1	0.03	0.06	0.51	.61
Week 2	-0.08	0.19	-0.43	.67
Week 2^2	0.01	0.03	0.25	.80
Week 1 X Condition Interaction	-0.07	0.09	-0.78	.43
Week 2 X Condition Interaction	-0.19	0.27	-0.69	.49
Week 2^2 X Condition Interaction	0.03	0.04	0.83	.41

Note. ATT=Attention training technique. Intercept represents the mean value of the outcome variable at day 1. Condition represents the change in the outcome mean as condition changes. Week 1 represents the slope of the outcome measure over the baseline period. Week 2 represents the slope of the outcome measure over the intervention period. Week 2^2 represents the quadratic term for Week 2. The interaction terms represent the interaction between condition and time.

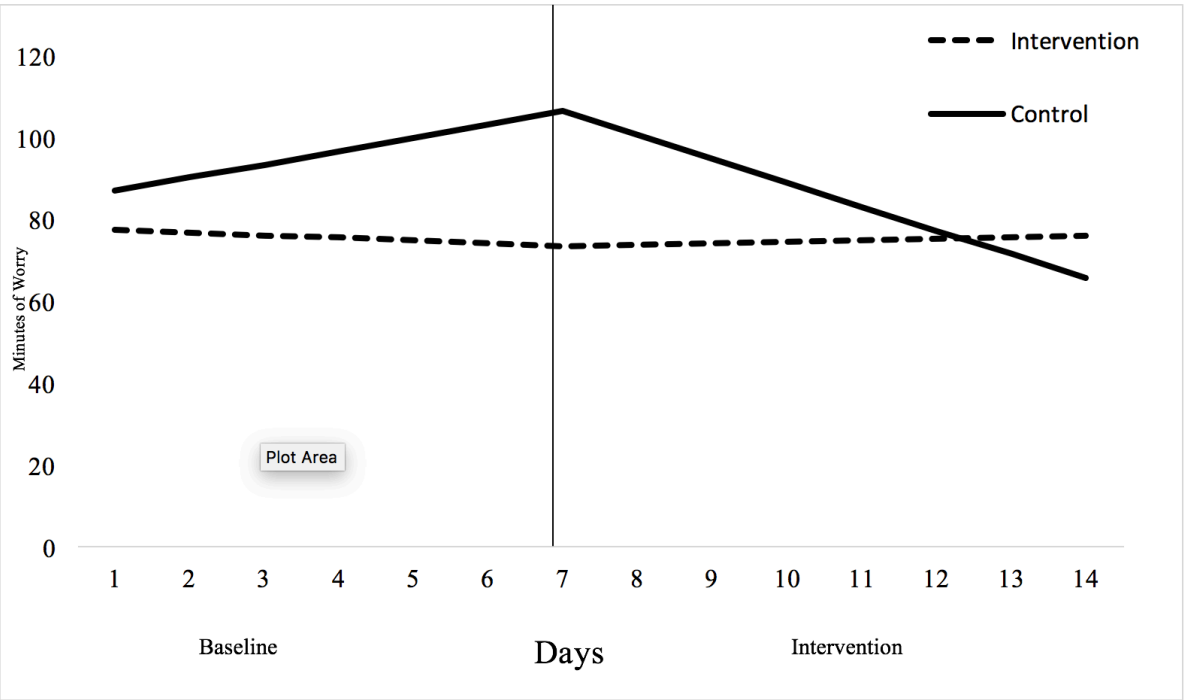
Appendix Y. Multilevel Main Effects Quadratic Models

	Estimate	SE	*t*	*p*
Number of Worry Episodes				
Intercept	4.23	0.48	8.81	<.001
Condition	-0.48	0.61	-0.78	.44
Week 1	0.02	0.06	0.37	.71
Week 2	-0.32	0.18	-1.76	.08
Week 2^2	0.03	0.03	1.22	.22
Minutes of Worry				
Intercept	88.16	28.03	3.15	.004
Condition	-16.94	38.66	-0.44	.67
Week 1	2.62	1.72	1.52	.13
Week 2	-10.98	5.32	-2.06	.04*
Week ^{2}	1.25	0.77	1.63	.10
Intensity of Worry				
Intercept	3.47	0.25	14.18	<.001
Condition	-0.02	0.26	0.08	.94
Week 1	-0.01	0.05	-0.18	.86
Week 2	0.01	0.14	0.04	.97
Week 2^2	-0.01	0.02	-0.25	.80

	Estimate	SE	*t*	*p*
Uncontrollability of Worry				
Intercept	3.61	0.30	12.09	<.001
Condition	-0.12	0.33	-0.37	.72
Week 1	-0.03	0.05	-0.66	.51
Week 2	0.02	0.16	0.14	.89
Week 2^2	-0.00	0.02	-0.11	.91
Focus of Attention				
Intercept	3.60	0.28	12.85	<.001
Condition	-0.00	0.33	-0.00	1.00
Week 1	-0.01	0.04	-0.12	.91
Week 2	-0.17	0.13	-1.24	.22
Week 2^2	0.02	0.02	1.12	.27

Note. ATT=Attention training technique. Intercept represents the mean value of the outcome variable at day 1 for the control condition. Condition represents the change in the outcome mean as condition changes (from control to ATT). Week 1 represents the slope of the outcome measure over the baseline period for the control condition. Week 2 represents the slope of the outcome measure over the intervention period for the control condition. Week 2^2 represents the quadratic term for Week 2.
*p=<.05

Appendix Z. Simple Slopes for Minutes of Worry.



Appendix AA. Relationship Between Number of Practices and Change in Outcome Measures from Preintervention to Postintervention in the ATT Condition

	B	*SE*	*p*
PSWQ-PW	.18	3.05	.54
Breathing Focus			
Intrusions	.08	0.63	.80
Negative Intrusions	.02	0.58	.94
Time Breathing	.11	5.75	.72
Time Worrying	.08	7.86	.80
Difficulty Breathing	.19	8.59	.54
ACS	-.23	2.98	.44
MCQ-CSC	.16	0.69	.59
MCQ-NB	.34	1.20	.24
SMQ	.02	3.98	.96
ANT	.22	14.37	.49
Dot-probe	.05	4.41	.91
Diary			
Number	.16	1.09	.64
Minutes	.42	29.02	.18
Intensity	.41	0.77	.18
	B	*SE*	*p*

Uncontrollability	.22	0.62	.50
Self-focus	.17	0.50	.61

Note. ATT=Attention training technique. Number=Change in number of worry episodes from day 8 to 14; Minutes=Change in minutes of worry from day 8 to 14; Intensity=Change in intensity from day 8 to 14; Uncontrollability=Change in uncontrollability of worry from day 8 to 14; Self-Focus=Change in self-focus attention from day 8 to 14; Intrusions=Difference in total number of intrusions, pre to post worry period; Negative Intrusions=Difference in number of negative intrusions, pre to post worry period; Time Breathing=difference in time spent breathing during breathing periods, pre to post worry; Time Worrying=Difference in time spent worrying during breathing periods, pre to post worry; Difficulty Breathing=Difference in difficulty focusing on breathing during breathing periods, pre to post worry; Attention Control Scale, Total Score; MCQ-CSC=Metacognitions Questionnaire-30, Cognitive Self Consciousness Subscale; MCQ-NB=Metacognitions Questionnaire-30, Negative Beliefs about Worry Subscale; PSWQ-PW=Penn State Worry Questionnaire Past Week; SMQ=Southampton Mindfulness Questionnaire; ABI=Attention Bias Index on the dot-probe task. ANT=Attention Network Task (AC=executive function score).

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author.

Amir, N., Beard, C., Burns, M., & Bomyea, J. (2009). Attention modification program in individuals with generalized anxiety disorder. *Journal of Abnormal Psychology, 118,* 28-33.

Ansari, T. L., Derakshan, N., & Richards, A. (2008). Effects of anxiety on task switching: Evidence from the mixed antisaccade task. *Cognitive, Affective, & Behavioral Neuroscience, 8*, 229-238.

Astle, D. E., & Scerif, G. (2009). Using developmental cognitive neuroscience to study behavioral and attentional control. *Developmental Psychobiology, 51*, 107-118.

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van Ijzendoorn, M. H. (2007). Threat related attentional bias in anxious and non-anxious individuals: A meta-analytic study. *Psychological Bulletin, 133*, 1-24.

Barker, M. J., Greenwood, K. M., Jackson, M., & Crowe, S. F. (2004a). Cognitive effects of long-term benzodiazepine use: A meta-analysis. *Central Nervous System Drugs, 18*, 37-48.

Barker, M. J., Greenwood, K. M., Jackson, M., & Crowe, S. F. (2004b). Persistence of cognitive effects after withdrawal from long-term benzodiazepine use: A meta-analysis. *Archives of Clinical Neuropsychology, 3*, 437-454.

Barrera, T. L., & Norton, P. J. (2009). Quality of life impairment in generalized anxiety disorder, social phobia, and panic disorder. *Journal of Anxiety Disorders, 23*, 1086-1090.

Baxter, A. J., Scott, K. M., Vos, T., & Whiteford, H. A. (2012). Global prevalence of anxiety disorders: A systematic review and meta-regression. *Psychological Medicine, 43*, 897-910.

Beck, A. T., & Clark, D. A. (1997). An information processing model of anxiety: Automatic and strategic processes. *Behaviour Research and Therapy, 35*, 49-58.

Beck, D. M., & Kastner, S. (2009). Top-down and bottom-up mechanisms in biasing competition in the human brain. *Vision Research, 49*, 1154-1165.

Beilock, S. L., & Carr, T.H. (2005). When high-powered people fail: Working memory and "choking under pressure" in math. *Psychological Science, 16*, 101-115.

Beilock, S. L., & DeCaro, M. S. (2007). From poor performance to success under stress: Working memory strategy selection and mathematical problem solving under pressure. *Journal of Experimental Psychology: Learning, Memory and Cognition, 33*, 983-998.

Berggren, N., & Derakshan. N. (2013). Attentional control deficits in trait anxiety: Why you see them and why you don't. *Biological Psychology, 92*, 440-446.

Bishop, S. (2008). Neural mechanisms underlying selective attention to threat. *Annuals of the New York Academy of Science, 1129*, 141–152.

Bishop, S. J. (2009). Trait anxiety and impoverished prefrontal control of attention. *Nature Neuroscience, 12,* 92–98.

Bishop, S., Duncan, J., Brett, M., & Lawrence, A. D. (2004). Prefrontal cortical function and anxiety: Controlling attention to threat-related stimuli. *Nature Neuroscience, 7*, 184–188.

Borkovec, T. D., & Inz, J. (1990). The nature of worry in generalized anxiety: A predominance of thought activity. *Behaviour Research and Therapy, 28*, 153-158.

Borkovec, T. D., Robinson, E., Pruzinsky, T., & DePree, J. A. (1983). Preliminary exploration of

worry: Some characteristics and processes. *Behaviour Research and Therapy, 21*, 9–16.

Borkovec, T. D., & Ruscio, A. M. (2001). Psychotherapy for generalized anxiety disorder. *Journal of Clinical Psychiatry, 62,* 37–42.

Boyce, M. W. (1981). Notes on self-consciousness. *Psychological Reports, 49*, 334.

Bradley, B. P., Mogg, K., White, J., Groom, C., & De Bono, J. (1999). Attentional bias for emotional faces in generalized anxiety disorder. *British Journal of Clinical Psychology, 38*, 267-278.

Broadbent, D. E. (1958). *Perception and communication*. Elmsford, NY: Pergamon Press.

Brown, T. A., Antony, M.M., & Barlow, D. H. (1992). Psychometric properties of the Penn State Worry Questionnaire in a clinical anxiety disorder sample. *Behaviour Research and Therapy, 30*, 33-37.

Browning, M., Holmes, E. A., Murphy, S. E., Goodwin, G. M., & Harmer, C. J. (2010). Lateral prefrontal cortex mediates the cognitive modification of attentional bias. *Biological Psychiatry, 65*, 919-925.

Buchanan, T. (2016). Self-report measures of executive function problems correlate with personality, not performance-based executive function measures, in nonclinical samples. *Psychological Assessment, 28*, 373-285.

Bush, G., Luu, P., & Posner, M. I. (2000). Cognitive and emotional influences in anterior cingulate cortex. *Trends in Cognitive Sciences, 4*, 215–222.

Callinan, S., Johnson, D., & Wells, A. (2015). A randomized controlled study of the effects of the attention training technique on traumatic stress symptoms, emotional attention set shifting and flexibility. *Cognitive Therapy and Research*, *39*, 4-13.

Carrasco, M. (2011). Visual attention: The past 25 years. *Vision Research, 51*, 1484-1525.

Cartwright-Hatton, S., & Wells, A. (1997). Beliefs about worry and intrusions: The Meta-Cognitions Questionnaire. *Journal of Anxiety Disorders, 11*, 279-296.

Cherry, E. C. (1953). Some experiments on the recognition of speech, with one and with two ears. *Journal of the Acoustical Society of America, 25*, 975-979

Cisler, J. M., & Koster, E. H. W. (2010). Mechanisms of attentional biases towards threat in anxiety disorders: An integrative review. *Clinical Psychology Review, 30*, 203-220.

Conway, A. R. A., Jane, M. J., Bunting, M. F., Hambrick, D. Z., Wilhelm, O., & Engle, R. W. (2005). Working memory span tasks: A methodological review and user's guide. *Psychonomic Bulletin & Review, 12*, 769-786.

Cuijpers, P. (2016). Are all psychotherapies equally effective in the treatment of adult depression? The lack of statistical power of comparative outcome studies. *Evidence-Based Mental Health, 19*, 39-42.

Culpepper, L. (2009). Generalized anxiety disorder and medical illness. *Journal of Clinical Psychiatry, 70*, 20-24.

Davey, G. C. (1993). A comparison of three worry questionnaires. *Behaviour Research and Therapy*, *31*, 51-56.

Dear, B.F., Titov, N., Sunderland, M., McMillan, D., Anderson, T., Lorian, C., & Robinson, E. (2011). Psychometric comparison of the Generalized Anxiety Disorder Scale-7 and the Penn State Worry Questionnaire for measuring response during treatment of generalised anxiety disorder. *Cognitive Behaviour Therapy, 40*, 216-227,

Derryberry, D., & Reed, M. A. (2002). Anxiety-related attentional biases and their regulation by attentional control. *Journal of Abnormal Psychology, 111*, 225– 236.

Desimone, R., & Duncan, J. (1995). Neural mechanisms of selective visual attention. *Annual Review of Neuroscience, 18*, 193-222.

Devilly, G. J., & Borkovec, T. D. (2000). Psychometric properties of the Credibility/Expectancy Questionnaire. *Journal of Behavior Therapy and Experimental Psychiatry, 31*, 73-86.

Dew, S. E., & Bickman. L. (2005). Client expectancies about therapy. *Mental Health Services Research, 7*, 21- 33.

Dickstein, L. S., Wang, N., & Whitaker, A. (1981). Private self-consciousness, public self-consciousness, and trait anxiety. *Psychological Reports, 49*, 518.

Donald, J., Abbott, M. J., & Smith, E. (2014). Comparison of attention training and cognitive therapy in the treatment of social phobia: A preliminary investigation. *Behavioural and Cognitive Psychotherapy, 42,* 74–91.

Dupuy, J. B., Beaudoin, S., Rhéaume, J., Ladouceur, R., & Dugas, M. J. (2001). Worry: Daily self-report in clinical and non-clinical populations. *Behaviour Research and Therapy, 39*, 1249-1255.

Duval S., & Wicklund, R. A. (1972). *A theory of objective self-awareness.* Oxford, UK: Academic Press.

Eaton, W.W., Muntaner, C., Smith, C., Tien, A., & Ybarra, M. (2004). Center for Epidemiologic Studies Depression Scale: Review and revision (CESD and CESD-R). In M. E. Maruish (Ed.), *The use of psychological testing for treatment planning and outcomes assessment* (pp. 363-377). Mahwah, NJ: Lawrence Erlbaum Associates.

Eide P., Kemp A., Silberstein R. B, & Nathan, P. J. (2002). Test-retest reliability of the emotional Stroop task: Examining the paradox of measurement change. *The Journal of Psychology, 136*, 514–520.

Eldar, S., & Bar-Haim, Y. (2010). Neural plasticity in response to attention training in anxiety. *Psychological Medicine, 40*, 667–678.

Engle, R. W. (2002). Working memory capacity as executive attention. *Current Directions in Psychological Science, 11*, 19-23.

Engle, R. W., & Kane, J. (2004). Executive attention, working memory capacity, and a two-factor theory of cognitive control. In B. Ross (Ed.), *The psychology of learning and motivation, Vol. 44* (pp.145-199). New York, NY: Elsevier.

Eysenck, M W., & Calvo, M. G. (1992). Anxiety and performance: The processing efficiency theory. *Cognition and Emotion, 6*, 409-434.

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion, 7*, 336-353.

Fan, J., McCandliss, B. D., Fossella, J., Flombaum, J. I., & Posner, M. I. (2005). The activation of attentional networks. *NeuroImage, 26*, 471– 479.

Fan, J., McCandliss, B. D., Sommer, T., Raz, A., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience, 14*, 340-347.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191.

Fenigstein, A., Scheier, M., & Buss, A. H. (1975). Public and private self-consciousness: Assessment and theory. *Journal of Consulting and Clinical Psychology, 43*, 522-527.

Fergus, T. A., Valentiner, D. P., McGrath, P. B., Gier-Lonsway, S., & Jencius, S. (2013). The CAS: Examining relations with mood and anxiety symptoms and distinctiveness from psychological inflexibility in a clinical sample. *Psychiatry Research, 210*, 215-219.

Fergus, T. A., Wheless, N. E., & Wright, L. C. (2014). The attention training technique, self-focused attention, and anxiety: A laboratory-based component study. *Behaviour Research and Therapy, 61,* 150–155.

Fox, E., Cahill, S., & Zougkou, K. (2010). Preconscious processing biases predict emotional reactivity to stress. *Biological Psychiatry, 67,* 371–377.

Fox, E., Zougkou, K., Ridgewell, A., & Garner, K. (2011). The serotonin transporter gene alters sensitivity to attention bias modification: Evidence for a plasticity gene. *Biological Psychiatry, 70*, 1049-1054.

Fresco, D. M., Mennin, D. S., Heimberg, R. G., & Turk, C. L. (2003). Using the Penn State Worry Questionnaire to identify individuals with generalized anxiety disorder: A receiver operating characteristic analysis. *Journal of Behaviour Therapy and Experimental Psychiatry, 34*, 283-291.

Goodwin, H., Eagleson, C., Mathews, A., Yiend, J., & Hirsch. C. (2016). Automaticity of attentional bias to threat in high and low worriers. *Cognitive Therapy and Research, 41*, 479-488.

Goodwin, H., Yiend, J., & Hirsch, C. R. (2017). Generalized anxiety disorder, worry and attention to threat: A systematic review. *Clinical Psychology Review, 54*, 107-122.

Gopher, D. (1982). A selective attention test as a predictor of success in flight training. *Human Factors*, *24,* 173-183.

Gopher, D. (1993). The skill of attention control: Acquisition and execution of attention strategies. In D. E. Meyer & S. Kornblum (Eds.), *Attention and performance XIV: Synergies in experimental psychology, artificial intelligence, and cognitive neuroscience,* (pp. 299-322). Cambridge, MA: MIT Press.

Gopher, D., & Kahneman, D. (1971). Individual differences in attention and the prediction of flight criteria. *Perceptual and Motor Skills, 33*, 1335-1342.

Gopher, D., & Sanders, A. F. (1984). S-Oh-R': Oh stages! Oh resources! In W. Prinz & A. F. Sanders (Eds.), *Cognition and motor processes.* Berlin, Germany: Springer.

Goosens, M. E. J. B., Vlaeyen, J. W. S., Hidding, A., Kole-Snijders, A. K., & Evers, S. M. A. A. (2005). Treatment expectancy affects the outcome of cognitive-behavioural interventions in chronic pain. *Clinical Journal of Pain, 21,* 18-26.

Gould, R. A., Safren, S. A., Washington, D. O., & Otto, M. W. (2004). A meta-analytic review of cognitive-behavioral treatments. In R. G. Heimberg, C. L. Turk, & D. S. Mennin (Eds.), *Generalized anxiety disorder: Advances in research and practice* (pp. 248–264). New York, NY: Guilford Press.

Gourion, D., Perrin, E., & Quintin, P. (2004). Fluoxetine: An update of its use in major depressive disorder in adults. *L'Encéphale, 30,* 392-399.

Hadwin, J.A., & Richards, H.J. (2016). Working memory training and CBT reduces anxiety symptoms and attentional biases to threat: A preliminary study. *Frontiers in Psychology, 7*, 47-64.

Hallion,L. S., & Ruscio, A. M. (2011). A meta-analysis of the effect of cognitive bias modification on depression and anxiety. *Psychological Bulletin, 137,* 940-958.

Hanrahan, F., Field, A. P., Jones, F. W., & Davey, G.C. (2013). A meta-analysis of cognitive therapy for worry in generalized anxiety disorder. *Clinical Psychology Review, 33*, 120-132.

Haukaas, R. B., Gjerde, I. B., Varting, G., Hallan, H. E., & Solem S. (20018). A randomized controlled trial comparing the attention training technique and mindfulness self-compassion for students with symptoms of depression and anxiety. *Frontiers in Psychology, 9,* 827.

Hayes, S., Hirsch, C. R., & Mathews, A. (2008). Restriction of working memory capacity during worry. *Journal of Abnormal Psychology, 117*, 712-717.

Hazen, R. A., Vasey, M. W., & Schmidt, N. B. (2009). Attentional retraining: A randomized clinical trial for pathological worry. *Journal of Psychiatric Research, 43,* 627–633.

Henning, E. R., Turk, C. L., Mennin, D. S., Fresco, D. M., & Heimberg, R. G. (2007). Impairment and quality of life in individuals with generalized anxiety disorder. *Depression and Anxiety, 24,* 342–349.

Hew, L. M. (1995). Regression toward the mean associated with measurement error and the identification of improvement and deterioration in psychotherapy. *Journal of Consulting and Clinical Psychology, 63*, 141-144.

Hirsch, C. R., Hayes, S., & Mathews, A. (2009). Looking on the bright side: Accessing benign meanings reduces worry. *Journal of Abnormal Psychology, 118,* 44-54.

Hirsch, C. R., & Mathews, A. (2012). A cognitive model of pathological worry. *Behaviour Research and Therapy, 50*, 636-646.

Hoffman, S. G., & Smits, J. A. J. (2008). Cognitive-behavioral therapy for adult anxiety disorders: A meta-analysis of randomized placebo-controlled trials. *Journal of Clinical Psychiatry, 69*, 621-632.

Horvath, P. (1990). Treatment expectancy as a function of the amount of information presented in therapeutic rationales. *Journal of Clinical Psychology, 46,* 636-642.

Ingram, R. E. (1990). Self-focused attention in clinical disorders: Review and a conceptual model. *Psychological Bulletin, 107*, 156-176.

Ishigami, Y., & Klein, R. M. (2010). Repeated measurement of the components of attention using two versions of the Attention Network Test (ANT): Stability, isolability, robustness, and reliability. *Journal of Neuroscience Methods, 190*, 117-128.

Ishigami, Y., & Klein, R. M. (2011). Repeated measurement of the components of attention of older adults using the two versions of the Attention Network Test: Stability, isolability, robustness, and reliability. *Frontiers in Aging Neuroscience, 3*, 17-30.

James, W. (1890). *The principles of psychology*, *Vol. 1* (pp. 403-404). New York, NY: Henry Holt and Company.

Johnson, D. (2009). Emotional attention set-shifting and its relationship to anxiety and emotion regulation. *Emotion, 9*, 681–690

Joyce, A. S., & Piper, W. E. (1998). Expectancy, the therapeutic alliance, and treatment outcome in short-term individual psychotherapy. *Journal of Psychotherapy Practice and Research, 3*, 236-248.

Judah, M. R., Grant, D. M., Mills, A. C., & Lechner, W. V. (2014). Factor structure and validation of the attentional control scale. *Cognition and Emotion, 28*, 433-451.

Kahneman, D. (1973). *Attention and Effort.* Englewood Cliffs, NJ: Prentice-Hall.

Kahneman, D., Ben-Ishai, R., & Lotan, M. (1973). Relation of a test of attention to road accidents. *Journal of Applied Psychology, 58*, 113-115.

Kane, M. J., Bleckley, M. K., Conway, A. R. A., & Engle, R. W. (2001). A controlled-attention view of working-memory capacity. *Journal of Experimental Psychology: General, 130,* 169 –183.

Kane, M. J., Brown, L. H., McVay, J. C., Silvia, P. J., Myin-Germeys, I., & Kwapil, T. R. (2007). For whom the mind wanders, and when: An experience-sampling study of working memory and executive control in daily life. *Psychological Science, 18*, 614-621.

Kazdin, A. E., & Krouse, R. (1983). The impact of variations in treatment rationales on expectancies for therapeutic change. *Behavior Therapy, 14,* 657-671.

Kinchla, R. (1980). The measurement of attention. In R. Nickerson (Ed.), *Attention and performance, Vol VIII,* (pp. 213-238). Princeton, NJ: Psychology Press.

Kinchla, R. A. (1992). Attention. *Annual Review of Psychology, 43*, 711-742.

Knowles, M. M., Foden, P, El-Deredy, W. E., & Wells, A. (2016). A systematic review of efficacy of the attention training technique in clinical and nonclinical samples. *Journal of Clinical Psychology, 72*, 999-1025.

Knudsen, E. I. (2007). Fundamental components of attention. *Annual Neuroscience Review, 30*, 57-78.

Korotitsch, W. J., Nelson, R. O. (1999). An overview of self-monitoring research in assessment and treatment. *Psychological Assessment, 4*, 415-425.

Koster, E. H. W., Baert, S., Bockstaele, M., & De Raedt, R. (2010). Attentional retraining procedures: Manipulating early or late components of attentional bias? *Emotion*, *10,* 230–236.

Krebs, G., Hirsch, C. R., & Mathews, A. (2010). The effect of attention modification with explicit vs. minimal instructions on worry. *Behaviour Research and Therapy, 48*, 251-256.

Lambert, M. J., and Barley, D. E. (2001). Research summary on the therapeutic relationship and psychotherapy outcome. *Psychotherapy Theory, Research, Practice, Training, 38*, 357-361.

Lambert, M. J., Hansen, N. B., and Finch, A. E. (2001). Patient-focused research: Using patient outcome data to enhance treatment effects. *Journal of Consulting and Clinical Psychology, 69*, 159–172.

Levaux, M.-N., Larøi, F., Offerlin-Meyer, I., Danion, J.-M., & Van der Linden, M. (2012). The effectiveness of the Attention Training Technique in reducing intrusive thoughts in schizophrenia: A case study. *Clinical Case Studies, 10,* 466–484.

Logan, G. D. (1985). Executive control of thought and action. *Acta Psychologica, 6*, 193-210.

Lonigan, C. J. & Vasey, M. W. (2009). Negative affectivity, effortful control, and attention to threat-relevant stimuli. *Journal of Abnormal Child Psychology, 37*, 387-399.

Luterek, J. A., Turk, C. L., Heimberg, R. G., Fresco, D. M., Mennin, D. S. (2002, November). Psychometric properties of the GAD-Q-IV among individuals with clinician-assessed generalized anxiety disorder. Paper presented at the meeting of the Association for the Advancement of Behavior Therapy, Reno, NV.

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 95*, 15–20.

Mahoney, J. R., Verghese, J., Goldin, Y., Lipton, R., & Holtzer, R. (2010). Alerting, orienting, and executive attention in older adults. *Journal of International Neuropsychological Society, 16*, 877-889.

Marcus, D. K., O'Connell, D., Norris, A. L., and Sawaqdeh, A. (2014). Is the Dodo bird endangered in the 21st century? A meta-analysis of treatment comparison studies. *Clinical Psychology Review, 34*, 519–530.

Martens, E. J., De Jonge, P., Na, B., Cohen, B. E., Lett, H., & Whooley, M. A. (2010). Scared to death? Generalized anxiety disorder and cardiovascular events in patients with stable coronary heart disease: The Heart and Soul Study. *Archives of General Psychiatry 67*, 750–758.

Mathews, A., & Mackintosh, B. (1998). A cognitive model of selective processing in anxiety. *Cognitive Therapy and Research, 22*, 539-560.

McEvoy, P. M., Graville, R., Hayes, S., Kane, R. T., & Foster, J. K. (2017). Mechanisms of change during attention training and mindfulness in high trait-anxious individuals: A randomized controlled study. *Behavior Therapy, 48*, 678-694.

McGowan, S. K., Stevens, E. S., Behar, E., Judah, M. R., Mills, A. C., & Grant, D. M. (2017). Concreteness of idiographic worry and anticipatory processing. *Journal of Behavior Therapy and Experimental Psychiatry, 54*, 195-203.

Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D. (1990). Development and validation of the Penn State Worry Questionnaire. *Behaviour Research and Therapy*, *28*, 487-495.

Meyer, B., Pilkonis, P. A., Krupnick, J. L., Egan, M. K., Simmens, S. J., & Sotsky, S. M. (2002). Treatment expectancies, patient alliance, and outcome: Further analyses from the National Institute of Mental Health treatment of depression collaborative research program. *Journal of Consulting and Clinical Psychology, 70*, 1051-1055.

Mitte, K. (2005). Meta-analysis of cognitive-behavioral treatment for generalized anxiety disorder: A comparison with pharmacotherapy. *Psychological Bulletin, 131,* 785–795.

Mogg K., & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behaviour Research and Therapy, 36*, 809–848.

Mogg, K., Millar, N., & Bradley, B. P. (2000). Biases in eye movements to threatening facial expressions in generalized anxiety disorder and depressive disorder. *Journal of Abnormal Psychology, 109*, 695-704.

Mogg, K., Waters, A. M., & Bradley, B. P (2017). Attention bias modification (AMB): Review of effects of multisession AMB training on anxiety and threat-related attention in high-anxious individuals. *Clinical Psychological Science, 5*, 698-717.

Mor, N., & Winquist, J. (2002). Self-focused attention and negative affect: A meta-analysis. *Psychological Bulletin, 128*, 638–662.

Moray, N. (1959). Attention in dichotic listening: Affective cues and the influence of instructions. *Quarterly Journal of Experimental Psychology*, *11*, 56-60.

Molina, S., & Borkovec, T. D. (1994). The Penn State Worry Questionnaire: Psychometric properties and associated characteristics. In G. C. L. Davey & F. Tallis (Eds.), *Worrying: Perspectives on theory, assessment and treatment* (pp. 265–283). Oxford, UK: John Wiley and Sons.

Moore, M. T., Anderson, N. L., Barnes, J. M., Haigh, E. A., & Fresco, D. M. (2014). Using the GAD-Q-IV to identify generalized anxiety disorder in psychiatric treatment seeking and primary care medical samples. *Journal of Anxiety Disorders*, *28*, 25-30.

Murphy, S. E., Downham, C., Cowen, P. J., & Harmer, C. J. (2008). Direct effects of diazepam on emotional processing in healthy volunteers. *Psychopharmacology, 199*, 503-513.

Murphy, N. A., & Isaacowitz, D. M. (2008). Preferences for emotional information in older and younger adults: A meta-analysis of memory and attention tasks. *Psychological Aging, 23,* 263-286.

Muthen, B. O., & Satorra, A. (1995). Complex sample data in structural equation modelling. *Sociological Methodology, 25*, 267-317.

Nassif, Y. (1999). Predictors of pathological worry. Unpublished M. Phil. Thesis. University of Manchester, UK.

Nassif, Y., & Wells, A. (2007). The Detached Mindfulness Questionnaire. *Unpublished self-report scale.* Manchester, UK: University of Manchester.

Nassif, Y., & Wells, A. (2014). Attention training reduces intrusive thoughts cued by a narrative of stressful life events: A controlled study. *Journal of Clinical Psychology, 70*, 510–517.

Neisser, U. (1967). *Cognitive psychology.* East Norwalk, CT: Appleton Century Crofts.

Nelson, R., & Hayes, S. (1981). Theoretical explanations for reactivity in self-monitoring. *Behaviour Modification, 5*, 3-14.

Newman, M. G., Zuellig, A. R., Kachin, K. E., Constantino, M. J., Przeworski, A., Erickson, T., & Cashman-McGrath, L. (2002). Preliminary reliability and validity of the Generalized Anxiety Disorder Questionnaire-IV: A revised self-report diagnostic measure of generalized anxiety disorder. *Behavior Therapy*, *33*, 215-233.

Norman, D. A., & Shallice, T. (1986). Attention to action: Willed and automatic control of behavior. In R. J. Davidson, G. E. Schwartz, & D. Shapiro (Eds.), *Consciousness and self-regulation: Advances in research and therapy Volume 4*, pp. 1-18. New York: NY, Springer.

North, R., & Gopher, D. (1976). Measures of attention as predictors of flight performance. *Human Factors, 18,* 1–13.

Pacheco-Unguietti, A. P., Acosta, A., Callejas, A., & Lupianez, J. (2010). Attention and anxiety: Different attentional functioning under state and trait anxiety. *Psychological Science, 21*, 298-304.

Papageorgiou, C., & Wells, A. (1998). Effects of attention training on hypochondriasis: A brief case series. *Psychological Medicine, 28*, 193–200.

Papageorgiou, C., & Wells, A. (2000). Treatment of recurrent major depression with attention training. *Cognitive and Behavioral Practice, 7,* 407–413.

Peers, P., & Lawrence, A. D. (2009). Attentional control of emotional distraction in rapid serial visual search presentation. *Emotion, 9,* 140-145.

Persson, J., & Reuter-Lorenz, P. A. (2008). Gaining control: Executive training and far transfer of the ability to resolve interference. *Psychological Science, 19*, 881-888.

Posner, M. I., & Petersen, S. E. (1990). The attention system of the human brain. *Annual Review of Neuroscience, 13*, 25-42.

Price, R. B., Kuckertz, J. M., Siegle, G. J., Ladouceur, C. D., Silk, J. S., Ryan, N. D., Dalh, R. E., & Amir, N. (2015). Empirical recommendations for improving the stability of the dot-probe task in clinical research. *Psychological Assessment, 27*, 365-376.

Pringle, A., Warren, M., Gottwald, J., & Cowen, P. J. (2016). Cognitive mechanisms of

diazepam administration: A healthy volunteer model of emotional processing. *Psychopharmacology, 233*, 2221-2228.

Psychology Software Tools, Inc. [E-Prime 2.0]. (2012). Available at: http://www.pstnet.com.

Qualtrics. (2017). *The Leading Research & Experience Software | Qualtrics*. [online] Available at: http://qualtrics.com

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurements, 1*, 385-401

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods, 2nd edition* (Vol. 1). Thousand Oaks, CA: Sage Publications.

Redick, T., & Engle, R. W. (2006). Working memory capacity and attention network test performance. *Applied Cognitive Psychology, 20*, 713-721.

Reinholdt-Dunne, M. L., Mogg, K., & Bradley, B. P. (2013). Attention control: Relationships between self-report and behavioural measures, and symptoms of anxiety and depression. *Cognition and Emotion, 27*, 430-440.

Rey, A., Marchand, F., Rappaz, R., Richelle, M., & Schaechtlin, M. (1957). Centration soutenue sur une tâche intellectuelle simple: Ordination continue de chiffres. *Archives de Psychologie, 36,* 29-61.

Reynolds, J. H., & Chelazzi, L. (2004). Attentional modulation of visual processing. *Annual Review of Neuroscience, 27*, 611-647.

Robinson, C. M., Klenck, S. C., & Norton, P. J. (2010). Psychometric properties of the Generalized Anxiety Disorder Questionnaire for DSM-IV among four racial groups. *Cognitive Behaviour Therapy*, *39*, 251-261.

Rodriguez, B. F., Weisberg, R. B., Pagano, M. E., Bruce, S. E., Spencer, M. A., Culpepper, L., & Keller, M. B. (2006). Characteristics and predictors of full and partial recovery from generalized anxiety disorder in primary care patients. *Journal of Nervous and Mental Disorders, 194*, 91-97.

Ruscio, A. M., & Borkovec, T. D. (2004). Experience and appraisal of worry among high worriers with and without generalized anxiety disorder. *Behaviour Research and Therapy, 42*, 1469-1482.

Ruscio, A. M., Borkovec, T. D., & Ruscio, J. A. (2001). Taxometric investigation of the latent structure of worry. *Journal of Abnormal Psychology, 110*, 413–422.

Salters-Pedneault, K., Roemer, L., Tull, M. T., Rucker, L., & Mennin, D. S. (2006). Evidence of broad deficits in emotion regulation associated with chronic worry and generalized anxiety disorder. *Cognitive Therapy and Research, 30,* 469-480.

Sari, B. A., Koster, E.H., Pourtois, G., & Derakshan, N. (2016). Training working memory to improve attentional control in anxiety: A proof-of-principle study using behavioral and electrophysiological measures. *Biological Psychology, 121, 203-212.*

Schmukle, S. C. (2005). Unreliability of the dot probe task. *European Journal of Personality 19,* 595–605.

Siegle, G. J., Ghinassi, F., & Thase, M. E. (2007). Neurobehavioral therapies in the 21st century: Summary of an emerging field and an extended example of cognitive control training for depression. *Cognitive Therapy and Research, 31*, 235–262.

Siegle, G. J., Price, R. B., Jones, N. P., Ghinassi, F., Painter, T., & Thase, M. E. (2014). You gotta work at it: Pupillary indices of task focus are prognostic for response to a

neurocognitive intervention for rumination in depression. *Clinical Psychological Science, 2*, 455–471.

Sheehan, D. V. (2015). *Mini International Neuropsychiatric Interview 7.0.* Jacksonville, FL: Medical Outcomes Systems.

Sharpe, L., Perry, K. N., Rogers, P., Dear, B. F., Nicholas, M. K., & Refshauge, K. (2010). A comparison of the effect of attention training and relaxation on responses to pain. *Pain, 150*, 469–476

Sibrava, N., & Borkovec T.D. (2006). The cognitive avoidance theory of worry. In: G. C. L. Davey & A. Wells (Eds.), *Worry and its psychological disorders: Theory, assessment and treatment* (pp. 217–237). Hoboken, NJ: John Wiley and Sons.

Spielberger, C. D. (1983). Manual for the State-Trait Anxiety Inventory STAI (form Y). Palo Alto, CA: Consulting Psychologists Press.

Stein, M. B., & Heimberg, R. G. (2004). Well-being and life satisfaction in generalized anxiety disorder: Comparison to major depressive disorder in a community sample. *Journal of Affective Disorders, 79*, 161-166.

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis.* Oxford, UK: Oxford University Press.

Stöber, J., & Bittencourt, J. (1998). Weekly assessment of worry: An adaptation of the Penn State Worry Questionnaire for monitoring changes during treatment. *Behaviour Research and Therapy, 36*, *645*-656.

Stokes, C., & Hirsch, C. R. (2010). Engaging in imagery versus verbal processing of worry: Impact on negative intrusions in high worriers. *Behaviour Research and Therapy, 48*, 418-423.

Szabo, M. (2011). The emotional experience associated with worrying: Anxiety, depression, or stress? *Anxiety, Stress, and Coping, 24*, 91-105.

Szabo, M., & Lovibond, P. F. (2002). The cognitive content of naturally occurring worry episodes. *Cognitive Therapy and Research, 26*, 167-177.

Tabachnick, B. G., and Fidell, L. S. (2013). *Using multivariate statistics, 6th ed.* Boston, MA: Pearson.

Tallis, F., Davey, G. C. L., & Capuzzo, N. (1994). The phenomenology of non-pathological worry: A preliminary investigation. In: G. C. L. Davey & F. Tallis (Eds.), *Worrying: Perspectives on theory, assessment and treatment* (pp. 61-89). Chichester, UK: John Wiley and Sons.

Tallis, F., Eysenck, M. W. & Mathews, A. (1992). A questionnaire for the measurement of non-pathological worry. *Personality and Individual Differences, 13,* 161-168.

Tallon, K. (2014). Does a restriction in working memory capacity mediate the relationship between worry and interpretive biases in generalized anxiety disorder? (Unpublished masters thesis). Ryerson University, Toronto, ON.

Thielsch, C., Ehring, T., Nestler, S., Wolters, J., Kopei, I., Rist, F., Gerlach, A. L., & Andor, T. (2015). Metacognitions, worry and sleep in everyday life: Studying bidirectional pathways using ecological momentary assessment in GAD patients. *Journal of Anxiety Disorders, 33*, 53-61.

Tonne, U., Hiltunen, A. J., Vikander, B., Engelbrektsson, K., Bergman, H., Bergman, I., Leifman, H., & Borg, S. (1995). Neuropsychological changes during steady-state drug use, withdrawal and abstinence in primary benzodiazepine-dependent patients. *Acta Psychiatry Scandinavia, 91*, 299-304.

Treisman, A. M. (1960). Contextual cues in selective listening. *Quarterly Journal of Experimental Psychology, 12*, 242-248.

Turner, S. M., Beidel, D. C., & Stanley, M. A. (1992). Are obsessional thoughts and worry different cognitive phenomena? *Clinical Psychology Review, 12*, 257-270.

Unsworth, N., Schrock, J. C., & Engle, R. W. (2004). Working memory capacity and the antisaccade task: Individual differences in voluntary saccade control. *Journal of Experimental Psychology: Learning, Memory and Cognition, 30*, 1302-1321.

Valmaggia, L. R., Bouman, T. K., & Schuurman, L. (2007). Attention training with auditory hallucinations: A case study. *Cognitive and Behavioral Practice, 14*, 127–133.

Vandierendonck, A., De Vooght, G., & Van der Goten, K. (2010). Does random time interval generation interfere with working memory executive functions? *European Journal of Cognitive Psychology, 10*, 413-442.

Verkuil, B., Brosschot, J. F., & Thayer, J. F. (2007). Capturing worry in daily life: Are trait questionnaires sufficient? *Behaviour Research and Therapy, 45*, 1835-1844.

Versluis, A., Verkuil, B., & Broscchot, J. F. (2016). Reducing worry and subjective health complaints: A randomized trial of an internet-delivered worry postponement intervention. *British Journal of Health Psychology, 21*, 318-335.

Watkins, E. R., Baeyens, C. B, & Read, R. (2009). Concreteness training reduces dysphoria: Proof-of-principle for repeated cognitive bias modification in depression. *Journal of Abnormal Psychology, 118*, 55-64.

Watson, C., & Purdon, C. (2008). Attention training in the reduction and reappraisal of intrusive thoughts. *Behavioural and Cognitive Psychotherapy, 36*, 61-70.

Weber, S. J., & Cook, T. D. (1972). Subject effects in laboratory research: An examination of subject roles, demand characteristics, and valid inference. *Psychological Bulletin*, *77*, 273-295.

Wells, A. (1985). Relationship between private self-consciousness and anxiety scores in threatening situations. *Psychological Report, 57*, 1063-1066.

Wells, A. (1990). Panic disorder in association with relaxation induced anxiety: An attentional training approach to treatment. *Behavior Therapy, 21*, 273–280.

Wells, A. (1994). A multi-dimensional measure of worry: Development and preliminary validation of the Anxious Thoughts Inventory. *Anxiety, Stress and Coping, 6*, 289-299.

Wells, A. (1995). Meta-cognition and worry: A cognitive model of generalized anxiety disorder. *Behavioural and Cognitive Psychotherapy*, *23*, 301–320.

Wells, A., White, J., & Carter, K. (1997). Attention training: Effects on anxiety and beliefs in panic and social phobia. *Clinical Psychology & Psychotherapy, 4*, 226–232.

Wells, A. (1999). A metacognitive model and therapy for generalized anxiety disorder. *Clinical Psychology & Psychotherapy, 6*, 86-95.

Wells, A. (2004). A cognitive model of GAD: Metacognitions and Pathological Worry. In R. G. Heimberg, C. L. Turk, & D. S. Mennin (Eds.), *Generalized anxiety disorder: Advances in research and practice*, (pp.164-186). New York, NY: Guilford Press.

Wells, A. (2005). The metacognitive model of GAD: Assessment of meta-worry and relationship with DSM-IV generalized anxiety disorder. *Cognitive Therapy and Research, 29*, 107-121.

Wells, A. (2008). Attention training technique (ATT) guidance notes. Retrieved from: www.mct-institute.com

Wells, A. (2009). *Metacognitive therapy for anxiety and depression*. New York, NY: Guilford Press.

Wells, A., & Cartwright-Hatton, S. (2004). A short form of the Metacognitions Questionnaire: Properties of the MCQ-30. *Behaviour Research and Therapy, 42*, 385-396.

Wells, A., & Davies, M. (1994). The Thought Control Questionnaire: A measure of individual differences in the control of unwanted thoughts. *Behaviour Research and Therapy, 32*, 871–878

Wells, A., & Mattews, G. (1996). Modelling cognition in emotional disorder: The S-REF model. *Behaviour Research and Therapy, 34*, 881-888.

Wells, A., & Morrison, A. P. (1994). Qualitative dimensions of normal worry and normal obsessions: A comparative study. *Behaviour Research and Therapy, 32*, 867-870.

Wells, A., & Papageorgiou, C. (1998). Relationships between worry, obsessive-compulsive symptoms and meta-cognitive beliefs. *Behaviour Research and Therapy, 36*, 899-913.

Williams, M. O., Mathews, A., & Hirsch, C. R. (2014). Verbal worry facilitates attention to threat in high-worriers. *Journal of Behavior Therapy and Experimental Psychiatry, 45,* 8-14.

Williams, J. M. G., Watts, F. N., MacLeod, C., & Matthews, A. (1988). Cognitive psychology and emotional disorders. Chichester, UK: John Wiley and Sons.

Woelk, H., & Schläfke, S. (2010). A multi-center, double-blind, randomised study of the lavender oil preparation Silexan in comparison to Lorazepam for generalized anxiety disorder. *Phytomedicine*, *17*, 94-99.

York, D., Borkovec, T. D., Vasey, M., & Stern, R. (1987). Effects of worry and somatic anxiety induction on thoughts, emotion and physiological activity. *Behaviour Research and Therapy, 25*, 523–526.