# Understanding Anxiety Through the Constructs of Attentional Bias and Attentional Scope

by

Mengran Xu

A thesis

presented to the University of Waterloo

in fulfillment of the

thesis requirement for the degree of

Doctor of Philosophy

in

Psychology

Waterloo, Ontario, Canada, 2017

## Examining Committee Membership

The following served on the Examining Committee for this thesis. The decision of the Examining Committee is by majority vote.

External Examiner:           Dr. Judith Laposa

Supervisor:                   Dr. Christine Purdon

Internal Member:            Dr. Michael Dixon

                                      Dr. Daniel Smilek

Internal-external Member:    Dr. Mathieu Doucet

## Author's Declaration

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.

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**Abstract**

Anxiety disorders are common and debilitating, and there are substantial research efforts to better understand and treat them. These efforts are characterized by two leading trends: an emphasis on the role of attentional biases in their development and persistence, and an emphasis on mindfulness as a means of ameliorating them. However, there are substantial problems with both lines of research. Fist, research on attentional biases to threat (ABT) has yielded highly inconsistent findings with respect to the nature of the biases and when they occur. Most studies to date have failed to account for factors that influence attentional deployment, such as motivation to approach vs. avoid threat, and almost no studies have examined attentional biases that occur when people are occupied with an attentionally demanding task, which far more resembles what happens in real life when faced with a threat. There is emerging evidence showing that visual attention to threat varies substantially according to motivation, and that clinically significant anxiety may be characterized more by ambivalence about where to deploy attention in face of threat. Second, mindfulness is now widely recommended as a treatment for anxiety disorders despite the absence of a viable theory as to the mechanism of action by which it is effective. This is especially concerning given the current hype about its effects. Research has clearly demonstrated that anxiety is associated with a narrow scope of attention (the one frowning face in an audience) as opposed to a broad scope of attention (the entire crowd). New theories proposed that a function of mindfulness is to broaden perspective, which may explain how mindfulness ameliorates anxiety.

This program of research aimed to address these issues in three studies. The first study was designed to assess the impact of motivation to attend to vs. avoid attending to an external threat (a live tarantula) in people who were high in spider fear, while they completed a competing attentionally demanding task. The second study was designed to better

understand ambivalent motivation by selecting a sample and stimuli that may yield a high degree of approach-avoidance conflict; in this study, individuals who self-identified as restrained eaters underwent a passive viewing task in which they were exposed to high calorie food vs. neutral images while their eye movements were tracked. The third study examined the extent to which a brief mindfulness intervention influenced the scope of perceptual attention, conceptual attention, and thought-action repertoires.

Results from Studies 1 and 2 revealed a significant impact of motivation on attentional deployment, such that different motivational groups demonstrated different patterns of attentional biases to threat. This calls into question the conceptualization of ATB as a homogenous construct, as it would seem anxious individuals may engage in different types of attentional deployment when confronting threat. Results also revealed that individuals who showed high motivation to both look at *and* to avoid looking at the tarantula (that is, participants who were ambivalent) did not show a decrease in fear of the spider whereas all other participants did. In Study 2, individuals who reported high motivation to both look at *and* to avoid looking at high calorie food endorsed more restrained eating behaviours and stronger pathological beliefs, such that even looking at food could make one gain weight. Thus, ambivalent motivation may be a characteristic of greater psychopathology. In Study 3, it was found that for participants whose baseline attentional scope was narrow, mindfulness was associated with the broadening of attentional scope and an improvement in mood state. Theoretical and clinical implications for understanding and treating anxiety were discussed.

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**1.1 Introduction**

Anxiety is a fundamental human emotion that can have a tremendous impact on our physical and psychological wellbeing. When dealing with objectively life-threatening objects (e.g., a poisonous snake) or situations (e.g., natural disasters), it is extremely adaptive to experience anxiety, as it triggers human defence mechanisms (e.g., fight or flight response) and increases our chances of survival. Anxiety leads to a sudden increase in adrenaline, which in turn activates the Sympathetic Nervous System and produces a series of physiological reactions (e.g., increased arousal, tightening of muscles, shutting down the digestive system, etc.) that prepare the human body for taking strenuous and quick actions in response to objective threat (Bateson, Brilot, & Nettle, 2011). However, some individuals frequently experience anxiety in the absence of objective threat (e.g., feeling extremely anxious upon seeing a harmless spider). Although not warranted by their immediate external environment, this anxiety will trigger the same physiological responses, and trigger maladaptive behaviours (e.g., inspecting every room for spiders, avoiding outdoor activities altogether), which can interfere with their normal functioning. When anxiety causes significant distress, it is no longer adaptive. Instead, it is considered symptomatic of an anxiety disorder, as defined by leading diagnostic classificatory systems such as the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013).

Anxiety disorders account for one of the most common types of psychological difficulties. The global prevalence rate of anxiety disorders has been estimated to be 7.3% (Baxter, Scott, Vos, & Whiteford, 2013). It was reported that the one-year and lifetime prevalence rates of anxiety disorders are 10.6% and 16.6%, respectively

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(Somers, Goldner, Waraich, & Hsu, 2006). Anxiety disorders also cause substantial disability, accounting for 3.5% of the overall burden of all diseases (Baxter, Vos, Scott, Ferrari, & Whiteford, 2014). Therefore, there is an imperative need to understand factors that contribute to anxiety disorders.

Decades of psychological research have shown that anxiety is characterized by unique information processing patterns, particularly processing of threat information (see Mathews & Mackintosh, 1998; Mogg & Bradley, 1998; Williams, Watts, MacLeod, & Mathews, 1988). Among the many different cognitive processes, attentional deployment to threat stimuli has attracted the most research focus to date. Individuals with anxiety difficulties typically present with attentional biases to threat (ATB), which include facilitated attention to threat cues, difficulty disengaging from threat cues, and avoidance of threat cues (Koster, Crombez, Verschuere, Van Damme, & Wiersema, 2006). There is a general consensus that these biases play a central role in the development and persistence of anxiety disorders (Yiend, 2010). However, with respect to the nature of these biases, there are various theoretical accounts and inconsistent empirical findings (for a review, see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007). The primary purpose of this chapter was to critically evaluate the current literature on attentional biases to threat among individuals with anxiety difficulties. Of interest in the current program of research was the extent to which attentional biases to threats that signal bodily harm (e.g., a spider for people who are afraid of spiders) mirror attentional biases to threat that interfere with personal goals (e.g., images of high calorie food in people who identify as restrained eaters). Hence, another purpose of this chapter was to review research on attentional biases to spider stimuli and to food stimuli.

**1.2 Defining Attentional Biases to Threat**

In general, attentional biases to threat refer to the observation that attention is deployed differently towards threatening compared to neutral stimuli (Cisler, Bacon, & Williams, 2009). The operationalization of attentional biases to threat, on the other hand, is much more nuanced. Attentional biases to threat can present with very different characteristics at different stages of information processing and as measured by different experimental paradigms. As concluded by Cisler and Koster (2010), three types of attentional biases to threat are commonly observed in research literature, including facilitated attention to threat, difficulty disengaging from threat, and attentional avoidance of threat.

Facilitated attention to threat refers to the relative ease with which attention is drawn to a threat stimulus. This attentional bias is characterized by faster attentional capture for threat vs. neutral stimuli, (e.g., Yiend & Mathews, 2001). Difficulty disengaging from threat refers to the degree to which attention remains fixed on threat such that when attention is allocated to threat, latency to shift attention to other stimuli is longer (e.g., Fox, Russo, Bowles, & Dutton, 2001). Attentional avoidance of threat refers to the preferential allocation of attention directly away from threat and towards neutral stimuli such that when both threat and neutral stimuli are present, attention is intentionally directed towards stimuli other than threat (e.g., Koster et al., 2006).

In addition, there is emerging evidence which suggests that each type of attentional bias to threat might be tied to a specific stage of information processing (for a review, see Cisler et al., 2009; Cisler & Koster, 2010). Facilitated attention to threat is said to occur at an earlier, more automatic stage of information processing (Ohman, 2005), whereas difficulty disengaging from threat and attentional avoidance

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of threat are said to take place at a later, more strategic stage of information processing (Eysenck, Derakshan, Santos, & Calvo, 2007). It has been proposed that, neurologically, facilitated attention represents a bottom-up process, and difficulty disengaging and attentional avoidance reflect a top-down process.

**1.3 Attentional Biases to Threat in Anxiety: Empirical Findings**

Attentional biases to threat have been consistently observed in anxious populations (Bar-Haim et al., 2007). As noted by Yiend (2010), most studies have examined whether emotional stimuli are processed differently in anxious individuals as compared to non-anxious individuals, hypothesizing that attentional biases to threat should be present in anxious individuals but absent in non-anxious individuals. The following sections reviewed three major findings in the current literature: (1) attentional biases to threat are observed among anxious individuals across different experimental tasks; (2) attentional biases to threat are observed across different anxiety diagnoses; and (3) treating anxiety reduces attentional biases to threat, and vice versa.

**1.3.1   Experimental Tasks**

Attentional bias to threat is usually assessed with one of the following paradigms: modified Stroop task, visual search task, dot probe task, spatial cueing task, and eye movement tasks.

In the modified Stroop task (Stroop, 1935), participants are presented with different types of words (e.g., threatening and neutral) that are printed in different colours. Participants are asked to ignore the word itself, and focus on naming the colour of the ink in which words are written of each as quickly as possible, either

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verbally or by key press. The underlying assumption is that in order to name the colour of the words, individuals need to inhibit their automatic tendency to read the content of the words. Individuals with anxiety difficulties are expected to exhibit slower response times in naming the colour of threat words relative to neutral words, as there will be facilitated attention to the semantic (i.e., threatening) nature of the word. A meta-analysis of 70 emotional Stroop studies (Phaf & Kan, 2007) revealed that latency to colour-name threat words was, indeed, longer in individuals with anxiety disorders and those with high trait anxiety.

In the visual search task (e.g., Ohman, Flykt, & Esteves, 2001), participants identify a target stimulus that is embedded in a matrix of distracting stimuli. For example, a picture of a spider might be presented within an array of pictures of neutral objects. Faster response times to detect the spider in a matrix of neutral pictures relative to response times to detect a neutral object in a matrix of neutral pictures would indicate facilitated attention to threat. Conversely, a picture of a neutral object might be displayed within a matrix of spider pictures. In this case, slower response times to detect a neutral object in a matrix of spider pictures relative to response times to detect a neutral object in a matrix of neutral pictures would indicate difficulty disengaging from threat. Both attentional biases to threat have been observed in a variety of studies, e.g., spider stimuli among spider-fearful individuals (Ohman et al., 2001; Rinck, Reinecke, Ellwart, Heuer, & Becker, 2005), and faces bearing negative emotional expressions among individuals with social anxiety disorder (Eastwood et al., 2005; Gilboa-Schechtman, Foa, & Amir, 1999).

The dot probe task is one of the most commonly used paradigms in measuring attentional biases to threat (MacLeod, Mathews, & Tata, 1986). In this task, participants are first presented with two stimuli (e.g., words or pictures) on a

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computer screen. After a short duration, these two stimuli disappear and a dot probe appears in one of the two locations previously occupied by the stimuli. Participants then need to press a button to indicate which of the two stimuli the probe has replaced. Faster response times to probes that replace threatening stimuli relative to probes that replace neutral stimuli indicate facilitated attention to threat. There is a body of research showing the presence of attentional biases to threat using the dot probe task (Bar-Haim et al., 2007; Mogg & Bradley, 1998). However, more recent studies have revealed a number of important methodological problems with the dot probe task and concerns about how dot probe data is analyzed (Fox, 2004; Koster, Crombez, Verschuere, & De Houwer, 2004).

In the spatial cueing task (Posner, 1980), participants focus on a fixation point located between two rectangles. A threatening stimulus then appears in one of two rectangles, followed by the appearance of a target stimulus in the same (i.e., congruent) or opposite rectangle (i.e., incongruent). Participants are asked to press a button to indicate the rectangle in which the target stimulus is located. Faster response times to congruent threat-cued trials relative to neutral-cued trials indicate facilitated attention to threat whereas slower response times to incongruent threat-cued trials relative to neutral-cued trials indicate difficulty disengaging from threat. Both types of attentional bias have been observed among individuals with anxiety disorders (Mogg, Bradley, & Williams, 1995; Mogg, Mathews, & Eysenck, 1992) and individuals high in trait anxiety (Fox, 1993; MacLeod & Mathews, 1988).

Unlike other tasks that use response times to infer attentional biases, eye movement tasks provide more direct measures of attention. The assumption is that where we look reveals what is on our mind (Armstrong & Olatunji, 2013). To assess attentional biases to threat, most studies have used a free viewing paradigm in which

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participants are first asked to fixate on a central location, and then look at image pairs (e.g., a neutral stimulus paired with a threat stimulus) for a limited duration while their eye movements are tracked in real time (e.g., Calvo & Avero, 2005; Nelson, Purdon, Quigley, Carriere, & Smilek, 2015). A number of studies have demonstrated that anxious individuals show facilitated attention to threat, as indicated by a greater probability of making first fixations on threat and faster first fixations towards threat (e.g., Calvo & Avero, 2005; Mogg, Garner, & Bradley, 2007). However, other studies failed to detect evidence of facilitated attention (Quigley, Nelson, Carriere, Smilek, & Purdon, 2012). With respect to difficulty disengaging, Mogg and Bradley (2006) proposed that it is exhibited by longer gaze durations on threat images initially fixated upon, relative to neutral images initially fixated on. Research findings on difficulty disengaging from threat have been inconsistent (Quigley et al., 2012). Attentional avoidance of threat is exhibited by a greater proportion of viewing time on neutral than threatening stimuli. Although a few studies found that anxious individuals exhibited a bias away from threat images at 2000 – 3000ms after stimulus onset (Calvo & Avero, 2005; Hermans, Vansteenwegen, & Eelen, 1999), others did not (Gamble & Rapee, 2010; Waechter, Nelson, Wright, Hyatt, & Oakman, 2013).

### 1.3.2 Anxiety Diagnoses

Attentional biases to threat have been observed in almost all anxiety disorders, including in individuals with social anxiety disorder (Amir, Elias, Klumpp, & Przeworski, 2003), obsessive-compulsive disorder (Cisler & Olatunji, 2010), generalized anxiety disorder (Mogg & Bradley, 2005; Rinck, Becker, Kellermann, & Roth, 2003), panic disorder (Buckley, Blanchard, & Hickling, 2002), post-traumatic stress disorder (Bryant & Harvey, 1995), and spider phobia (Rinck et al., 2005). In

addition, attentional biases to threat have been found in individuals with significant eating-related anxiety, such as those who present with an eating disorder or engage in disordered eating behaviours (Brooks, Prince, Stahl, Campbell, & Treasure, 2011).

Results from a meta-analysis of 172 studies (Bar-Haim et al., 2007) confirmed that there is a robust link between attentional bias to threat and anxiety, with a low-to-medium effect size of 0.45. Interestingly, this meta-analysis also revealed that attentional biases to threat appear to occur in equal magnitude in all anxiety disorders. Hence, attentional biases to threat might not be a feature of any specific anxiety disorder but rather a component of elevated trait anxiety.

### 1.3.3   Anxiety Treatment

If we assume that attentional biases to threat is a symptom of anxiety disorder, then treating anxiety would be sufficient to attenuate attentional biases to threat. Similarly, if we consider attentional biases to threat as a cause for anxiety disorder, then attenuating attentional biases to threat would lead to a reduction in anxiety. The exact nature of the relation between attentional biases and anxiety is not of direct interest to the current program of research. However, if there is evidence confirming either of these hypotheses, it will provide further support to the close link between attentional biases to threat and anxiety. As observed by Browning, Holmes, and Harmer (2010), there are three lines of anxiety treatment: pharmacological methods, therapeutic methods, and experimental methods.

A wide range of antidepressant and anxiolytic medications has been found to attenuate attentional biases to threat. In one study, healthy participants were randomly assigned to receive either a single dose of serotonergic antidepressant citalopram or a placebo. A single dose of citalopram led to facilitated attention to positive words, as

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compared to the placebo condition (Browning, Reid, Cowen, Goodwin, & Harmer, 2007). Similarly, a single dose of citalopram reduced initial orientation towards negative facial expressions in healthy individuals (Kerestes et al., 2009). Healthy participants who received citalopram for seven days showed less initial orientation to fearful faces (Murphy, Yiend, Lester, Cowen, & Harmer, 2009).

Psychotherapy that does not directly address attentional bias to threat also attenuates attentional biases to threat. After seven sessions of Cognitive Behavioural Therapy, individuals with anxiety disorders no longer displayed facilitated attention to threat measured through a modified Stroop task and a visual search task (Mathews, Mogg, Kentish, & Eysenck, 1995). Similarly, individuals with Obsessive-Compulsive Disorder exhibited less facilitated attention toward threat-related words after three weeks of daily exposure to obsessional concerns (Foa & McNally, 1986). The attenuating effect of psychotherapy has also been observed in individuals with spider phobia (Lavy, van den Hout, & Arntz, 1993), social anxiety (Pishyar, Harris, & Menzies, 2008), and post-traumatic stress disorder (D'Andrea & Pole, 2012).

Finally, there are some cognitive tasks have been developed to directly attenuate attentional biases to threat. This approach is referred to as *Attention Bias Modification*, which typically utilizes variants of the dot-probe task to train an attentional bias away from threat by presenting targets at the location of the neutral stimuli more often. Attention Bias Modification has been found to be effective in reducing trait anxiety in sub-clinical populations and anxiety symptoms in individuals with anxiety diagnoses (for a review, see Bar-Haim, 2010).

**1.4 Attentional Biases to Threat in Anxiety: Theoretical Models**

Different lines of research have all revealed a robust link between attentional biases to threat and anxiety. To account for the role of attentional biases to threat in anxiety disorders, many theoretical models have been proposed in the literature.

**1.4.1   Williams, Watts, MacLeod, and Mathews, 1988**

Williams et al. (1988; 1997) proposed one of the first models to account for information processing biases in anxiety. In their model, there are two important systems: *Affective Decision Mechanism* and *Resource Allocation Mechanism*. They postulated that all individuals are constantly assessing the valence and threat value of stimuli in their environment. The *Affective Decision Mechanism* determines the threat value of any incoming stimuli. If stimulus input is deemed highly threatening, the *Resource Allocation Mechanism* will be activated, which directs attentional resources to threat. However, if stimulus input is deemed low threatening, attentional resources will be allocated to the current task and away from the new stimulus input. Central to their theory is their proposition that the *Resource Allocation Mechanism* is moderated by trait anxiety—individuals with high trait anxiety are more likely to allocate attention to threat, whereas individuals with low trait anxiety are more likely to ignore threatening information.

**1.4.2   Beck and Clark, 1997**

Beck and Clark (1997) proposed that anxiety is characterized by biases at three different stages of information processing: (1) an initial *orienting mode*, (2) the immediate activation of a *primal mode*, and (3) the secondary activation of a *metacognitive mode*. At the first stage, anxious individuals are in an *orienting mode*,

which involves automatic identification of threat. Once threat is detected, anxious individuals enter a *primal mode*, which involves a series of cognitive (e.g., thoughts), affective (e.g., fear), physiological (e.g., arousal), and behavioural (e.g., fight or flight) responses that serve to maximize the chances of survival. At the final stage (i.e., a *metacognitive mode*), anxious individuals engage in effortful and elaborative processing of threat, such as evaluating one's ability to cope with a potential threat. The central argument is that anxious individuals tend to over-estimate the value of threat. Hence, mild threat stimuli can easily activate the *orienting mode* as well as the *primal mode*, which prevents the individual from entering the *metacognitive mode*.

### 1.4.3   Mogg and Bradley, 1998

Mogg and Bradley (1998) considered facilitated attention to threat a normal and adaptive mechanism as it improves our chances of survival upon encountering imminent dangers. In their model, attention biases to threat are determined by two systems: (1) a *Valence Evaluation System*, and (2) a *Goal Engagement System*. Incoming stimuli, together with contextual factors and the individual's prior learning, are first appraised by the *Valence Evaluation System* in an automatic fashion. If a stimulus is deemed highly threatening, then the *Goal Engagement System* will interrupt current behaviours and direct attention to the stimulus input. However, if a stimulus is deemed low threatening, then current behaviours will not be interrupted and attention will be maintained at ongoing tasks.

According to this model, both anxious and non-anxious individuals will show attentional biases to highly threatening information. While anxious individuals will appraise mild threatening information as highly threatening and attend to this information, non-anxious individuals will appraise it as low threatening and ignore

this information. In addition, Mogg and Bradley (1998) proposed that for anxious individuals, attentional biases to threat follow a vigilant-avoidant pattern. Anxious individuals develop increased attentional vigilance towards mild threat, which evokes high state anxiety. In an attempt to reduce this high state anxiety, anxious individuals replace this vigilance with avoidance.

### 1.4.4   Matthews and Mackintosh, 1998

Mathews and Mackintosh (1998) proposed that attentional biases to threat only occur when threat has to compete with other stimuli or task demands. It was further postulated that attentional biases to threat are a result of two systems: (1) a *Threat Evaluation System*, and (2) an *Effortful Task Demand System*. If the stimulus input is appraised as highly threatening by the *Threat Evaluation System*, attention will be oriented towards the perceived threat, thus causing interference with the current task. To counter this distraction caused by threat, the *Effortful Task Demand System* will be activated, which leads to increased effort to attend to targets from the task at hand. According to this model, the threshold of the *Threat Evaluation System* is moderated by trait anxiety level, such that anxious individuals would have lower thresholds than non-anxious individuals. Hence, highly threatening stimuli will attract attention in everyone, whereas mild threat will only evoke attentional biases in highly anxious populations.

### 1.4.5   Eysenck, Derekshan, Santos, and Calvo, 2007

Eysenck et al. (2007) proposed an attentional control theory to account for the impact of anxiety on attentional processes. Central to their theory is the hypothesis that anxiety impairs two executive functions related to attentional control: (1) *inhibition*,

which refers to the ability to inhibit a dominant and automatic response, and (2) *shifting*, which refers to the ability to shift attention between different tasks. Their model further posits that anxiety increases the stimulus-driven bottom-up processing while decreasing the goal-driven top-down regulatory control. Increased bottom-up processing leads to facilitated attention to threat, whereas decreased top-down regulation results in a difficulty to disengage from threat.

### 1.4.6 Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, and van IJzendoorn, 2007

Bar-Haim et al. (2007) developed a multidimensional model in which attentional biases to threat can occur at any of the following four stages of information processing: (1) the *Pre-attentive Threat Evaluation System*, which automatically evaluates the threat value of any incoming stimulus; (2) the *Resource Allocation System*, which activates physiological alertness, interrupts ongoing activity, and orients attention to the location of the stimulus, once a stimulus is deemed highly threatening; (3) the *Guided Threat Evaluation System*, which further assesses the threat value of the stimulus by taking into account the current context, prior experience and memory, and coping mechanisms; and (4) the *Goal Engagement System*, which continues to interrupt ongoing activity and direct attention towards the threat, if the stimulus is still appraised to have a high threat value. This model posits that anxiety can lead to attentional biases to threat through each of the four systems: (1) anxious individuals tend to appraise mild threat stimuli as highly threatening, (2) anxious individuals are more likely to orient to threat, (3) anxious individuals tend to be skewed in their elaborative evaluation of threat, and (4) anxious individuals may have deficits in disengaging from threat.

### 1.4.7   Cisler and Koster, 2010

In their review paper, Cisler and Koster (2010) outlined three distinct mechanisms that mediate each of the three types of attentional biases to threat: (1) a *Threat Detection System*, which evaluates the threat value of any incoming stimuli and underlies facilitated attention to threat, (2) *Attentional Control*, which refers to the individual's ability to regulate their attentional allocation and modulates difficulty disengaging from threat, and (3) *Emotion Regulation Strategies/Goals*, which refers to the individual's ability to influence their emotional experience and modulates attentional avoidance of threat. Their model further posits that these mechanisms operate at different stages of information processing and are embodied by different neural networks: *Threat Detection System* operates during automatic processing and is centered around the amygdala, whereas *Attentional Control* and *Emotion Regulation Strategies/Goals* operate during strategic processing and are centered around the prefrontal cortex and related structures. This was the first model to conceptualize attentional biases to threat as a multi-component phenomenon that can be modulated by different mechanisms, thus introducing much more complexity into this field of research.


### 1.5 Attentional Biases to Threat in Spider-Related Anxiety

Some stimuli, such as spiders, signal bodily harm and are considered universally threatening. In fact, spiders are considered one of the most common phobic stimuli (Ohman & Mineka, 2001). According to the Preparedness Theory of Phobias (Seligman, 1971), spiders receive priority from our brain because they may carry venom and can potentially pose survival threats to human species. Hence, we would expect spiders to elicit more biases in the automatic stage of information processing.

An extensive amount of research has demonstrated the presence of facilitated attention towards spider-related stimuli. Ohman et al. (2001) developed a visual search task in which participants had to detect either a spider picture in a matrix of neutral distractors, or a neutral picture in a matrix of spider-related distractors. It was found that spider-fearful individuals were significantly faster to detect the spider picture than the neutral one in a matrix of discrepant stimuli. In a subsequent study, Mogg and Bradley (2006) had participants high or low in spider fear complete a visual probe task. Results showed that spider-fearful individuals were faster to respond to the dot probe that replaced a spider picture compared to a cat picture, but only when stimuli were present for a short duration (e.g., 200ms). Vrijsen, Fleurkens, Nieuwboer, and Rinck (2009) replicated this finding using a modified dot-probe task. It was found that spider-fearful individuals were faster in responding to the probe that replaced a moving spider than a moving neutral object.

There is less research showing the presence of difficulty disengaging from spider-related stimuli. Wilson, Russell, and Helton (2015) had university students complete two versions of the Sustained Attention to Response Task (SART; Robertson, Manly, Andrade, Baddeley, & Yiend, 1997). The SART is an experimental paradigm where participants are asked to respond to frequent Go stimuli and withhold responses to infrequent No-Go stimuli. Participants had to inhibit responses to a particular number (e.g., pressing the spacebar for any number but "3") in one version of the SART, and withhold responses to a particular picture (e.g., pressing the spacebar for spider pictures but not neutral pictures) in the other version. Interestingly, participants showed fewer commission errors and slower response times in the picture version of the SART, indicating a difficulty in switching attention from spider to neutral pictures (Wilson et al., 2015). Paulitzki, Risko, Oakman, and Stolz

(2008) presented spider-fearful individuals with spider pictures and asked them to either describe the texture of the spider (referred to as "the spider task") or identify an associated digit (referred to as "the neutral task"). Fearful participants were faster to switch into the spider task relative to the neutral task but slower to switch out of the spider task relative to the neutral task, suggesting difficulty disengaging from threat.

In addition, there is increasing evidence suggesting that attentional biases to spiders follow a vigilance-avoidance pattern. Hermans et al. (1999) conducted a study in which participants with or without spider anxiety watched a series of spider pictures paired with flower pictures while their eye movements were recorded. Spider-fearful individuals spent more time looking at the spider for the first 500ms of the trial and as time progressed, they spent more time looking at the flower for the last 1000ms of the trial. Rinck and Becker (2006) had individuals with or without spider anxiety watch four pictures presented simultaneously (a spider, a butterfly, a dog, and a cat) for one minute while their eye movements were recorded. Compared to non-anxious individuals, those with spider anxiety spent more time looking at the spider for the first 500ms and less time looking at the spider for the remainder of the trial.

**1.6 Attentional Biases to Threat in Eating-Related Anxiety**

Whereas some stimuli (e.g., spiders) signal bodily harm and are considered universally threatening, others signal a threat to personal goals and only certain populations will perceive them to be threatening. One such stimulus is high calorie food. For most people, a rich moist chocolate cake would most likely produce appetite. For individuals with eating-related anxiety (such as those who have an eating disorder), the sight of a chocolate cake might be viewed as a threat. According to Webb et al. (2011), eating-related anxiety is broadly defined as experiencing a

significant fear of weight gain and subsequently engaging in a variety of disordered eating behaviours to control weight (including restrained eating, excessive exercising, and purging). Hence, eating-related anxiety is present in individuals with anorexia nervosa (e.g., restricting and being significantly underweight), bulimia nervosa (e.g., binge eating and purging regularly), and restrained eaters (e.g., restricting food intake).

For individuals with eating-related anxiety, one reason a chocolate cake might be threatening is that even looking at an image of a high calorie food can cause some people to feel more "fat" (Coelho, Baeyens, Purdon, Pitet, & Bouvard, 2012). This phenomenon has been identified by Shafran, Teachman, Kerry, and Rachman (1999) as "thought-shape fusion", and is similar to the construct of "thought-action fusion" observed in Obsessive-Compulsive Disorder (Rachman, 1993), in which thinking a negative thought is viewed as the moral equivalent of committing the deed represented in the thought, and that thinking about an event makes it happen. Unlike spiders, high calorie food may elicit different attentional biases from different individuals, depending on their personal goals regarding eating and weight.

Most of the studies to date have used the Stroop task, in which participants are shown words that are either neutral or food-related, and asked to name the colours of the ink in which the words are printed (see Fairburn, Cooper, Cooper, McKenna, & Anastasiades, 1991). The rationale is that the food-related words will give rise to emotional processing, which interferes with colour naming. A meta-analysis of 28 Stroop studies (Dobson & Dozois, 2004) concluded that facilitated attention to food and body/weight stimuli is consistently found in bulimia nervosa, less consistently observed in anorexia nervosa, and trivial to modest for restrained eaters. In a more recent meta-analysis, Brooks et al. (2011) reviewed 25 Stroop tasks that exclusively

measured facilitated attention to food stimuli. Results showed that the pooled effect size was medium for individuals with bulimia nervosa, and small for individuals with anorexia nervosa and for restrained eaters.

Studies that adopted the visual dot probe task have revealed conflicting findings. In a study conducted by Veenstra, de Jong, Koster, and Roefs (2010), both restrained and disinhibited eaters showed a tendency to direct attention away from pictures of high fat food relative to neutral pictures presented for 500ms, but no attentional biases were found when pictures were presented for 1500ms. In a follow-up study, Veenstra and de Jong (2012) compared a group of patients who were diagnosed with restrictive eating disorders and a group of matched healthy individuals. Results showed that participants with restrictive eating disorders displayed stronger attentional engagement with low fat food and attentional avoidance of high fat food. In a more recent study, Shank et al. (2015) asked youth to engage in a visual probe task where images of high palatable food, low palatable food, and neutral objects were shown. For those who endorsed lack of control eating (e.g., binge eating), leaner participants exhibited attentional avoidance of high palatable food, while heavier ones demonstrated facilitated attention towards high palatable food.

There is some emerging evidence suggesting that attentional biases to food may follow a vigilance-avoidance pattern. According to Mogg and Bradley (1998), anxious individuals initially exhibit facilitated attention to threat, which is then replaced by attentional avoidance of threat. Werthmann et al. (2011) had overweight and healthy-weight females complete a visual dot-probe task, in which they were presented with palatable food images paired with neutral images and their eye movements were measured. They found that overweight participants showed an initial orientation towards food images, followed by diminished durations of fixations on

food images, representing attentional avoidance of threat. These findings were replicated by Hollitt, Kemps, Tiggemann, Smeets, and Mills (2010) in a group of restrained eaters. It was observed that retrained eaters were disproportionately faster to detect a food-related word amongst neutral distractors compared to a neutral word amongst neutral distractors. Moreover, restrained eaters were disproportionately faster to detect a neutral word amongst food distractors compared to a neutral word amongst neutral distractors, suggesting attentional avoidance of food cues.

**1.7 Summary**

Attentional biases to threat are a well-established phenomenon in the domain of anxiety disorders. When encountering threat stimuli, anxious individuals exhibit attentional biases, including facilitated attention to threat, difficulty disengaging from threat, and attentional avoidance of threat. Attentional biases to threat as a general phenomenon has been reliably documented using a variety of experimental tasks and in different anxiety diagnoses. However, the exact nature of attentional biases to threat remains unclear. In fact, different studies using different experimental tasks and different threatening stimuli have revealed rather inconsistent findings. Many theories have been proposed to account for attentional biases to threat in anxiety. However, there is a huge variability in terms of how attentional biases to threat are conceptualized and operationalized in each of these theories. More recent models (e.g., Bar-Haim et al., 2007; Cisler & Koster, 2010) seem to share a consensus that top-down processes such as emotion regulation strategies and goals can moderate attentional biases to threat.

There is also a growing trend in the research literature to conceptualize attentional biases to threat as a multi-dimensional construct instead of a simple by-

product of anxiety. Generally speaking, there are two types of threat stimuli: one that is a universal threat and signals bodily harm (e.g., a spider), and the other that is specific to certain populations and signals a threat to personal goals (e.g., high calorie food in people who are restrained eaters or have eating disorders). Interestingly, while both stimuli elicit attentional biases, the pattern of biases observed in different groups of people with eating disorders (e.g., high vigilance in binge eaters, high avoidance in restrained eaters) suggests that motivation to attend or avoid the cue may be of considerable importance in understanding attentional biases.

## Chapter 2

## Motivation and Anxiety

### 2.1 Introduction

Research on attentional biases to threat is still in its early stage. Previous studies have mainly focused on the validity and reliability of this construct. It was only until recently did researchers begin to understand the complexity of this construct, i.e., factors that may influence attentional biases to threat. In fact, the newest model (Cisler & Koster, 2010) proposed that emotion regulation strategies and goals may modulate attentional biases to threat. If we consider attentional biases as an observable epiphenomenon (i.e., how one allocates attentional resources in response to threatening stimuli), it should be subject to the influence of high-level mental processes, such as motivation and goals (Anderson, 2011).

Motivation is a fundamental, universal determinant of behaviour and functions as a strategic process through which individuals determine their responses to external stimuli. There are two fundamental motivation systems: rewards elicit *approach motivation*, and punishments elicit *avoidance motivation*. In current cognitive theories of anxiety (Bar-Haim et al., 2007; Mogg & Bradley, 1998), motivation is considered a central component in determining how individuals respond to threatening stimuli.

The purpose of this chapter was to review and critically evaluate the current literature on approach and avoidance motivation among individuals with various anxiety difficulties. Of interest in the current program of research was the extent to which motivation towards stimuli that are universally threatening (e.g., a spider for people who are afraid of spiders) mirror motivation towards stimuli that signal a threat to personal goals (e.g., images of high calorie food in people who restrict their

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eating). Hence, another purpose of this chapter was to review research on approach and avoidance motivation to spider stimuli and to food stimuli.

**2.2 A Two-Factor Model: Approach and Avoidance Motivation**

It is widely acknowledged that human behaviour is determined by two motivational systems: one is approach motivation and the other is avoidance motivation. As summarized by Elliot and Thrash (2002), approach motivation refers to a behavioural predisposition towards positive stimuli, whereas avoidance motivation refers to a behavioural predisposition away from negative stimuli. The distinctions between approach and avoidance motivation are not only present in major psychological tradition but also supported by empirical research.

From an evolutionary perspective, it is adaptive that positive stimuli elicit approach motivation and negative stimuli elicit avoidance motivation. In a series of landmark experiments, Chen and Bargh (1999) asked participants to respond to a variety of positive and negative words by either pushing or pulling a response lever. It was found that positive words elicited approach-like muscle movements, i.e., pulling the object towards oneself. Negative words, however, elicited avoidance-like muscle movements, i.e., pushing the object away from oneself. In a recent meta-analysis, Phaf, Mohr, Rotteveel, and Wicherts (2014) reviewed 29 studies that examined the relation between emotional stimuli and motivation. Results showed a small-to-medium effect of positive stimuli on approach motivation and a similar effect of negative stimuli on avoidance motivation.

Gray (1970) proposed that approach and avoidance motivation utilize two different nervous systems. The Behavioural Activation System (BAS) facilitates behaviours and generates positive affect, and is therefore considered a positive

motivational system. The Behavioural Inhibition System (BIS) inhibits behaviours and generates negative affect, and is therefore considered a negative motivational system. Evidence from neuroimaging research generally supports this differentiation. In a seminal study, Davidson, Ekman, Saron, Senulis, and Friesen (1990) measured electroencephalogram (EEF) activity when participants engaged in facial expression of different emotions. It was found that approach-based positive affect was associated with greater activation in the left side of the prefrontal and anterior temporal regions. Avoidance-based negative affect was associated with greater activation in the right side of the prefrontal and anterior temporal regions.

**2.3 Approach and Avoidance Motivation in Anxiety: Theoretical Models**

Anxiety, as a general sense of negative affect, is usually considered a natural response to threats (see Beck & Clark, 1997). Most threatening stimuli are perceived to be negative and would involve negative consequences. Hence, according to motivational models, threat should elicit a tendency to avoid. While the correspondence between threat and avoidance motivation is self-evident, this does not exclude a potential link between threat and approach motivation.

There are a few reasons why threats may elicit approach motivation. Firstly, there are benefits in paying attention to threats and staying alert. Take spiders as an example; for those who are highly afraid of spiders and live in areas where spiders are more populated, it is adaptive to watch out for spiders and check common hiding places for spiders (e.g., bushes, shrubs, plants, etc.), which prepares for rapid actions if necessary (e.g., fight or flight). In life-threatening situations (e.g., policemen pursuing a gunman, homeowner fighting an intruder), approach behaviours can be

critical to our or other's survival and hence, approach motivation may even override avoidance motivation.

Secondly, some threatening stimuli can be appetitive and aversive at the same time. Take high calorie food as an example; for those who engage in restrained eating, high calorie food is threatening, as it hinders their dieting goals. At the same time, high calorie food can be rewarding, as food is essential for human survival and restrained eaters are particularly deprived of energy. Hence, there might be situations where individuals are motivated to approach and avoid threats at the same time, thus experiencing an ambivalent motivation. In fact, as Schlund et al. (2016) argued, it is common for anxious individuals to experience a conflict between approach and avoidance motivation (i.e., ambivalence). The notion that threatening stimuli can activate different motivational systems is an important element to many current theories of anxiety.

Mogg and Bradley (1998) developed a cognitive-motivational model of anxiety, which consists of two essential components: a *Valence Evaluation System*, which assesses the threat value of a stimulus, and a *Goal Engagement System*, which determines the allocation of resources for cognitive processing. According to this model, when a stimulus is deemed moderately threatening, it will trigger avoidance motivation, as avoiding helps to maintain attention on current goals and preserve a positive mood state. However, when a stimulus is tagged as high threat, it will activate approach motivation, which allows risk monitoring and rapid response.

Bar-Haim et al. (2007) offered an integrative model based on results of their meta-analysis. If a stimulus is perceived to be threatening, it feeds forward into a *Resource Allocation System*, which triggers physiological alert and leads to a more elaborate, conscious assessment of risk. Subsequently, if this stimulus is considered a

low-to-moderate threat, it will result in a strong motivation to avoid. However, if this stimulus is deemed high threat, it will result in a strong motivation to approach and monitor.

Overall, both models suggest that threatening stimuli can activate different motivational systems, depending on the subjective evaluation of the presenting threat.

**2.4 Approach and Avoidance Motivation in Spider-Related Anxiety**

Some stimuli, such as spiders, signal bodily harm and are considered universally threatening. Such stimuli tend to trigger more avoidance than approach motivation, as avoidance would increase our chances of survival. Surprisingly, very few studies have explicitly measured motivation in spider-related anxiety. Some looked at the readiness to approach and avoid spider stimuli, and others examined the actual approach and avoidance behaviours. The majority of research to date has paid exclusive attention to avoidance motivation and how exposure can reduce such a tendency to avoid spider stimuli (for a review, see Siegel & Warren, 2013).

Two tasks are commonly used to measure approach and avoidance tendencies in spider-related anxiety: one is the approach-avoidance task developed by Rinck and Becker (2007), and the other is the classic implicit association test developed by Greenwald, McGhee, and Schwartz (1998). In the approach-avoidance task, participants are presented with a variety of pictures and have to respond to each picture by either pushing or pulling a joystick that is connected to the computer. The size of the picture changes in accordance with the movement of the joystick: pulling increases the picture size and creates the visual impression that the picture is coming closer, while pushing decreases the picture size and creates the impression that the picture is moving away. The hypothesis is that spider-fearful individuals have an

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automatic tendency to avoid spider stimuli and would show a preference in pushing spider pictures away. In a series of experiments, Rinck and Becker (2007) found that spider-fearful individuals were indeed quicker to push spider picture away than to pull them closer, even when they were explicitly asked not to pay attention to the content of the pictures. In another study, Klein, Becker, and Rinck (2011) had a group of children complete the approach-avoidance task. It was found that all participants, regardless of their level of spider fear, showed an automatic readiness to avoid spider pictures but not pictures of butterflies.

In the implicit association task, participants are presented with two pairs of category labels on the computer screen and have to decide which pair fits the given stimulus better. For example, participants might see a picture of a spider and have to decide whether it belongs to "spider" and "danger" or "snake" and "safety". The hypothesis is that spider-fearful individuals automatically associate spider stimuli with danger. Teachman and Woody (2003) found that spider-fearful individuals were faster in their response when spider stimuli were matched with "danger" as compared to "safety". In another study, Teachman (2007) observed that spider-fearful individuals were faster in responding to spider pictures when they were matched with "afraid" and this automatic association predicted behavioural avoidance of a live spider.

## 2.5 Approach and Avoidance Motivation in Eating-Related Anxiety

Whereas some stimuli (e.g., spiders) are considered universally threatening and elicit mostly avoidance motivation, others (e.g., high calorie food) are only threatening to certain populations and may evoke different motivation in different individuals. Unfortunately, similar to spider-related anxiety, there are very few studies that have

explicitly examined motivation in eating-related anxiety. The majority of studies have exclusively focused on approach motivation through manipulating craving in a laboratory setting.

There is an abundance of research showing that individuals are highly motivated to approach food stimuli when they are deprived of food. In a study conducted by Kemps and Tiggemann (2009), self-identified chocolate cravers demonstrated a higher tendency to approach chocolate-related pictures but not pictures of other highly desired food (e.g., pizza). Moreover, these self-identified chocolate cravers reported higher craving ratings and even more so after being deprived of chocolate for 24 hours. Using a pictorial implicit association task, Kemps, Tiggemann, Martin, and Elliott (2013) found that chocolate cravers were more likely to associate chocolate with "approach". More interestingly, when participants were trained to associate chocolate images with "approach", they reported more cravings (Kemps et al., 2013).

Research on the relation between restrained eating and motivation is rather inconclusive. Ahern, Field, Yokum, Bohon, and Stice (2010) conducted a study in which participants completed a visual probe task where food images were paired with neutral images, and a food reinforcement task where points could be earned towards a snack food. No difference was found between restrained eaters and non-restrained eaters in their processing of food stimuli as well as their sensitivity to food rewards. Ahern et al. (2010) concluded that these null findings might be a result of an ambivalent motivation towards food cues. Restrained eaters may experience a high level of food craving (i.e., approach motivation), but they may also find this experiencing anxiety-provoking, which activates their dieting goals (i.e., avoidance motivation). In fact, in a recent review, Werthmann, Jansen, and Roefs (2015)

proposed that restrained eaters may be torn in a standoff between craving and dieting goals. These individuals are motivated to approach food cues, as they want to eat them. At the same time, they are also motivated to avoid food cues, as they intend to diet. Werthmann et al. (2015) proposed that this ambivalent motivation might account for the observed null findings.

**2.6 Summary**

Motivation is a fundamental psychological process that determines how human beings respond to external stimuli. It has been long established in psychological research that approach and avoidance motivation are two distinct systems. Anxiety is usually considered as resulting from a dominance of avoidance motivation over approach motivation. Indeed, stimuli that are considered universally threatening (e.g., spiders) elicit a predominant motivation to avoid such stimuli. However, stimuli that signal a threat to personal goals (e.g., high calorie food in individuals who are restrained eaters or have an eating disorder) might evoke equally strong motivation to approach and avoid such stimuli at the same time, thus creating an ambivalence. Hence, the relation between motivation and anxiety seems to be more nuanced than initially anticipated (e.g., Fowles, 1987). Unfortunately, research on this topic is scarce and the majority of studies have not explicitly measured motivation.

**Chapter 3**

**Integrating Attentional Biases to Threat and Motivation in Anxiety**

**3.1 Introduction**

As outlined in the first two chapters, decades of research have clearly demonstrated an intrinsic link between attentional biases and anxiety, and between motivation and anxiety. Attentional biases play a central role in the development and maintenance of anxiety (see Mathews & Mackintosh, 1998; Williams et al., 1988; Yiend, 2010). Anxious individuals exhibit three types of attentional biases, including facilitated attention to threat, difficulty disengaging from threat, and attentional avoidance of threat. Motivation is also considered a central component in determining how individuals respond to emotional stimuli (see Eysenck, 1992, 1997). There are two fundamental motivational systems: approach motivation and avoidance motivation. Anxiety is traditionally conceptualized as a dominance of avoidance over approach motivation. More recent evidence suggests that some anxious people might experience an approach-avoidance conflict when encountering threat.

To summarize, there is abundant research on both attentional biases to threat and motivation within anxiety literature. However, little attention has been paid to the integration of these two constructs. In light of Cisler and Koster's (2010) proposed modulating effect of emotion regulation goals (e.g., motivation in response to threat) on attentional biases to threat, a synthesis of these two lines of research is particularly important. Moreover, most studies to date have not explicitly measured motivation in anxious populations, nor have they explored the potential approach-avoidance conflict. This leaves a significant gap for more integrative research. The purpose of this chapter was to review theoretical and empirical research on the integration of attentional biases to threat and motivation, and the integration of approach and

avoidance motivation in anxiety disorders. If anxious populations indeed can be separated into different subgroups based on their motivation to approach and avoid threat, this heterogeneity might account for, at least partially, the inconsistent and sometimes contradictory findings on attentional biases to threat.

Also of interest in the current program of research was the interplay between approach and avoidance motivation in different types of threat stimuli. For stimuli that are considered universally threatening (e.g., spiders), is it possible for individuals to feel motivated to approach and avoid the spider at the same time? For stimuli that are only threatening to certain populations (e.g., high calorie food for individuals who are restrained eaters or have an eating disorder), are there situations where anxious individuals experience a conflict between approach and avoidance motivation? Another purpose of this chapter was to review research on approach and avoidance motivation towards spider stimuli and food stimuli.

**3.2 The Modulating Effect of Motivation on Attentional Biases to Threat**

As suggested by Gross (1998), motivation can be conceptualized as a top-down process through which individuals exert influence over their experience of and response to emotional stimuli. If we consider attentional biases to threat as an observable, overt epiphenomenon, then it might be subject to the influence of various high-level processes including motivation. Cisler and Koster (2010) proposed two mechanisms through which attentional biases to threat can be modulated: one is attentional control, and the other is emotion regulation goals (e.g., motivation regarding emotional stimuli). According to Cisler and Koster (2010), emotion regulation goals are distinct from attentional control because it is not an ability per se, but rather it reflects one's strategy for coping with emotional stimuli. There has been

some evidence supporting the modulating effect of motivation on attentional biases to threat.

D. R. Johnson (2009) presented participants with pairs of angry and happy faces in a dot-probe task. Some participants were instructed to pay attention to happy faces and avoid angry faces, while others received no instruction. Results showed that participants who were asked to pay attention to happy faces showed reduced facilitated attention towards angry faces as well as increased attentional avoidance of angry faces. Furthermore, participants who were asked to approach happy faces showed less frustration in reaction to a stressful anagram task and persisted longer in this task. In a study conducted by Richeson and Trawalter (2008), participants were first tested on their motivation to respond without prejudice towards black individuals. Participants then completed a dot-probe task in which they were presented with pairs of white and black male faces, bearing either a neutral or happy facial expression, for either 30ms or 450ms. Interestingly, participants who were highly motivated to respond without prejudice demonstrated facilitated attention towards neutral black faces presented at 30ms and attentional avoidance of neutral black faces at 450ms.

In addition, Dunning and Hajcak (2009) conducted two experiments in which participants were presented with neutral and unpleasant pictures and their late positive potential (LPP), a brain electrical activity indicating attentional vigilance to stimuli, was recorded. Some participants were instructed to view the pictures passively, while others were asked to direct their attention to more or less arousing parts within the unpleasant pictures. They found that unpleasant pictures were generally associated with facilitated attention under passive viewing instructions, indicated by an increased LPP. However, for those who were instructed to pay attention to non-arousing parts of the unpleasant pictures, they displayed reduced facilitated attention, indicated by a

decreased LPP. Combined, these studies have provided some preliminary evidence showing that motivation may modulate attentional biases to threat.

**3.3 Integrating Approach and Avoidance Motivation in Anxiety**

If we consider approach and avoidance motivation as two distinctive systems (Elliot & Thrash, 2002), each individual can theoretically endorse a high or low motivation to approach or avoid threat. In fact, multiple theoretical models posit that threat stimuli can elicit either approach or avoidance motivation (Bar-Haim, 2010; Mogg & Bradley, 1998) and sometimes both (Schlund et al., 2016). Hence, we can divide anxious individuals into the following four groups: (1) a high motivation to approach threat combined with a high motivation to avoid threat, i.e., ambivalent; (2) a high motivation to approach threat combined with a low motivation to avoid threat, i.e., engagers; (3) a low motivation to approach threat combined with a high motivation to avoid threat, i.e., avoiders; and (4) a low motivation to approach threat combined with a low motivation to avoid threat, i.e., indifferent. This classification system provides a theoretical framework as such anxious individuals can engage in approach motivation, avoidance motivation, ambivalent motivation, or no motivation in response to threatening stimuli.

Traditionally, anxiety has been characterized as a dominance of avoidance motivation over approach motivation, i.e., anxious individuals are highly motivated to avoid threat while experiencing little or no motivation to approach threat. This avoidance motivation would lead to avoidance behaviours (e.g., running away from threat, looking away from threat), which provides a temporary relief, thus reinforcing their avoidance behaviours. While such an account is empirically supported (Rachman, 2004), it also implies that anxious individuals are a homogenous

population with little within-group variance. Indeed, most research to date has mainly focused on avoidance motivation and even when both approach and avoidance motivations were included in the same study, they were considered mutually exclusive constructs (D. R. Johnson, 2009; Richeson & Trawalter, 2008). Very little research attention has been paid to the potential interplay between approach and avoidance motivation. Furthermore, there may be an important difference between physical responding and attentional responding. Whereas physically people may be more likely to avoid threat, mentally they may be highly motivated to engage with threatening stimuli in order to monitor and process the information. However, very little research has addressed approach/avoidance motivation within the context of attentional deployment.

Amongst all four groups that we proposed here, the most intriguing is those who are ambivalent. On one hand, they are motivated to approach threat. There may be several reasons for this: some threating stimuli are inherently rewarding (e.g., high calorie food to restrained eaters), or it is adaptive to watch out for danger (e.g., a moving spider). At the same time, they are motivated to avoid threat, as doing so preserves a positive mood, prevents further deterioration of mood, or sustains their performance on the current task. Hence, we would argue that ambivalent individuals are locked into an approach-avoidance conflict so that they cannot decide on how to allocate their attentional resources in response to threat. This ambivalence will not result in any resolution to the perceived threat. Instead, the inability to make a decision may add to cognitive load and compromise performance on other tasks, and may make the experience especially unpleasant, which in turn sustains anxiety.

**3.4 Going Beyond Avoidance Motivation in Anxiety: Theoretical Models**

Some leading theories of anxiety, such as Behavioural Inhibition System theory (Gray & McNaughton, 2000) and the Attentional Maintenance model (Fox et al., 2001; Yiend & Mathews, 2001), have attempted to integrate approach and avoidance motivation by conceptualizing anxiety as a result of an approach-avoidance conflict.

In their animal model, Blanchard and Blanchard (1990) made a strong distinction between fear (when a predator is immediately present) and anxiety (when a predator may or may not be present). For animals, the actual presence of a predator will activate fear, which is then followed by avoidance behaviours (e.g., running away). However, as part of hunting process (i.e., looking for food), animals have to enter potentially dangerous places where their predator may also be present, which will in turn activate anxiety. Gray and McNaughton (2000) advanced this animal model and proposed that anxiety originates from a conflict between approach and avoidance goals, i.e., animals might be motivated to obtain food (approach goal), but at the same time, they do not want to become food for their predator (avoidance goal).

In this case, as proposed by McNaughton and Gray (2000), anxiety will lead to an inhibition of approach behaviour (e.g., standing still) rather than an activation of avoidance behaviour (e.g., escaping). They further proposed that the *Behavioural Inhibition System* is particularly sensitive to conflicts between approach and avoidance goals, thus acting as the underlying neural mechanism for anxiety. When individuals experience an approach-avoidance conflict (e.g., wanting to eat a delicious chocolate cake and wanting to lose weight at the same time), their behavioural inhibition system will be activated, which then generates the feeling of anxiety and inhibits approach behaviours (e.g., ordering something lighter).

The Attentional Maintenance model was proposed to explain the difficulty anxious individuals experience in disengaging from threats (Fox et al., 2001; Yiend & Mathews, 2001). According to this model, difficulty disengaging from threat originates from a conflict between approach and avoidance goals. Early in viewing, anxious individuals are drawn to threatening stimuli, because there is value in attending to them (e.g., to evaluate risk and to prepare for further actions). However, paying attention to threating stimuli makes them uncomfortable, which promotes avoidance motivation. When individuals are transitioning from facilitated attention to attentional avoidance, they likely experience a conflict between approach and avoidance motivation, which manifests as difficulty disengaging from threat.

**3.5 Going Beyond Avoidance Motivation in Anxiety: Empirical Findings**

There is, however, very limited empirical research aimed at integrating approach and avoidance motivation in the context of anxiety difficulties. To the author's best knowledge, only one study published so far has directly examined approach and avoidance motivation in relation to attentional biases to threat (Nelson, Purdon, Quigley, Carriere, & Smilek, 2014). In this study, participants with high, medium, and low trait anxiety completed a free-viewing Eye Movement Attention Task (EMAT), in which they were presented with emotional images paired with neutral images for 3 seconds per trial and asked to look at these images as they wished. In addition, participants also received a mood induction procedure prior to and during the EMAT (either calming or anxiety-provoking), reported their anxiety level before and after the EMAT, and indicated their level of motivation to approach and to avoid each type of images.

The correlation between motivation to attend to threat and motivation to avoid attending to threat was -.37 in this study, suggesting that the two valences of motivation do not track each other well. Nelson et al. (2014) were able to divide participants into four groups based on their motivation ratings: ambivalent (high motivation to look at threat combined with high motivation to avoid looking at threat), engagers (high motivation to look at threat combined with low motivation to avoid looking at threat), avoiders (low motivation to look at threat combined with high motivation to avoid looking at threat), and indifferent (low motivation to look at threat combined with low motivation to avoid looking at threat). They found that the ambivalent group showed the greatest facilitated attention to threat in the first 500ms, the engagers showed the greatest facilitated attention to threat between 1500ms and 5000ms, and the avoiders showed the lowest facilitated attention to threat between 2500-5000ms. Most importantly, the ambivalent group demonstrated eye movements that were similar to the indifferent group and yet reported significantly higher anxiety.

**3.6 Integrating Attentional Biases and Motivation: Spider-Related Anxiety**

Some stimuli, such as spiders, signal bodily harm and are considered universally threatening. As reviewed in the previous chapter, fear of spiders has been viewed as being driven by a constant, unreasonable tendency to avoid spiders. The majority of past research has attempted to understand spider anxiety as a disorder of extreme avoidance.

To the author's best knowledge, only one study published to date has examined the interplay between approach and avoidance motivation in face of spider stimuli. Pittig, Brand, Pawlikowski, and Alpers (2014) had spider-fearful individuals and non-anxious controls complete a gambling task that involved spider stimuli. In

this gambling task, participants were presented with four decks of cards and had to choose one card in each trial. Two decks were considered disadvantageous as they yielded high immediate gains but higher occasional losses. The other two decks were considered advantageous as they yielded small immediate gains but small occasional losses. The rationale was that participants could use feedback of gains and losses to learn which decks were advantageous and which were disadvantageous.

In one version of the gambling task, spider pictures were depicted on the back of the advantageous decks and butterfly pictures on the disadvantageous decks. In the other version, the position of pictures was reversed. Interestingly, this study created a situation in which spider-fearful individuals would experience ambivalence: when spider pictures were loaded on the advantageous decks, participants should be motivated to approach them because they yield higher overall gains, but they should also be motivated to avoid them because they induce anxiety. Results confirmed the presence of ambivalence: participants showed initial avoidance of spider pictures and despite some improvements over time, they were impaired in the learning of advantageous decks across both versions of the gambling task.

**3.7 Integrating Attentional Biases and Motivation: Eating-Related Anxiety**

Unlike spiders, other stimuli signal a threat to personal goals and are only perceived to be threatening by certain populations. Such stimuli (e.g., high calorie food) are more likely to elicit different motivation. In fact, in the domain of eating-related anxiety, there is increasing evidence showing that people who engage in restrained eating (e.g., dieting) tend to experience an ambivalent motivation.

Stroebe, Mensink, Aarts, Schut, and Kruglanski (2008) proposed a Goal Conflict Model of Eating. According to this theory, restrained eaters are subject to a

chronic conflict between two incompatible goals—one is eating enjoyment, and the other is weight control. When facing high calorie food, restrained eaters experience a high degree of ambivalence in their attitude: they want to eat it because it tastes good, and they also want to restrict eating it because it leads to potential weight gain. They hypothesized that this ambivalent attitude towards food plays a key role in the development of disordered eating.

Stroebe et al. (2008) conducted a series of experiments to test their Goal Conflict Model of Eating. In the first experiment, they had a group of female university students report their attitude towards food. It was found that restrained eaters indeed experienced a conflict between the goals of eating enjoyment and weight control. In two subsequent experiments, participants were first presented with either eating enjoyment or neutral words and then completed a lexical decision task in which they had to decide whether or not a presented word was related to dieting. Results showed that restrained eaters were slower in recognizing dieting-related words when primed with eating enjoyment, suggesting a conflict between eating enjoyment and dieting goals.

In a separate study, Papies, Stroebe, and Aarts (2008) conducted two experiments to examine the extent to which priming food cues and dieting goals influences attentional processing of palatable food. In the first experiment, participants were first primed with either food or neutral words and then completed a visual probe task in which food images were presented. It was found that priming food cues elicited facilitated attention towards palatable food in restrained eaters. The second experiment was identical to the first one except that half of the participants who were primed with food words were also primed with dieting words. Interestingly, those who were primed with dieting goals failed to show facilitated attention to food.

**3.8 Current Program of Research: Study 1 and Study 2**

The current program of research was designed to bridge the gap between theoretical advances and empirical research, with a particular focus on integrating attentional biases and motivation, and integrating approach and avoidance motivation in the context of anxiety. Attentional biases to threat, as a general construct, are well established in research literature. However, the exact nature of attentional biases to threat remains unclear. More recent models proposed that motivation, as an emotion regulation strategy, might modulate attentional biases to threat. Unfortunately, little research has been done to examine the extent to which motivation influences attentional biases to threat. Moreover, anxiety has been traditionally conceptualized as a dominance of avoidance motivation towards threat and little effort has been made to integrate approach and avoidance motivation, despite the increasing evidence showing that anxiety may originate from an approach-avoidance conflict (i.e., ambivalent motivation).

Hence, the current program of research aimed to answer the following research questions: Can we divide anxious individuals into different groups based on their motivation to approach and avoid threat? If anxious individuals can be categorized based on their motivation, do they engage in different types of attentional biases? Do some anxious individuals experience an approach-avoidance conflict when encountering threat? Does this ambivalent motivation towards threat exacerbate anxiety?

In general, there are two types of threat stimuli both of which have been thoroughly studied in the anxiety literature. Some stimuli, such as spiders, signal bodily harm and are considered universally threatening. Others signal a threat to personal goals and are only perceived to be threatening by certain populations, e.g.,

high calorie food in individuals who are restrained eaters. These two particular stimuli (e.g., spiders and high calorie food) also have good ecological validity in that using these stimuli in a laboratory setting triggers the same responses as would be expected outside of the laboratory. Taking these into account, the current program of research aimed at assessing the relation between attentional biases to threat and motivation, and between approach and avoidance motivation in spider-related anxiety and eating-related anxiety respectively.

**Chapter 4**

**Attentional Scope in Anxiety and the Broadening Effect of Mindfulness**

**4.1 Introduction**

Whereas attentional biases describe where attention is being directed, attentional scope refers to how attention is being deployed. By definition, attentional scope refers to the extent to which the attentional field is focused broadly or narrowly and can occur at both perceptual and conceptual levels (for a review, see Friedman & Förster, 2010). It is believed that individuals with a narrow attentional scope tend to focus on local details (e.g., trees), whereas those with a broad attentional scope are more likely to see the big picture (e.g., forest).

Attentional scope, as a construct, has attracted much research attention due to its close link with emotions (for a review, see Huntsinger, 2013). This research originates from the Easterbrook (1959) hypothesis that negative emotions narrow the scope of attention. Decades of empirical research have consistently demonstrated a close link between anxiety and a narrowed scope of attention. Mindfulness meditation, a practice that finds its origin in Buddhist teachings, has become increasingly popular as an effective treatment for anxiety disorders (see Hofmann, Sawyer, Witt, & Oh, 2010; Vollestad, Nielsen, & Nielsen, 2012). There is some, albeit mixed, evidence supporting the use of mindfulness in broadening the scope of attention. The purpose of this chapter was to review current literature on attentional scope and mindfulness-based intervention in the context of anxiety.

**4.2 Defining Attentional Scope**

Attentional scope is a loosely defined construct and involves a broader range of attentional systems. Leading models (see Förster, Friedman, Özelsel, & Denzler,

2006; Fredrickson & Branigan, 2005) propose that there are three levels to attentional scope: perceptual attention, conceptual attention, and thought-action repertoires. The scope of perceptual attention is defined as the extent to which attention is focused upon central versus peripheral information. The scope of conceptual attention refers to the extent to which mental representations are activated with lower versus higher accessibility. The scope of thought-action repertoires is characterized by the relative breadth of thoughts and action tendencies one is prepared to pursue (Fredrickson, 1998).

A variety of visual paradigms have been used to measure the scope of perceptual attention. The most commonly used one is the Navon Letter Task (Navon, 1977). In this task, participants are presented with a series of larger, global letters that are composed of smaller, local letters (e.g., a large T made of small Fs). In each trial, a fixation cross will first appear in the centre of the screen, which is then followed by the composite letter. There are generally two variants of this task. In one version (for an example, see Förster et al., 2006; Gable & Harmon-Jones, 2010), participants are told to respond to each stimulus as quickly as possible by pressing one computer key if they see one target letter but another computer key if they see a different target letter. There are two target letters and only one will occur in a given stimulus. However, this target letter can occur at either the global or local level. For example, the target letters can be H and L, and in each trial, only one of them will be present as either the global or local letter. Hence, it might be a large H made of small Ts, a large L made of small Ts, a large T made of small Hs, or a large T made of small Ls. These trials can be divided into two categories: global trials where the large letter is the target letter (e.g., a large H or L made of small Ts), and local trials where the small letter is the target letter (e.g., a large T made of small Hs or Ts). Faster responses to

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global trials would indicate a broad focus of attention, while faster responses to local trails would indicate a narrow focus of attention.

In the other version of the Navon Letter task (for an example, see Navon, 1977; Yovel, Revelle, & Mineka, 2005), participants are asked to focus their attention on one of the levels (global or local) and decide which of the two target letters is present at the specified level, while ignoring the other level. In each trial, there is always a target letter occurring at the specified level, but the other target letter might appear at the opposite level or might not appear in the stimulus at all. For example, the target letters can be H and L. If the participant is asked to focus on the global level, the correct answer for a big H made of small Ls should be H. However, if the participant is asked to focus on the local level, the correct answer for the same stimulus will be L. Hence, trials can be divided into three categories: consistent trials where the same target letter appears at both the global and local levels, inconsistent trials where two target letters appear at different levels, and neutral trials where an non-target letter appears at the unattended level. In this case, a broad focus of attention will be indicated by: (1) the global precedence effect, where participants identify the target letter faster when the global level is specified, and (2) the global interference effect, where participants are distracted by the global, inconsistent letters when the local level is specified.

For the scope of conceptual attention, the most commonly used measure is the Categorization Task (Isen & Daubman, 1984). In this task, participants are asked to rate items on a 10-point scale, indicating the degree to which they feel each item belongs or does not belong to a given general category. Participants are further instructed that a breakpoint exists between 5 and 6: while 5 indicates that the item does not belong to the category but is very similar to members of that category, 6

indicates that the item does belong to the category but is not a very good example of it. In every trial, participants are presented with a general category at the top of the screen, together with a specific item and the 10-point scale. Within each category, there are weak exemplars, moderate exemplars, and strong exemplars. For example, the general category can be "vehicle", and exemplars can be "tank" (weak), "boat" (moderate), and "car" (strong). In the Categorization Task, the critical items are the weak exemplars. A broad scope of conceptual attention is indicated by a tendency to rate weak exemplars as members of a given category (see Price & Harmon-Jones, 2010; Smith & Trope, 2006).

There are other measures for assessing the scope of conceptual attention. One is the Remote Associates Task (Rosch, 1975). In this task, participants are given a series of three-word sets and have to generate a one-word solution that relates to all of the words. For instance, the correct answer to "fountain", "baking", and "pop" should be "soda". Those who correctly generate the word solution are hypothesized to have a broad scope of conceptual attention, as these word associations are unusual and this task requires creative problem solving. Another measure is the Unusual Use Task (Guilford, 1967). This task involves generating as many unusual uses for a common object (e.g., a brick). Answers will then be analyzed on the basis of uniqueness, which then provides an index of divergent, inclusive thinking (Torrance, 2008).

There are fewer tasks that allow for measuring the scope of thought-action repertoires. One such measure is the Twenty Statement Test (Kuhn & McPartland, 1954). This task was originally designed to identify and measure self-attitudes. In the original version, participants are given twenty blanks and have to write as many answers to the question "Who am I?" in the blanks. Fredrickson and Branigan (2005) developed a modified version of this Twenty Statement Test. In this version,

participants are asked to imagine being in a given situation and based on their felt emotions, list all the things they would like to do right now. Participants are given twenty blank lines that begin with "I would like to ____". The number of completed statements is tallied, ranging from 0-20. A higher number indicates a larger thought-action repertoire, i.e., a wider range of action tendencies.

**4.3 Attentional Scope and Anxiety**

When facing threatening stimuli, anxious individuals are likely to display a narrowed attentional scope (for a review, see Barry, Vervliet, & Hermans, 2015). This constriction of attentional scope can be functional, as it helps anxious individuals focus on the problem at hand and prepares them for emergency. However, a narrow scope of attention can also be detrimental, as it prevents anxious individuals from processing information from the periphery and learning that not everything is as negative as they anticipate. In fact, there is overwhelming research demonstrating a close link between anxiety and a narrowed scope of attention (see Friedman & Förster, 2010).

Derryberry and Reed (1998) were among the first to study attentional scope in anxious individuals. They conducted two experiments in which participants were asked to identify one target letter that might appear at either a global or local level. Participants were placed in two conditions: they either received positive incentives for accurate responses or were punished for inaccurate responses. Results revealed that in both experiments, anxious individuals only showed faster processing of local information when they were punished for inaccurate responses, indicating a narrowed scope of attention under stress. Similar results were obtained by Caparos and Linnell (2012). In their study, participants completed a flanker task in which they had to

identify target letters while ignoring irrelevant distractors occurring at a varying

distance from the target. Results showed that individuals with high trait anxiety were

less distracted by stimuli presented in the periphery, suggesting narrowed spatial

attention.

Anxious individuals also experience difficulties in expanding their attentional

scope. In a study conducted by Najmi, Kuckertz, and Amir (2012), participants had to

identify targets that were shown in boxes and these boxes might increase or decrease

in their size from trial to trial. Anxious individuals were impaired in their ability to

expand attentional scope from a small area to a large one. Interestingly, this difficulty

to broaden attentional scope was only related to anxious, but not depressive

symptoms. The narrowing effect of anxiety also applies to the scope of conceptual

attention. Mikulincer, Kedem, and Paz (1990) found that individuals with high trait

anxiety were more likely to reject non-typical exemplars from a given category and

perceived less relatedness between exemplars that belonged to the same categories,

both of which indicated a narrower scope of concepts. In a separate paper, Mikulincer,

Paz, and Kedem (1990) reported similar findings. They observed that individuals with

high trait anxiety were less inclusive in categorizing exemplars and perceived less

similarity among semantic stimuli that belonged to the same categories.


**4.4 Mindfulness: Definition and Treatment for Anxiety**

Mindfulness, a concept that is central to Buddhist philosophy has attracted growing

scientific interest in the last few decades (McIntosh, 1997). Jon Kabat-Zinn provided

one of the earliest modern definitions of mindfulness as "paying attention in a

particular way, on purpose, in the present moment, and non-judgmentally" (Kabat-

Zinn, 1994, p. 4). As summarized by Bishop et al. (2004), mindfulness has been

operationalized as a combination of: (1) self-regulation of attention, such as sustained attention, attention switching, and inhibition, and (2) a particular orientation towards one's experience, including curiosity, openness, and acceptance.

Mindfulness training was first introduced as a behavioural intervention for patients with chronic pain, in the form of Mindfulness Based Stress Reduction (MBSR; Kabat-Zinn, 1990) . Since then, mindfulness has steadily gained momentum in the medical and psychological literature. Following the establishment of MBSR, three other mindfulness-based interventions have been developed, including the Mindfulness-Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2002), Dialectical Behavioural Therapy (DBT; Linehan, 1993), and Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson, 1999).

There is extensive research supporting the use of mindfulness-based interventions in the treatment for anxiety disorders. A few comprehensive reviews have been conducted in the past decade. Hofmann et al. (2010) conducted a meta-analysis of 39 mindfulness studies. It was estimated that the effect size (Hedge's $g$) was 0.97 for patients with diagnosed anxiety disorders, and 0.67 for individuals with undiagnosed, elevated levels of anxiety symptoms. More importantly, these effect sizes were robust, as they were unrelated to publication year, treatment length, or study quality. Similar results were reported in another meta-analysis by Vollestad et al. (2012). They selected 19 empirical studies in which mindfulness- and acceptance-based therapies were administered to patients with anxiety disorders. It was estimated that the within-group effect size for anxiety symptoms from pre- to post-treatment was 1.09 (Hedge's $g$). These effect sizes remained robust when controlling for publication bias. A review of acceptance-based behavioural therapies (e.g., MBSR, ACT, and DBT) by Roemer, Williston, Eustis, and Orsillo (2013) revealed consistent

findings. It was concluded that the effectiveness of acceptance-based behavioural therapies has the most empirical support for generalized anxiety disorder and obsessive-compulsive disorder, and is considered promising for social anxiety disorder and post-traumatic stress disorder.

The next question is whether mindfulness-based interventions produce comparable effects to traditional CBT for anxiety disorders. Arch et al. (2012) conducted a randomized clinical trial in which they compared ACT to CBT for heterogeneous anxiety disorders. In this study, community participants who were diagnosed with one or more anxiety disorders completed 12 weekly individual sessions of either ACT or CBT. ACT and CBT showed comparable effects on anxiety symptoms from pre- to post-treatment and at a one-year follow-up. Another randomized clinical trial by Arch et al. (2013) compared CBT to an adapted MBSR for a sample of veterans who were diagnosed with an anxiety disorder. Treatment was delivered through ten weekly group sessions. Again, CBT and MBSR showed comparable improvements from pre- to post-treatment and at a three-month follow-up.

**4.5 Mindfulness as a Strategy for Broadening Attentional Scope**

There is ample evidence supporting a robust link between anxiety and a narrowed scope of attention. Similarly, a wealth of clinical studies has shown the effectiveness of mindfulness-based interventions in treating anxiety. It is possible that through practicing mindfulness, anxious individuals might be able to broaden their scope of attention, which will in turn reduce anxiety symptoms. In fact, one of the original goals of practicing mindfulness, according to classic Buddhist literature, was to broaden one's perspective and develop insight into the transient nature of suffering

(Bodhi, 2011). The hypothesis that mindfulness training can broaden one's scope of attention is consistent with clinical observations (Stelter, 2009) and seems plausible from a theoretical perspective.

A few conceptual models have been proposed to distinguish mindfulness from other mental states on the basis of attentional scope. Dane (2010) defined mindfulness as high on present-moment orientation and wide on attentional breadth, e.g., individuals are focused on the present environment and attuned to a relatively wide range of external and internal stimuli. Dreyfus (2011) made an interesting distinction between mindfulness and concentration: while mindfulness expands the scope of attention so that one can be aware of and hold together various aspects of the objects, concentration stabilizes the mind on a chosen object and restricts what else can be considered.

Garland, Farb, Goldin, and Fredrickson (2015) developed a mindfulness-to-meaning theory. In this model, mindfulness is considered an emotion regulation strategy that disrupts negative mood state and cultivates positive psychological processes. It was proposed that mindfulness facilitates a decentering from maladaptive appraisals of stressful events and an understanding that distressing thoughts and emotions are transient events. By accepting adversity instead of perseverating on it, distressed individuals can broaden their attentional scope and start to focus more on pleasant and meaningful events that have been previously ignored. Hence, they can develop more positive reappraisals of stressful life events, and engage in life with a sense of meaningfulness, thus reducing their stress level.

Empirical research, on the other hand, is lagging behind theoretical advances. First of all, only a handful of studies to date have looked into the broadening effect of

mindfulness training on attentional scope in the general population. Secondly, research findings from these studies are far from conclusive.

There is some preliminary evidence supporting the hypothesis that mindfulness training broadens attentional scope. Slagter et al. (2007) had a group of experienced meditators undergo a three-month retreat during which they practiced insight-focused meditation 10-12 hours per day. Participants were also given an attentional blink task before and after intervention, during which they had to identify two target numbers embedded in a stream of distractor letters. Results showed that participants were better at detecting the second target after retreat, indicating an expanded scope of perceptual attention. In another study, Moore and Malinowski (2009) had experienced meditators and novices complete a timed test in which they had to discriminate and cancel out targets from visually similar distractors. Meditators outperformed novices and demonstrated more accurate processing of peripheral information. Wenk-Sormaz (2005) randomly assigned participants to a 20-minute meditation, a cognitive control condition (learning a mnemonic strategy), and a resting control condition. It was found that following meditation, participants reported more atypical responses in a word production task, indicating a broader scope of conceptual attention.

Other studies have revealed contradictory findings. For instance, Chan and Woollacott (2007) found no difference between experienced meditators and novices in their scope of perceptual attention as measured by a modified Navon Letter Task. Instead, both groups responded faster to global targets, indicating a global focus of attention. Similarly, Braboszcz et al. (2013) observed that after a three-month intensive meditation retreat, participants did not show a broadened scope of attention and instead demonstrated a local focus of attention. This finding was replicated by

Colzato, van der Wel, Sellaro, and Hommel (2016). In their study, novice participants practiced focused attention meditation in one session and open monitoring in the other session, and completed the Navon Letter Task. Results demonstrated that meditation had no impact on the global precedence effect.

One caveat with the above-mentioned studies is that they have all adopted a general mindfulness practice (e.g., breathing meditation, mindfulness of thoughts) rather than a mindfulness practice specifically developed to broaden one's perspective. Mountain meditation is one such practice in which practitioners are explicitly asked to extend their perspective beyond their own body and cultivate a broader sense of time and space (Kabat-Zinn, 2014). Specifically, practitioners are asked to first visualize a mountain, then imagine being this mountain themselves, and observe various weather patterns, storms, and seasons passing before this mountain while noticing being grounded in the earth. The goal of mountain meditation is to enable practitioners to view their own thoughts, emotions, and life challenges as external, fleeting, and impersonal events, in a manner that is similar to changing weather patterns experienced by the mountain (Minor, Carlson, Mackenzie, Zernicke, & Jones, 2006). Unfortunately, no study to this date has examined the extent to which mountain meditation influences the scope of attention. Hence, it is impossible to conclude if the inconsistent findings noted above are due to particular types of mindfulness practice or mindfulness practice as a whole.

**4.6 Current Program of Research: Study 3**

Decades of research have shown a close link between anxiety and a narrow scope of attention. In addition, anxious individuals also experience difficulty in expanding their attentional scope. Therefore, the broadening of attentional scope is of particular

importance in the treatment of anxiety disorders. There is some preliminary evidence suggesting that mindfulness may be a promising strategy for broadening attentional scope. However, research findings on this topic are rather inconclusive. No study to date has examined whether or not mountain meditation, a particular mindfulness practice designed to expand one's perspective, can broaden attentional scope, thus leaving a significant research gap.

The current program of research was designed to clarify the specific impact of mountain meditation on various aspects of attentional scope, including perceptual attention, conceptual attention, and thought-action repertoire. Given it still remains unclear whether or not mindfulness practice broadens attentional scope in the general population, we decided to follow the approach of previous studies and recruit unselected participants instead of anxious individuals. This would allow us to compare our results to those from past studies and help us reach a conclusion regarding the broadening hypothesis of mindfulness. Furthermore, we aimed to examine if the broadening effect of mindfulness meditation extends beyond that of relaxation and a passive control condition.

**Chapter 5**

**Study 1: Attentional Biases to Threat and Motivation in Spider-Related Anxiety**

**5.1 Introduction**

The purpose of Study 1 was to examine the impact of motivation on attentional biases to threat, and the relation between approach and avoidance motivation in the context of spider-related anxiety. A considerable amount of research has shown that spider-fearful individuals exhibit a range of attentional biases to spider stimuli. However, little is known about the factors that moderate attentional biases to spider stimuli. Historically, spider-related anxiety has been conceptualized as a dominance of avoidance motivation over approach motivation. However, results from more recent studies suggest that spider-fearful individuals may experience an approach-avoidance conflict (Pittig et al., 2014). Hence, it is possible that spider-fearful individuals may vary in their motivation to attend to vs. avoid attending to the same spider stimuli, and, subsequently, exhibit different attentional biases. Unfortunately, most studies to date have not taken motivation into account, nor have they examined the extent to which motivation influences attention to threat.

In real life, spider stimuli may cause the most distress when individuals encounter them while they are in the middle of an important task (e.g., writing an exam). In this situation, there is a significant cost to physical avoidance (e.g., running away from the spider means failing the exam) and attentional avoidance (e.g., the spider might creep up on you), but there is also a significant cost to physical approach (e.g., the spider might crawl onto you or bite you) and attentional engagement (e.g., it might increase anxiety and disgust, might make it harder to concentration on the exam). Some may choose to engage because they have made the decision that defending personal safety is more important than the exam. Some may choose to

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avoid because they have made the decision to focus on the exam, even if that leaves them vulnerable to a surprise close-up encounter with the spider.

However, ambivalent individuals are those who perhaps cannot make the decision to compromise exam performance by monitoring the spider, or forgo protecting their sense of security by ignoring the spider. Furthermore, whereas the engagers and avoiders have the potential to succeed in their goals (safety, and exam performance, respectively), people who are ambivalent, and whose attention is frequently shifting between the spider and the exam, may feel that they are satisfying neither the goal for safety nor the performance goal. They may also expend considerable cognitive resources towards trying to decide how best to cope, thus leading to more distractions and poorer performance on the current task. The fact that there is no ideal solution to the dilemma may also cause them to feel trapped and may enhance anxiety.

Taking all factors into account, the current study aimed to address the following questions in an eye-tracking experiment: (1) do spider-fearful individuals experience significant differences in their motivation to attend to vs. avoid attending to a spider? (2) do spider-fearful individuals exhibit significant differences in their attentional biases to threat? (3) do ambivalent individuals experience more persistent spider fear and more negative mood state? and (4) when spider stimuli are presented together with an attentionally demanding task, do ambivalent individuals experience more spider-related thoughts and perform more poorly on the task?

In Study 1, individuals with significant spider fear were introduced to a live tarantula and then completed the Metronome Response Task (MRT), which is a sustained-attention task, with the spider in view. The MRT simply presents the beats of a metronome and participants are instructed to press the keyboard space bar in time

with the metronome. Performance disruption is reflected in response variability, i.e., the extent to which key presses are asynchronous with the metronome. Participants first rated their spider fear and mood state, were then shown the tarantula, and completed the MRT while their eye movements were recorded with a portable eye tracker. During the MRT, 12 thought probes were presented at random intervals. At each thought probe the task ceased and participants recorded, verbatim, the thought that they had experienced just prior to the probe and rated their motivation to attend to the spider, to avoid attending to the spider, and to perform well on the task.

We tested the following hypotheses in the current study: (1) a sample of spider-fearful individuals could be assigned to different groups based on their motivation to attend to vs. avoid attending to the spider (i.e., ambivalent, engagers, avoiders, and indifferent); (2) the sample as a whole would exhibit attentional biases to threat that are different from some of the motivational groups; (3) different motivational groups would exhibit attentional biases to threat that are different from one another; (4) relative to other groups, ambivalent individuals would experience more persistent spider fear and more negative mood state at the end of the study; and (5) relative to other groups, ambivalent individuals would report more spider-related thoughts and show greater performance disruption during the MRT.

## 5.2 Methods

### 5.2.1 Participants

University students ($N = 98$) who endorsed significant fear of spiders were recruited from the University of Waterloo. Participants received course credits or cash remuneration (ten Canadian dollars per person) in exchange for their participation. In order to enhance motivation to perform well on the MRT, participants were told that they would receive a ten-dollar gift certificate if they responded to at least 90% of the trials in the Metronome Response Task. All 98 participants fulfilled this requirement and received an additional gift card. This study was advertised through an online sign-up system and posters on campus. Before signing up for this study, potential participants were asked to complete the Fear of Spiders Questionnaire (FSQ; Szymanski & O'Donohue, 1995) online as to determine their eligibility. Only those who scored in the top 15th percentile on the FSQ (i.e., with a minimum total score of 80) were invited to participate in this study. A cut-off score of 80 on the FSQ is a close approximation of individuals diagnosed with clinically significant spider phobia (see Muris & Merckelbach, 1996).

Out of the original 98 participants, two participants did not complete all study procedures and were therefore excluded. Hence, the final sample consisted of 96 participants (15 males) with a mean age of 19.8 years ($SD = 1.4$). With regards to eye movement data, we excluded 10 participants due to failed calibration of the eye tracker, six participants due to a low tracking ratio of the eye tracker (i.e., lower than 50%), three participants due to unusable data (i.e., stimuli of interest were not present in the visual field), and one participant due to missing data. Therefore, there were 76 participants with available eye movement data for analysis. Outliers on self-report measures, MRT measures, and eye movement indices (i.e., three standard deviations

above or below the means) were corrected by replacing them with the next highest or lowest values. All participants were informed that the purpose of this study was to examine how individuals perform on a cognitive task in the presence of a spider. The protocol received ethical clearance from the Office of Research Ethics at the University of Waterloo and all participants provided informed consent.

**5.2.2 Self-Report Measures**

**5.2.2.1 Fear of Spiders Questionnaire**

Participants completed the Fear of Spiders Questionnaire (FSQ; Szymanski & O'Donohue, 1995) online as part of the screening process and only those who scored 80 or above were invited to participate in this study. The FSQ is an 18-item scale that assesses individuals' fear of spiders in several domains, including cognitive, behavioural, physiological, negative attitudes, and fear of harm by spiders. On an 8-point Likert scale (from 1 "totally disagree" to 7 "totally agree"), participants rated to what extent they agree with each statement (e.g. "Spiders are one of my worst fears"). This measure has demonstrated satisfactory psychometric properties in past studies (Muris & Merckelbach, 1996; Teachman & Woody, 2003).

**5.2.2.2 Positive and Negative Affect Schedule**

Participants completed the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) at three different time points—in the beginning of the study, immediately after seeing the spider, and at the end of the study. The PANAS consists of 20 items measuring mood state (i.e., how the individual is feeling at the moment). This measure generates two subscales: one measuring positive affect and the other measuring negative affect (10 items per scale). Using a 5-point Likert scale (from 1

"very slightly or not at all" to 5 "extremely"), participants rated the extent to which each item was consistent with their current mood state. The PANAS has demonstrated good validity and reliability (Crawford & Henry, 2004). The PANAS was included to assess changes to participants' mood state throughout the study.

**5.2.2.3 Subjective Units of Distress Scale**

Similar to PANAS, participants completed the Subjective Units of Distress Scale (SUDS) at three different time points—in the beginning of the study, immediately after seeing the spider, and at the end of the study. The SUDS is a single item question measuring participants' level of spider fear. On a 10-point Likert scale (from 0 "No fear whatsoever", to 5 "A moderate but tolerable amount of fear", to 10 "An extremely high, intolerable amount of fear"), participants responded to the question "how much do you fear the spider at this moment?". The SUDS is a self-report measure commonly used in clinical practice (Siegel & Warren, 2013). The SUDS was included to assess changes to participants' spider fear throughout the study.

**5.2.3 Metronome Response Task Measures**

**5.2.3.1 Metronome Response Task**

The Metronome Response Task (MRT; Seli, Cheyne, & Smilek, 2013) is a sustained-attention task in which participants have to respond to a periodic metronome tone presented through the speakers. On each MRT trial, participants were presented with 650 ms of silence, followed by a metronome tone lasting 75 ms, and then another 575 ms of silence. Participants were instructed to press the spacebar in synchrony with the metronome so that their key-press was made at the exact time at which each metronome tone was presented. Participants completed one block of the MRT on a

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computer using the E-Prime software (Psychology Software Tools, 2007), which included 20 practice trials and 600 testing trials.

**5.2.3.2 Thought Probes and Motivation Ratings**

To assess the extent to which participants were distracted by the tarantula, we intermittently presented "thought probes" throughout the MRT. These probes are simply task interruptions that require participants to report on their thoughts in the moment just prior to the presentation of each probe. One probe was randomly presented within every set of 50 MRT trials. Hence, there were 12 thought probes in total. The MRT was structured in a way that there was a minimum interval of 10 trials between any of the two thought probes. Upon the presentation of each thought probe, the MRT temporarily stopped and the computer gave the prompt: "what was the thought you were having just prior to this moment". Participants were to type their thought(s), verbatim. Next, participants provided three separate reports of motivation: (1) "how motivated were you to attend to the spider?", i.e., approach motivation; (2) "how motivated were you to avoid attending to the spider?", i.e., avoidance motivation; and (3) "how motivated were you to perform well on this task?", i.e., performance motivation, using a 9-point Likert scale (from 1 "No motivation at all" to 9 "Very strong motivation"),

Three independent judges were recruited to code reported thoughts. Each thought was rated on spider-relatedness (i.e., whether the thought was related to a spider) and assigned to one of the two categories: (1) spider-related thoughts, e.g., "the spider is moving", and (2) other thoughts, e.g., "which gift card I should choose". Inter-rater reliability (Cohen's kappa) ranged from 0.95 to 0.97, suggesting excellent

reliability across coders. Inter-rater averages were calculated and significant

discrepancies were resolved through discussion.

### 5.2.3.3 Performance Measures

The Rhythmic Response Time (RRT) was first calculated as the absolute difference

between the time of the key-press and the onset of the metronome tone. A higher RRT

variance indicates less synchronous responding, which in turn reflects poorer

performance (Seli, Carriere, & Smilek, 2015). Variance data was highly skewed in the

positive direction, which is typical to studies using the MRT. Hence, we followed

established procedures and adjusted the RRT variance using a natural logarithm

transform (see Seli et al., 2013). Mean RRT variance was calculated by using a

moving window of the current and preceding four trials across all trials except the

very first five trials and the five trials following each thought probe. Mean RRT

variance serves as an indicator of participants' overall performance on the MRT. We

also calculated the proportion of spider-related thoughts for each participant, which

measures the extent to which participants were distracted by the tarantula during the

MRT.

### 5.2.4 Materials and Stimuli

Participants were seated at a table over the entire course of the MRT. A 15-inch

desktop computer monitor was placed in the centre of the table. A terrarium

measuring 10cm in width, 10cm in length, and 12cm in height, and a basket-shaped

pencil holder measuring 8cm in diameter and 12cm in height were placed to the left

and right of the computer monitor (with an approximately 10° visual angle,

counterbalanced across participants). The terrarium contained a live, Chilean Rose

tarantula, which acted as our threat stimulus. The pencil holder carried a variety of gift certificates, which was similar in size to the terrarium and acted as our control stimulus. In this study, participants were seated approximately 90cm away from the computer monitor, and 85cm away from the terrarium and pencil holder. These distances were held constant across participants.

**5.2.5. Eye Movement Measures**

**5.2.5.1 Eye-Tracking Procedure**

We used the iView X™ head-mounted eye-tracking device system (SensoMotoric Instruments, 2009) to record participants' eye movements during the completion of the MRT. Participants were asked to sit in a chair, have the chinstrap securely fastened, and minimize their head movement during the study. Participants first underwent a process known as calibration, which required participants to gaze at five dots on a black board while the position of their eye was determined. Once the cameras were calibrated, participants proceeded to the MRT during which their eye movements were recorded. A range of stimuli, including the computer screen, caged spider, and gift certificates, were placed within participants' visual field.

**5.2.5.2 Eye Movement Indices**

Eye movement data was coded using the BeGaze™ software (SensoMotoric Instruments, 2014). For each participant, there were 12 thought probes embedded in the MRT. Hence, the recording of each participant's eye movements was interrupted 12 times, leaving 13 segments of data for coding. Due to the structuring of the Metronome Response Task, the first thought probe could occur shortly after the start of the task. Similarly, the last thought probe could take place immediately before the

end of the task. Therefore, we discarded the first segment (from the beginning of the Metronome Response Task to the start of the 1st thought probe) as well as the last segment (from the end of the 12th thought probe to the end of the Metronome Response Task) due to their short durations. We also discarded the second last segment (from the end of the 11th thought probe to the start of the 12th thought probe) due to a technical problem we encountered with the BeGaze™ software, which prevented us from accessing this segment of eye movement data for 15 participants.

Therefore, there were 10 segments of eye tracking data for each participant (e.g., from the end of the 1st thought probe to the start of the 2nd thought probe, from the end of the 2nd thought probe to the start of the 3rd thought probe, etc.). We then defined the following two areas of interest (AOIs) by annotating the relevant spatial regions in the BeGaze™ software: (1) the terrarium that contains the spider, and (2) the pencil holder that contains gift certificates. For each AOI, we generated the following eye movement indices: (1) proportion of viewing time (PVT), i.e., percentage of time spent on looking at a particular AOI; (2) average fixation duration (AFD), i.e., average duration of fixations on a particular AOI; (3) probability of first fixation (PFF), i.e., the probability of having the first fixation on a particular AOI in the beginning of any given segment; and (4) first fixation duration (FFD), i.e., average duration of the first fixations on a particular AOI. These four indices allow us to examine: (1) initial orienting of attention, as a greater PFF indicates an attentional bias towards the current stimulus; (2) maintenance of attention, as a higher AFD and a higher FFD both indicate sustained attention towards the current stimulus; and (3) selective attention, as a higher PVT indicates more attention being paid to the current stimulus. In addition, we also calculated the PVT for each of the ten time segments, which allows the examination of the time-course of attentional allocation.

It should be noted that some of these eye tracking measures (e.g., PVT on spider vs. PVT on gift certificates) are not redundant to one another, as there were additional stimuli to the tarantula and gift certificates (e.g., computer screen, wall, table, etc.) and participants generally spent a substantial amount of time viewing their surrounding environment.

### 5.2.6 Procedures

Participants first completed the FSQ online and only those with a total score of 80 or higher were invited to participate in this study. Participants were tested individually in the laboratory. Upon their arrival, participants first completed the PANAS and SUDS ratings in the absence of the tarantula. Following the baseline measures, a transparent terrarium containing a live tarantula was placed in the lab and the researcher demonstrated that the tarantula was alive by prodding it gently with a pen to evoke movement. Participants then completed the PANAS and SUDS ratings for the second time, after which they were calibrated on the eye tracker and underwent the MRT. In order to enhance motivation to perform well on the MRT task, participants were told that in addition to the standard remuneration (course credit or cash) they would receive an additional reward of a ten-dollar gift certificate of their choice if they responded to at least 90% of the trials in the MRT, which is actually the performance level student samples typically achieve. At random intervals, the task was interrupted and participants reported the content of their thoughts immediately prior to the probe and provided ratings of their motivation to attend to the spider, to avoid attending to the spider, and to do well on the MRT task. After the MRT, participants completed the PANAS and SUDS ratings for the third time. In total, the procedure lasted roughly 60 minutes.

**5.3 Results**

**5.3.1 Do Spider-Fearful Individuals Experience Significant Differences in Their Motivation to Attend to Vs. Avoid Attending to the Spider?**

At each of the 12 thought probes, participants rated their motivation to attend to the spider (i.e., approach motivation), motivation to avoid attending to the spider (i.e., avoidance motivation), and motivation to perform well on the task (i.e., performance motivation). For each participant, all 12 reports were aggregated and the average was calculated for each rating. Overall, there was no significant correlation between approach and avoidance motivation, $r = -.05$, $p = .662$, suggesting that approach and avoidance motivation are indeed distinct constructs. Performance motivation, on the other hand, was significantly correlated with avoidance motivation, $r = .249$, $p = .015$, but not approach motivation, $r = .071$, $p = .490$.

To test our fist hypothesis, we divided the sample into four groups based on their motivation ratings, as per Nelson et al. (2015): (1) ambivalent, i.e., those who scored 5 or above on both motivation to attend and motivation to avoid attending ($N = 16$); (2) engagers, i.e., those who scored 5 or above on motivation to attend and below 5 on motivation to avoid attending ($N = 18$); (3) avoiders, i.e., those who scored 5 or above on motivation to avoid attending and below 5 on motivation to attend ($N = 22$); and (4) indifferent, i.e., those who scored below 5 on both motivation to attend and motivation to avoid attending ($N = 40$). Means and standard deviations of motivation ratings for each group are presented in Table 1. Hence, our first hypothesis was confirmed: a sample of spider-fearful individuals can be assigned to different groups based on their motivation towards the spider.

**Table 1. Study 1: Motivation Ratings by Group**

| | $N$ | Approach motivation | Avoidance motivation | Performance motivation |
|---|---|---|---|---|
| All Participants | 96 | 4.24 (2.28) | 4.50 (2.59) | 7.77 (1.40) |
| Ambivalent | 16 | 6.96 (1.21) | 7.22 (1.24) | 8.29 (0.77) |
| Engagers | 18 | 6.74 (1.18) | 2.42 (1.21) | 7.58 (1.53) |
| Avoiders | 22 | 2.47 (1.16) | 7.44 (1.03) | 8.10 (1.23) |
| Indifferent | 40 | 3.01 (1.23) | 2.73 (1.21) | 7.47 (1.56) |

Note: Standard deviations from the mean are presented in brackets.

**5.3.2 Do Spider-Fearful Individuals Exhibit Significant Differences in Their**

**Attentional Biases to Threat?**

We aimed to test the following two hypotheses: (1) the sample as a whole would exhibit attentional biases to threat that are different from some of the motivational groups, and (2) different motivational groups would exhibit attentional biases to threat that are different from one another. Based on the design of the current study, there were two ways to measure attentional biases to threat. One was to aggregate eye movement data collected in each segment of the MRT and look at the overall pattern of eye movements. The other was to directly examine the time-course of eye movements within each segment of the MRT (e.g., proportion of viewing time). We followed both approaches in testing each of our hypotheses.

We first aggregated eye movement data across segments of the MRT and calculated the following eye movement indices: Proportion of Viewing Time (PVT); Average Fixation Duration (AFD); Probability of First Fixation (PFF); First Fixation Duration (FFD). Means and standard deviations of these indices are presented in Table 2. Collectively (when all four groups were combined), participants spent a greater proportion of time looking at the spider than gift certificates, $t$ (75) = 6.33, $p$ < .001, and had significantly longer fixations on the spider than gift certificates, $t$ (71) = 2.50, $p$ = .015. In addition, participants were more likely to have their first fixations on the spider than gift certificates, $t$ (74) = 3.99, $p$ < .001, and their first fixations were significantly longer on the spider than gift certificates, $t$ (75) = 4.35, $p$ < .001. In general, our sample of spider-fearful individuals demonstrated facilitated attention to the spider.

To examine the impact of motivation on initial orienting of attention, we conducted a 2 (Stimulus: spider vs. gift certificates) x 4 (Group: ambivalent vs.

engagers vs. avoiders vs. indifferent) mixed ANOVA on PFF. This analysis revealed a significant main effect of stimulus, $F (1, 71) = 43.18$, $\eta^2_p = .378$, $p < .001$, a significant main effect of group, $F (3, 71) = 18.39$, $\eta^2_p = .437$, $p < .001$, and a significant stimulus by group interaction, $F (3, 71) = 20.84$, $\eta^2_p = .468$, $p < .001$. Follow-up paired-sample t-tests showed that while participants were more likely to have their first fixations on the spider than gift certificates for the ambivalent group, $t(10) = 2.93$, $p = .015$, and engagers group, $t(14) = 4.61$, $p < .001$, there was no such bias for the indifferent group, $t (30) = 0.69$, $p = .498$. The avoiders group, on the other hand, demonstrated no first fixations on either spider or gift certificates, thus not entered for the paired-sample t-test (due to zero variance).

To examine the impact of motivation on maintenance of attention, we conducted the same 2 (Stimulus: spider vs. gift certificates) x 4 (Group: ambivalent vs. engagers vs. avoiders vs. indifferent) mixed ANOVA on AFD and FFD, respectively. For AFD, we observed a significant main effect of stimulus, $F (1, 68) = 10.41$, $\eta^2_p = .133$, $p = .002$, no main effect of group, $F (3, 68) = 0.54$, $p = .659$, and a significant stimulus by group interaction, $F (3, 68) = 3.85$, $\eta^2_p = .145$, $p = .013$. For FFD, we observed a significant main effect of stimulus, $F (1, 72) = 15.42$, $\eta^2_p = .176$, $p < .001$, no main effect of group, $F (3, 72) = 1.35$, $p = .266$, and no stimulus by group interaction, $F (3, 72) = 0.53$, $p = .664$. Follow-up paired-sample t-tests showed that while participants had longer fixations on the spider than gift certificates for the ambivalent group, $t (11) = 2.30$, $p = .042$, and avoiders group, $t (165) = 2.33$, $p = .035$, there was no such bias for the engagers group, $t (14) = -0.52$, $p = .609$, and indifferent group, $t (29) = 0.59$, $p = .560$. First fixations were significantly longer on the spider than gift certificates for the engagers group, $t (14) = 2.56$, $p = .023$, and indifferent

group, $t(30) = 2.87$, $p = .007$, but not for the avoiders group, $t(17) = 1.21$, $p = .243$, and ambivalent group, $t(11) = 2.00$, $p = .071$.

To examine the impact of motivation on selective attention, we conducted a 2 (Stimulus: spider vs. gift certificates) x 4 (Group: ambivalent vs. engagers vs. avoiders vs. indifferent) mixed ANOVA on PVT. This analysis showed a significant main effect of stimulus, $F(1, 72) = 60.32$, $\eta^2_p = .456$, $p < .001$, a significant main effect of group, $F(3, 72) = 5.85$, $\eta^2_p = .196$, $p = .001$, and a significant stimulus by group interaction, $F(3, 72) = 7.04$, $\eta^2_p = .227$, $p < .001$. Follow-up paired-sample t-tests showed that participants had higher proportions of viewing time on the spider than gift cards for the ambivalent group, $t(11) = 3.09$, $p = .010$, engagers group, $t(14) = 4.54$, $p < .001$, avoiders group, $t(17) = 2.35$, $p = .031$, and indifferent group, $t(30) = 3.89$, $p < .001$.

We then separated eye movement data into each individual segment (as separated by thought probes) and calculated the proportion of viewing time (PVT) for spider and gift certificates within each segment. Means and standard errors of proportion of viewing time are presented in Table 3. Collectively (when all four groups were combined), participants demonstrated a consistent viewing pattern over the course of the MRT. We conducted a 2 (Stimulus: spider vs. gift certificates) x 10 (Time: S1-10) repeated measures ANOVA on PVT. Mauchly's test indicated that the assumption of sphericity had been violated for main effect of time, $\chi^2(44) = 198.35$, $p < .001$, and stimulus by time interaction, $\chi^2(44) = 209.42$, $p < .001$, therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon = .628$ for time, and $\varepsilon = .634$ for stimulus by time). This analysis revealed a significant main effect of time, $F(5.65, 423.96) = 2.70$, $\eta^2_p = .035$, $p = .016$, and a trending stimulus by time interaction, $F(5.70, 427.70) = 2.12$, $\eta^2_p = .028$, $p = .053$. Follow-up paired-

sample t-tests showed that participants spent significantly more time looking at the spider than gift certificates during each of the segments (all $p_s < .001$). In general, our sample of spider-fearful individuals demonstrated facilitated attention to the spider throughout the MRT.

Next, we examined if different motivational groups demonstrated different trends in their eye movements over the course of the MRT. We first conducted a 2 (Stimulus: spider vs. gift certificates) x 4 (Group: ambivalent vs. engagers vs. avoiders vs. indifferent) x 10 (Time: S1-10) repeated measures ANOVA on proportion of viewing time. Mauchly's test indicated that the assumption of sphericity had been violated for main effect of time, $\chi^2$ (44) = 174.15, $p < .001$, and stimulus by time interaction, $\chi^2$ (44) = 181.84, $p < .001$, therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon = .679$ for time, and $\varepsilon = .681$ for stimulus by time). This analysis revealed a significant main effect of stimulus, $F$ (1, 72) = 62.36, $\eta^2_p = .464$, $p < .001$, a significant main effect of time, $F$ (6.11, 439.86) = 3.84, $\eta^2_p = .051$, $p < .001$, a significant main effect of group, $F$ (3, 72) = 10.59, $\eta^2_p = .306$, $p < .001$, a significant stimulus by group interaction, $F$ (3, 72) = 11.90, $\eta^2_p = .332$, $p < .001$, a significant time by group interaction, $F$ (18.33, 439.86) = 3.03, $\eta^2_p = .112$, $p < .001$, a significant stimulus by time interaction, $F$ (6.13, 441.50) = 3.51, $\eta^2_p = .046$, $p = .002$, and a significant stimulus by time by group interaction, $F$ (18.40, 441.50) = 4.03, $\eta^2_p = .144$, $p < .001$.

To explore this significant stimulus by time by group interaction, we calculated the PVT bias score by subtracting gift certificates PVT from spider PVT for each participant per segment. Hence, a PVT bias score that is significantly greater than 0 would indicate an attentional bias towards the spider, whereas a PVT bias score that is significantly lower than 0 would indicate an attentional bias towards gift

certificates. Means and standard errors of PVT bias scores are depicted in Figure 1.

For each segment within each motivational group, we performed multiple one-sample

t-tests in which the PVT bias score was compared to 0 (which indicates no significant

bias). The ambivalent group showed a greater PVT on the spider during S1 – S7, and

S10 (all $p_s$ < .040), but not during S8 and S9 (both $p_s$ > .070). The engagers group

demonstrated a greater PVT on the spider during S1 – S10 (all $p_s$ < .018). The

avoiders group only showed a greater PVT on the spider during S1 – S3, S5, S8, and

S9 (all $p_s$ < .046), but not during S4, S6, S7, and S10 (all $p_s$ > .068). The indifferent

group demonstrated a greater PVT on the spider during S1 – S7, and S9 – S10 (all $p_s$

< .023), but not during S8, $t$ (30) = 1.65, $p$ = .110.

　　　To further explore if different motivational groups demonstrated different time

courses of eye movements, we performed multiple one-way ANOVAs in which PVT

bias score was tested as a function of group (ambivalent vs. engagers vs. avoiders vs.

indifferent) within each segment. We observed a significant main effect of group

during S1, $F$ (3, 72) = 7.97, $\eta^2_p$ = .249, $p$ < .001, S2, $F$ (3, 72) = 6.86, $\eta^2_p$ = .222, $p$

< .001, S3, $F$ (3, 72) = 7.01, $\eta^2_p$ = .226, $p$ < .001, S4, $F$ (3, 72) = 8.78, $\eta^2_p$ = .268, $p$

< .001, S5, $F$ (3, 72) = 7.73, $\eta^2_p$ = .244, $p$ < .001, S6, $F$ (3, 72) = 3.87, $\eta^2_p$ = .139, $p$

= .013, S7, $F$ (3, 72) = 11.98, $\eta^2_p$ = .333, $p$ < .001, S8, $F$ (3, 72) = 13.35, $\eta^2_p$ = .357, $p$

< .001, S9, $F$ (3, 72) = 8.47, $\eta^2_p$ = .261, $p$ < .001, but not during S10, $F$ (3, 72) = 1.44,

$p$ = .239. Post hoc comparisons (Tukey's HSD) showed that during S1, S2, S5, and

S6, the engagers group had a significantly higher PVT bias score than avoiders and

indifferent groups (all $p_s$ < .021). During S7, S8, and S9, the engagers group had a

significantly higher PVT bias score than all other groups (all $p_s$ < .002). During S3,

the engagers group had a significantly higher PVT bias score than avoiders and

indifferent groups (both $p_s$ < .026), and similarly, the ambivalent group had a

significantly higher PVT bias score than avoiders and indifferent groups (both $p_s$ < .018). During S4, the ambivalent group had a significantly higher PVT bias score than avoiders and indifferent groups (both $p_s$ < .001), and the engagers group also had a significantly higher PVT bias score than the avoiders group ($p = .019$).

Together, these results suggest that there are significant differences in their attentional biases to threat between some of the motivational groups and the sample as a whole, and between different motivational groups, thus confirming our second and third hypotheses.

**Table 2. Study 1: Eye Movement Indices by Group**

| | All Participants ($N = 76$) | | Ambivalent ($N = 12$) | | Engagers ($N = 15$) | | Avoiders ($N = 18$) | | Indifferent ($N = 31$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Spider | GC | Spider | GC | Spider | GC | Spider | GC | Spider | GC |
| PVT (%) | 11.89 | 2.43 | 15.16 | 0.96 | 23.03 | 3.01 | 6.81 | 1.86 | 8.18 | 3.04 |
| | (13.31) | (2.97) | (15.61) | (1.20) | (17.05) | (3.63) | (9.06) | (2.01) | (8.69) | (3.37) |
| AFF (ms) | 430.87 | 349.37 | 560.05 | 293.33 | 382.07 | 410.12 | 423.17 | 262.56 | 407.44 | 384.81 |
| | (254.70) | (189.34) | (333.70) | (233.60) | (122.91) | (136.21) | (266.58) | (173.14) | (257.40) | (187.73) |
| PFF (%) | 8.26 | 0.73 | 9.47 | 0.00 | 29.10 | 0.00 | 0.00 | 0.00 | 2.49 | 1.76 |
| | (16.00) | (2.48) | (11.53) | (0.00) | (24.47) | (0.00) | (0.00) | (0.00) | (4.30) | (3.65) |
| FFD (ms) | 349.36 | 199.44 | 368.35 | 207.96 | 360.85 | 196.41 | 231.32 | 158.41 | 404.98 | 221.42 |
| | (298.21) | (195.30) | (226.33) | (255.52) | (159.75) | (195.43) | (262.94) | (151.35) | (375.08) | (197.65) |

Note: Standard deviations from the mean are presented in brackets. GC: Gift Certificates; PVT: Proportion of Viewing Time; AFD: Average Fixation Duration; PFF: Probability of First Fixation; FFD: First Fixation Duration.

**Table 3. Study 1: Segment-Specific Eye Movement Indices by Group**

| Index | Group | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PVT Spider (%) | All Participants (N = 76) | 10.56 (16.40) | 12.90 (19.30) | 12.51 (18.82) | 11.67 (16.97) | 10.05 (19.15) | 5.88 (9.34) | 8.97 (16.35) | 11.06 (17.44) | 9.68 (16.10) | 10.63 (14.44) |
| | Ambivalent (N = 12) | 12.61 (13.80) | 12.63 (17.21) | 24.57 (34.01) | 26.28 (27.94) | 8.51 (11.11) | 3.35 (3.37) | 6.73 (7.29) | 6.37 (6.54) | 3.63 (5.10) | 5.17 (6.94) |
| | Engagers (N = 15) | 26.03 (26.69) | 30.95 (28.99) | 23.51 (18.74) | 19.34 (16.49) | 27.22 (34.36) | 13.89 (16.11) | 27.29 (29.18) | 30.94 (29.21) | 25.88 (28.17) | 16.52 (17.59) |
| | Avoiders (N = 18) | 2.37 (3.00) | 3.71 (4.24) | 6.31 (9.44) | 1.94 (2.56) | 0.56 (0.64) | 3.44 (4.82) | 3.11 (4.59) | 5.29 (7.62) | 5.71 (7.54) | 7.81 (10.61) |
| | Indifferent (N = 31) | 7.05 (9.52) | 9.61 (13.99) | 6.12 (7.91) | 7.96 (10.84) | 7.86 (10.62) | 4.41 (6.27) | 4.39 (5.23) | 6.60 (8.19) | 6.48 (8.35) | 11.53 (16.13) |
| PVT GC (%) | All Participants (N = 76) | 1.34 (2.24) | 1.17 (2.09) | 1.59 (2.54) | 2.50 (4.11) | 2.20 (3.63) | 1.34 (2.06) | 0.98 (1.72) | 2.53 (4.38) | 2.09 (3.00) | 1.61 (2.54) |
| | Ambivalent (N = 12) | 0.58 (0.91) | 0.17 (0.25) | 0.43 (0.66) | 0.62 (0.65) | 0.13 (0.23) | 0.43 (0.79) | 0.00 (0.00) | 2.56 (3.95) | 0.68 (1.02) | 0.43 (0.53) |
| | Engagers (N = 15) | 2.20 (2.73) | 2.28 (3.57) | 1.38 (1.98) | 3.47 (5.11) | 1.73 (2.27) | 2.53 (3.12) | 0.47 (0.70) | 0.76 (0.99) | 1.68 (2.23) | 2.78 (3.91) |
| | Avoiders (N = 18) | 0.33 (0.51) | 0.54 (0.70) | 1.41 (1.95) | 1.89 (2.98) | 2.64 (4.24) | 1.23 (1.68) | 0.99 (1.42) | 1.07 (1.77) | 1.30 (1.24) | 2.43 (3.06) |
| | Indifferent (N = 31) | 1.81 (2.67) | 1.38 (1.82) | 2.24 (3.31) | 2.98 (4.22) | 1.18 (1.78) | 1.60 (2.25) | 4.23 (5.84) | 3.30 (4.02) | 1.03 (1.24) | 2.00 (2.74) |

Note: Standard deviations from the mean are presented in brackets. GC: Gift Certificates; PVT: Proportion of Viewing Time.

**Figure 1. Study 1: Proportion of Viewing Time Bias Scores by Segment**
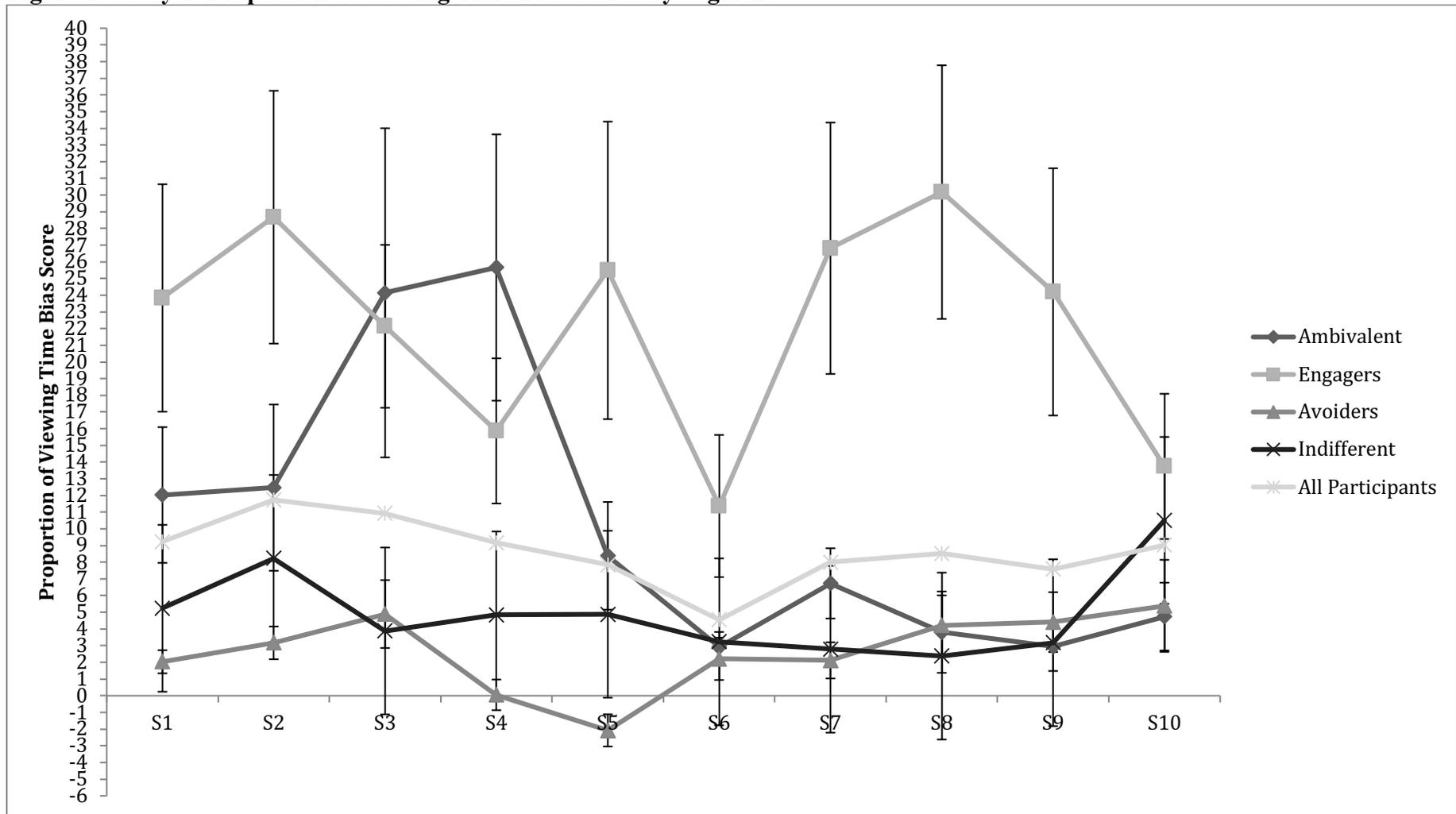


Note: Error bars are ±1 standard error.

**5.3.4 Do Ambivalent Individuals Experience More Persistent Spider Fear and More Negative Mood State at the End of the Study?**

Spider fear and mood state were measured through the SUDS and PANAS at three different time points in the current study: time 1, in the beginning of the study; time 2, immediately after participants saw the spider; and time 3, at the end of the study. To test our fourth hypothesis, we conducted separate analyses exploring the impact of motivation on positive affect, negative affect, and spider fear.

To examine the impact of motivation on positive affect, we first conducted a mixed ANOVA, in which time (time 1 vs. time 2 vs. time 3) was entered as the within-subject factor and group (ambivalent vs. engagers vs. avoiders vs. indifferent) was entered as the between-subject factor. Means and standard errors of positive affect ratings by time are depicted in Figure 2. Mauchly's test indicated that the assumption of sphericity had been violated, $\chi^2$ (2) = 13.93, $p$ = .001, therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon$ = .920). This analysis revealed a significant main effect of time, $F$ (1.84, 169.36) = 8.70, $\eta^2_p$ = .077, $p$ < .001, a significant time by group interaction, $F$ (5.52, 169.36) = 2.27, $\eta^2_p$ = .069, $p$ = .044, but no main effect of group, $F$ (3, 92) = 0.93, $p$ = .430. To explore this significant interaction, we conducted repeated measures ANOVAs in which positive affect was tested as a function of time (time 1 vs. time 2 vs. time 3) in each group. We observed a significant main effect of time for the indifferent group, $F$ (2, 78) = 13.66, $\eta^2_p$ = .259, $p$ < .001, such that positive affect remained constant from time 1 to time 2, $p$ = .924, but decreased significantly from time 2 to time 3, $p$ = .001. However, we observed no main effect of time for other groups (all $p_s$ > .177), such positive affect remained relatively stable over time for the ambivalent, engagers, and avoiders groups. To examine if different groups reported different levels of positive affect at

each of the time points, we conducted one-way ANOVAs in which positive affect was tested as a function of group (ambivalent vs. engagers vs. avoiders vs. indifferent). Results showed no significant main effect of group at any time point (all $p_s > .238$).

For negative affect, we conducted the same mixed ANOVA in which time (time 1 vs. time 2 vs. time 3) was entered as the within-subject factor and group (ambivalent vs. engagers vs. avoiders vs. indifferent) was entered as the between-subject factor. Means and standard errors of negative affect ratings by time are depicted in Figure 3. This analysis showed a significant main effect of time, $F(2, 184) = 75.08$, $\eta^2_p = .449$, $p < .001$, a significant main effect of group, $F(3, 92) = 9.99$, $\eta^2_p = .246$, $p < .001$, and a significant time by group interaction, $F(6, 184) = 4.59$, $\eta^2_p = .130$, $p < .001$. To better understand this interaction, we conducted follow-up repeated measures ANOVAs and observed a significant quadratic trend between time and negative affect (all $p_s < .001$) for all four groups, such that all participants reported a significant increase in negative affect from time 1 to time 2 (all $p_s < .046$), and a significant decrease from time 2 to time 3 (all $p_s < .017$). However, while we observed a significant linear trend between time and negative affect for the engagers, avoiders, and indifferent groups (all $p_s < .027$), such that they all reported a significant decrease in negative affect from time 1 to time 3, there was no significant linear trend between time and negative affect for the ambivalent group, $F(1, 15) = 1.39$, $p = .256$, such that they reported no significant change in negative affect from time 1 to time 3. In addition, we also conducted one-way ANOVAs to examine if different groups reported different levels of negative affect at each of the time points. Results showed a significant main effect of group on negative affect at time 2, $F(3, 92) = 6.25$, $\eta^2_p = .169$, $p < .001$, and time 3, $F(3, 92) = 17.89$, $\eta^2_p = .368$, $p < .001$, but not at time 1, $F(3, 92) = 1.37$, $p = .256$. Post hoc comparisons (Tukey's HSD) revealed that at time

2, the avoiders and ambivalent groups reported significantly higher negative affect than the indifferent group (both $p_s < .007$). However, at time 3, the ambivalent group reported significantly higher negative affect than all other groups (all $p_s < .001$).

With respect to spider fear ratings, we conducted the same mixed ANOVA in which time (time 1 vs. time 2 vs. time 3) was entered as the within-subject factor and group (ambivalent vs. engagers vs. avoiders vs. indifferent) was entered as the between-subject factor. Means and standard errors of spider fear ratings by time are depicted in Figure 4. This analysis revealed a significant main effect of time, $F(2, 184) = 68.91$, $\eta^2_p = .428$, $p < .001$, a significant main effect of group, $F(3, 92) = 11.33$, $\eta^2_p = .270$, $p < .001$, and a significant time by group interaction, $F(6, 184) = 4.65$, $\eta^2_p = .132$, $p < .001$. To explore this time by group interaction, we conducted follow-up repeated measures ANOVAs and observed a significant quadratic trend between time and SUDS (all $p_s < .001$) for all four groups, such that all participants reported a significant increase in spider fear from time 1 to time 2 (all $p_s < .001$, with the exception of the indifferent group, $p = .573$), and a significant decrease from time 2 to time 3 (all $p_s < .006$). However, while we observed a significant linear trend between time and spider fear for the engagers, avoiders, and indifferent groups (all $p_s < .005$), such that they all reported a significant decrease in SUDS from time 1 to time 3, there was no significant linear trend between time and spider fear for the ambivalent group, $F(1, 15) = 0.34$, $p = .569$, such that they reported no significant change in spider fear from time 1 to time 3. In addition, we also conducted one-way ANOVAs to examine if different groups reported different levels of negative affect at each of the time points. Results showed a significant main effect of group on negative affect at time 2, $F(3, 92) = 8.31$, $\eta^2_p = .213$, $p < .001$, and time 3, $F(3, 92) = 18.41$, $\eta^2_p = .375$, $p < .001$, but not at time 1, $F(3, 92) = 2.22$, $p = .091$. Post hoc

comparisons (Tukey's HSD) revealed that at time 2, the avoiders and ambivalent groups reported significantly higher spider fear than the indifferent group (both $p_s$ < .001). However, at time 3, the ambivalent group reported significantly higher negative affect than all other groups (all $p_s$ < .007), and the engagers and avoiders groups reported significantly higher negative affect than the indifferent group (both $p_s$ < .001).

In summary, all four groups reported heightened negative affect and spider fear immediately after seeing the spider. Positive affect, on the other hand, decreased significantly for the indifferent group and remained relatively constant for all other groups. Whereas the levels of negative affect and spider fear dropped significantly below baseline for other groups at the end of the study, the ambivalent group experienced sustained levels of negative affect and spider fear, thus confirming our fourth hypothesis.

**Figure 2. Study 1: Ratings on Positive Affect by Time**
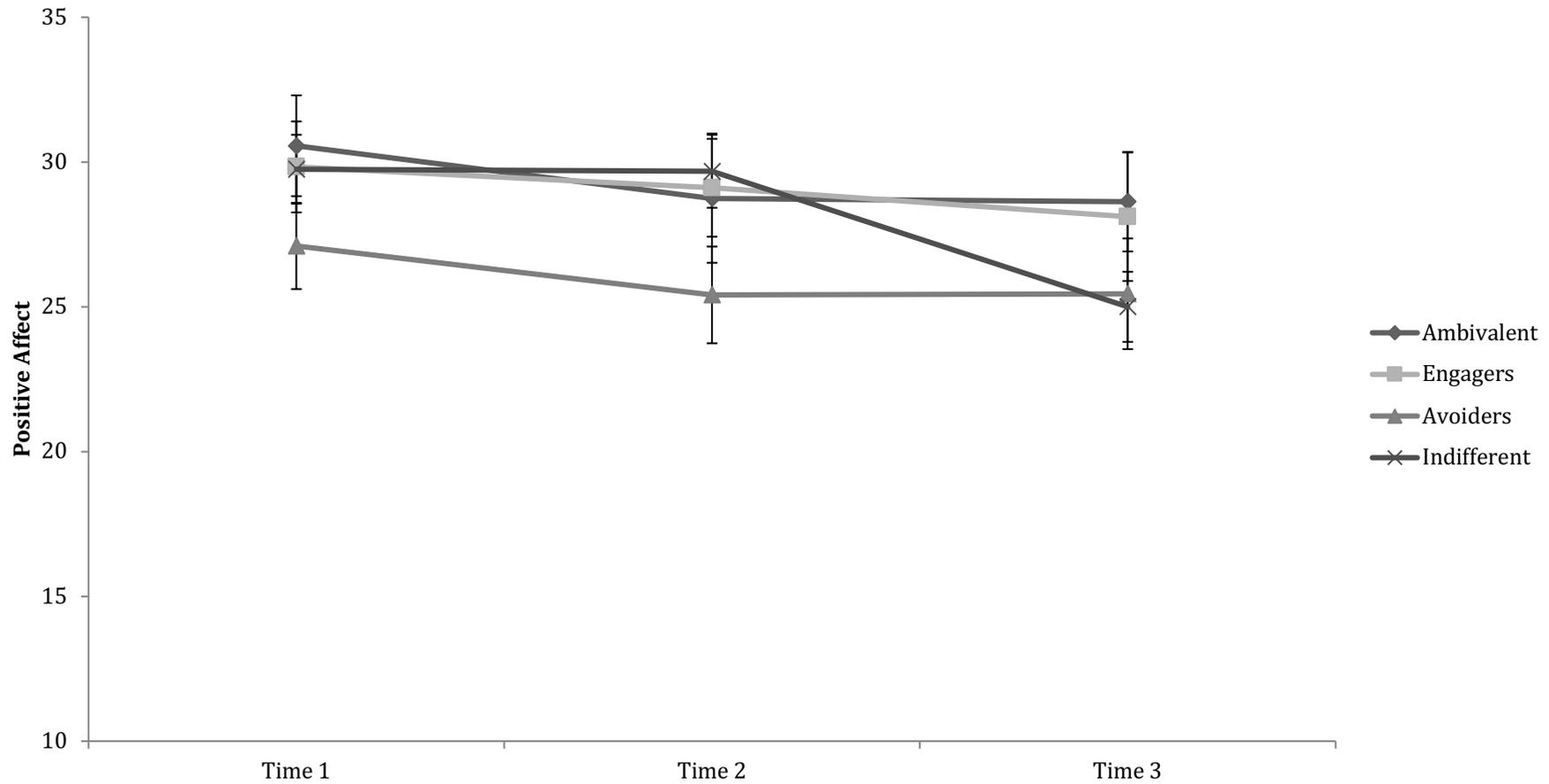


Note: Note: For ambivalent group, $N = 16$; for engagers group, $N = 18$; for avoiders group, $N = 22$; for indifferent group, $N = 40$. Error bars are ±1 standard error.

**Figure 3. Study 1: Ratings on Negative Affect by Time**
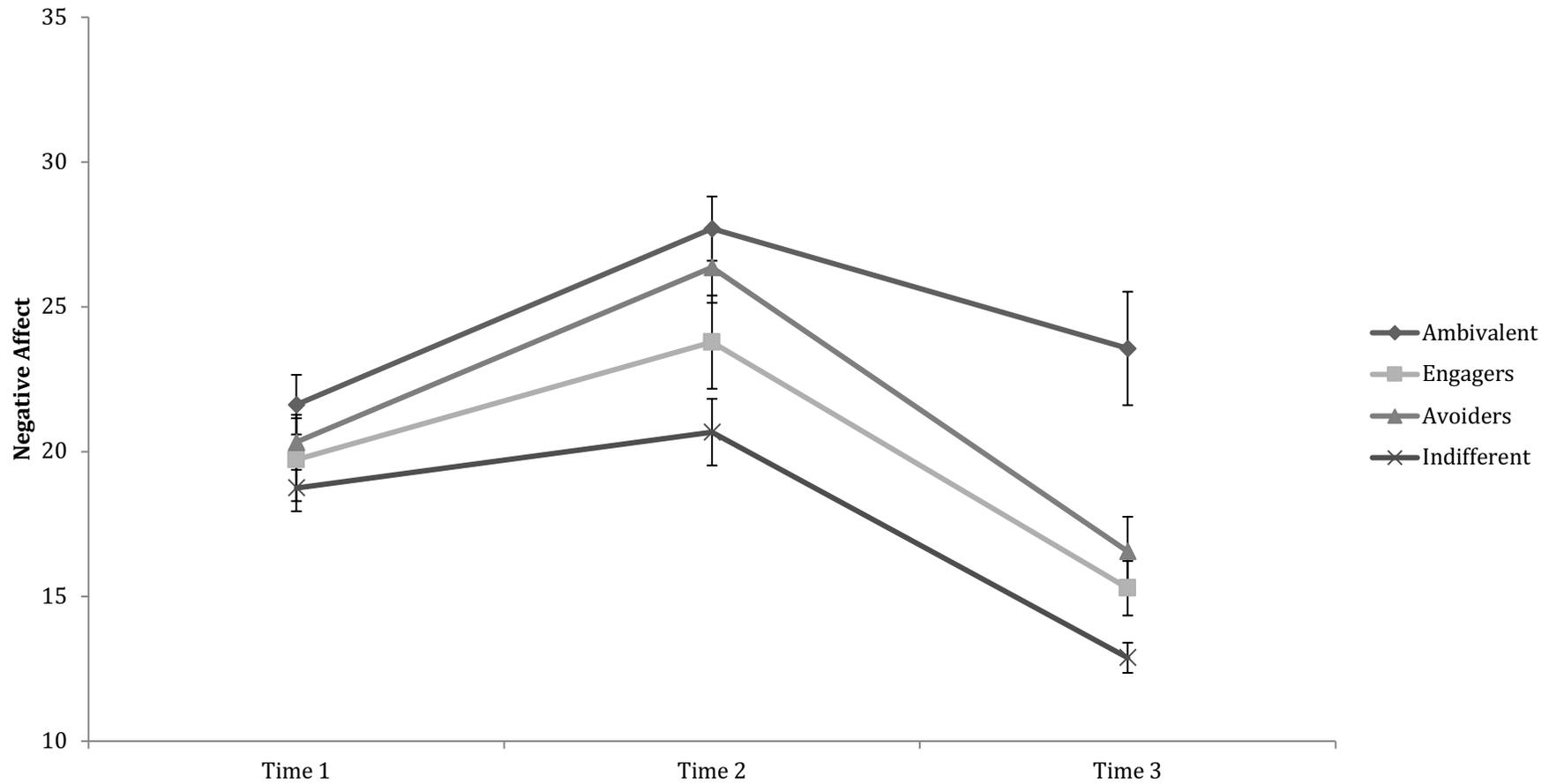


Note: Note: For ambivalent group, $N = 16$; for engagers group, $N = 18$; for avoiders group, $N = 22$; for indifferent group, $N = 40$. Error bars are ±1 standard error.

**Figure 4. Study 1: Ratings on Spider Fear by Time**
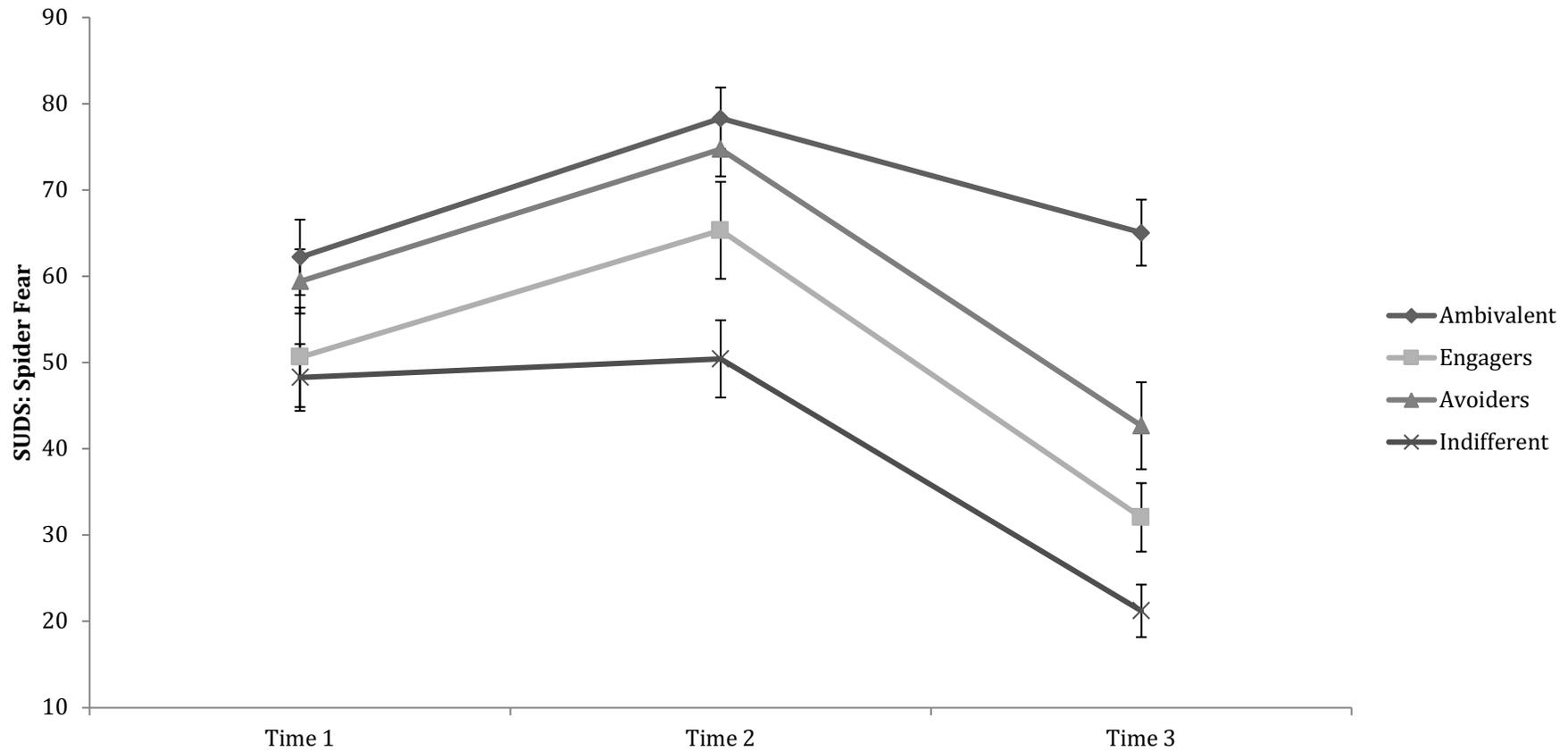


Note: Note: For ambivalent group, $N = 16$; for engagers group, $N = 18$; for avoiders group, $N = 22$; for indifferent group, $N = 40$. Error bars are ±1 standard error.

**5.3.4 Do Ambivalent Individuals Report More Spider-Related Thoughts and Show Greater Performance Disruption During the MRT?**

In the current study, performance on the MRT was measured through variance in response time. We also calculated the proportion of reported thoughts that were related to the spider. Means and standard deviations of MRT measures are presented in Table 4. To examine the impact of motivation on MRT performance, we conducted multiple one-way ANOVAs in which each MRT measure was tested as a function of group (i.e., ambivalent vs. engagers vs. avoiders vs. indifferent). We observed a significant main effect of group for mean RRT variance, $F(3, 92) = 2.92$, $\eta^2_p = .087$, $p = .038$, and for the proportion of spider-related thoughts, $F(3, 92) = 10.54$, $\eta^2_p = .256$, $p < .001$. Post hoc comparisons (Tukey's HSD) revealed that the engagers group displayed higher mean RRT variance than the indifferent group, $p = .041$, indicating poorer performance throughout the MRT. In addition, the engagers group also reported a higher proportion of spider-related thoughts than the avoiders and indifferent groups (both $p_s < .001$), indicating more spider-related thoughts. Hence, the ambivalent group did not experience more spider-related thoughts or perform more poorly on the MRT, thus rejecting our fifth hypothesis.

**Table 4. Study 1: MRT Measures by Group**

|  | Ambivalent (N = 16) | Engagers (N = 18) | Avoiders (N = 22) | Indifferent (N = 40) | F |
|---|---|---|---|---|---|
| Mean RRT variance | 7.89 (0.40) | 8.28 (0.52) | 7.98 (0.36) | 7.93 (0.49) | 2.92* |
| Proportion of spider-related thoughts % | 44.79 (21.92) | 56.48 (20.92) | 35.26 (17.30) | 30.00 (13.32) | 10.54*** |

Note: Standard deviations from the mean are presented in brackets; RRT: Rhythmic Response Time. One-way ANOVAs were performed to examine between-group differences. $^*p < .05$, $^{***}p < .001$.

Ambivalent    Engagers    Avoiders    Indifferent

**5.4 Discussion**

The purpose of Study 1 was to examine the impact of motivation on attentional biases to threat, and the relation between approach and avoidance motivation in the context of spider-related anxiety. Specifically, we aimed to examine: (1) if a sample of spider-fearful individuals could be assigned to different groups based on their motivation to attend to vs. avoid attending to the spider; (2) if the sample of spider-fearful individuals would exhibit attentional biases to threat that are different from some of the motivational groups; (3) if different motivational groups would exhibit attentional biases to threat that are different from one another; (4) ambivalent individuals would experience more persistent spider fear and more negative mood state at the end of the study; and (5) ambivalent individuals would report more spider-related thoughts and show greater performance disruption during the MRT.

In general, the current data provided support to the first four hypotheses but not the last one. Based on their motivation ratings, we were able to divide a sample of spider-fearful individuals into four different sub-groups, thus confirming our first hypothesis. More importantly, when spider-fearful individuals were divided into different motivational groups, they demonstrated different attentional biases to threat as measured by eye tracking technology. Our sample, as a whole, consistently demonstrated facilitated attention to the spider, which was not observed in some of the motivational groups. Moreover, the engagers group showed more facilitated attention to threat than the avoiders and indifferent groups, whereas the ambivalent group displayed a sudden increase in their visual attention towards the spider in segment 3 and segment 4. Hence, our second and third hypotheses were supported. At the end of the study, ambivalent individuals reported more negative mood state and greater spider fear than any other groups, thus confirming our fourth hypothesis. Ambivalent individuals, however, did not report more spider-related thoughts or performed more poorly on the MRT. Hence, our fifth hypothesis was not supported.

The most important finding was that our sample of spider-fearful individuals was not a homogenous group. Historically, psychological research has conceptualized anxiety as resulting from a dominance of avoidance motivation over approach motivation (e.g., Fowles, 1987). In the current study, however, not every spider-fearful individual endorsed strong motivation to avoid attending to the spider. Instead, a significant proportion of our participants endorsed strong motivation to attend to the spider. The current study also revealed that approach motivation and avoidance motivation can interact with each other: some participants were low on one and high on the other (e.g., engagers or avoiders), some participants were high on both (e.g., ambivalent), and some participants were low on both (e.g., indifferent). Hence, anxious individuals can be classified into four motivational groups, rather than two (i.e., engagers and avoiders) as suggested by leading models of anxiety (Bar-Haim et al., 2007; Mogg & Bradley, 1998). Categorizing spider-fearful individuals on the basis of their motivation towards the spider was further supported by eye movement data, self-report measures, and response time measures. Different motivational groups demonstrated different patterns of visual attention towards the spider during the MRT. Similarly, different motivational groups also reported different levels of mood state and spider fear, and performed differently on the MRT. If we had treated our sample as a homogenous group and analyzed the data as a whole, we would have missed this huge range of variance and drawn conclusions that are misrepresentative at best.

Interestingly, only a minority of our anxious sample endorsed ambivalent motivation towards the spider. The proportion of ambivalent individuals in Study 1 (approximately 17%) is somewhat consistent with findings from previous research. Nelson et al. (2015) reported that 20 out of 161 participants (approximately 12%) indicated having ambivalent motivation towards threat images, using the same motivation measures and classification system. While our sample consisted of individuals who reported clinical levels of spider fear, participants

from Nelson et al.'s study (2015) included individuals with various levels of trait anxiety. Our results suggest that the proportion of ambivalent individuals may be higher in clinical populations. Alternatively, if we consider this experiment as an exposure for spider-fearful individuals (as they had to stay in the vicinity of a live tarantula by themselves for about 40 minutes), ambivalent individuals were the only group whose anxiety did not decline in response to prolonged exposure. Hence, the proportion of ambivalent individuals may represent the proportion of spider-fearful individuals who do not respond to a single session of exposure therapy. This percentage (approximately 17%) is consistent with what has been reported by past studies, ranging from 15-20% (see Andersson et al., 2009; Zlomke & Davis, 2008).

Surprisingly, a significant proportion of our sample (approximately 42%) endorsed indifferent motivation towards the spider, whereas only 19% of participants were classified as indifferent by Nelson et al. (2015). Our data revealed that the indifferent group reported lower levels of negative mood state and spider fear at both time 2 (immediately after seeing the spider) and time 3 (at the end of the study). However, indifferent individuals scored similarly to other groups on the FSQ that was administered prior to their participation in the study. There are two potential explanations. One is that these individuals may have had very limited exposure to spiders in the past and upon seeing the tarantula, they realized that spiders were not as threatening as they had anticipated, thus rendering them indifferent to the spider during the task. The other is that this group may not have liked the spider very much but, because the spider was well contained in the terrarium, they may have appraised the situation as "safe" and felt no need to monitor or avoid it.

Another purpose of the study was to examine the relationship between motivation and attentional bias to threat in the context of spider anxiety. We hypothesized that different motivational groups would demonstrate different attentional bias to threat. Our results

provide strong support to this hypothesis. However, it should be noted that the differences noted in the current study were rather nuanced: some groups demonstrated facilitated attention to threat, whereas others did not. Nonetheless, our findings support the modulating effect of motivation on attentional bias to threat, as proposed by Cisler and Koster (2010).

We also observed that ambivalent individuals displayed a unique pattern of eye movements over the course of the MRT: the PVT bias score suddenly increased in segments 3 and 4, indicating increased facilitated attention to the spider during segment 3 and 4. Other groups showed a more consistent pattern of eye movements over time: engagers had the greatest facilitated attention to the spider from segment 1 to segment 9, whereas avoiders and indifferent groups had least facilitated attention to the spider from segment 1 to segment 9. We do not have any a priori theory to account for this behaviour of the ambivalent group. However, such viewing pattern seems to suggest a difficulty in disengaging from threat, as outlined in the Attentional Maintenance Model of Anxiety (Fox et al., 2001; Yiend & Mathews, 2001). Once ambivalent individuals attended to the spider, their attention might have been captured by the threat stimulus for some periods of time (e.g., segments 3 and 4) before they were able to switch their attention away from it.

One interesting finding was that the baseline level of spider fear and negative affect was sustained for ambivalent individuals whereas it declined for everyone else. All participants reported a significant increase in spider fear and negative mood state upon seeing the tarantula, which is consistent with the observation that anxious individuals show fear activation in the beginning of exposure therapy (see Kamphuis & Telch, 2000). At the end of the study, the engagers, avoiders, and indifferent groups reported a level of spider fear and negative mood state that was significantly lower than what they experienced in the beginning of the study (i.e., before seeing the tarantula). This significant decrease in spider fear is consistent with the observation that anxious individuals show fear habituation over the course

of exposure therapy (see Kashdan, Adams, Read, & Hawk, 2012). On the contrary, the ambivalent group did not exhibit this fear habituation. Instead, they reported a level of spider fear and negative mood state that were significantly higher than that of other groups. This finding is also consistent with Nelson et al.'s (2015) observation that ambivalent individuals reported the highest level of anxiety. Together, our results provide evidence consistent with Gray and McNaughton's (2000) hypothesis that anxiety can be elicited as a result of a conflict between approach and avoidance goals.

Results from the current study did not support the hypothesis that ambivalent individuals would have more spider-related thoughts and perform more poorly on the MRT. We hypothesized that ambivalent individuals would experience difficulty deciding where to allocate their attention and as a result, more cognitive resources would be devoted to rectifying this dilemma (i.e., whether to monitor or avoid the threat), thus causing more spider-related thoughts and poorer performance on the MRT. In fact, the only significant differences we observed were between the engagers, avoiders and indifferent groups, such that engagers reported more spider-related thoughts than avoiders and indifferent individuals, and performed more poorly than indifferent individuals. Previous work in our lab indicates that more on-task thoughts predicted better task performance (see Seli, Cheyne, Xu, Purdon, & Smilek, 2015; Xu, 2014). Therefore, it is not surprising that participants who had a higher number of off-task thoughts (i.e., spider-related thoughts) did not perform as well on the MRT. However, more research is needed to further examine if there are any meaningful differences between ambivalent and other groups in their MRT performance.

There are several limitations to the current study. The first limitation is the small sample size. As close to half of our participants endorsed an indifferent attitude towards the spider, we had fewer than 20 participants in the ambivalent and engagers group and barely above 20 participants in the avoiders group. This small sample size introduced more variance

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in our data and limited our ability to conduct appropriate analyses to examine some of our research questions. We recommend future researchers to recruit more participants and potentially individuals who have been diagnosed with a spider phobia. Another limitation is that we only measured spider fear using subjective reports. We are confident that subjective reports provided reliable measures of spider fear in the present study, as there was a significant correlation between the one-item SUDS and the negative affect subscale of PANAS, and we were able to detect fear activation and habituation using these measures. However, future studies should consider including objective measures of spider fear, such as the behavioural avoidance test (e.g., Van Bockstaele et al., 2011), the approach-avoidance task (e.g., Rinck & Becker, 2007), and startle response to spider pictures (e.g., Kashdan et al., 2012). Moreover, we recommend measuring spider fear at multiple time points throughout the study (e.g., once every segment), which would allow us to examine how anxiety evolves over time and its relation to motivation and attentional bias to threat. Lastly, we lost a considerable amount of data because of the portable eye tracking technology we used in the current study. We were unable to access some of the participants' eye movements in one segment and many of our participants had a low tracking ratio. Future researchers might want to consider using more reliable portable eye tracking technology.

In summary, Study 1 examined the impact of motivation on attentional bias to threat, and the interaction between approach and avoidance motivation, in the context of spider-related anxiety. A sample of spider-fearful individuals were divided into four different groups based on their motivation to approach and avoid the spider, and they demonstrated different types of attentional biases to threat. Individuals who were ambivalent about whether to approach or avoid the spider experienced sustained levels of spider fear and negative mood state, but did not report more spider-related thoughts or performed more poorly on an attentionally demanding task. Our findings support the modulating effect of motivation on

attentional biases to threat (Cisler & Koster, 2010). The current study also provides evidence

for the important role that ambivalent motivation plays in the development and maintenance

of anxiety (Gray & McNaughton, 2000).

**Chapter 6**

**Study 2: Attentional Biases to Threat and Motivation in Eating-Related Anxiety**

**6.1 Introduction**

In Study 1, we divided a sample of spider-fearful individuals into four different groups based on their motivation to pay attention to and avoid paying attention to threat (i.e., a live spider). In addition, we observed different patterns of attentional biases to threat in different motivational groups. Interestingly, we identified a subset of participants who reported ambivalent motivation about where to deploy their attention. Similar to Nelson et al. (2015), ambivalent individuals were characterized by higher anxiety, and their fear over the spider failed to decrease. These findings suggest that ambivalent motivation is both interesting and important to study. However, in both the Nelson et al. (2015) study and Study 1, the number of participants reporting ambivalent motivation was low. As reviewed in earlier chapters, there are two types of threat stimuli: one that signals bodily harm (e.g., a spider in spider-fearful individuals), and the other signals a threat to personal goals (e.g., images of high calorie food in restrained eaters). The first type of threat stimuli is more likely to evoke avoidance motivation as there are evolutionary values in self-preservation. The second type of threat stimuli only evokes anxiety from certain populations as they involve a conflict between incompatible goals. Hence, an approach-avoidance conflict is inherent to the second type of threat. Stimuli such as images of high calorie food might provide a better opportunity to study ambivalent motivation.

The primary purpose of Study 2 was to examine the impact of motivation on attentional biases to threat, and the relation between approach and avoidance motivation, in a sample of individuals who identified themselves as restrained eaters. We reasoned that people who are restraining their caloric intake may have more ambivalence about whether or not to

attend to images of food cues. On the one hand, food may be appealing; but on the other hand, images of tempting food may threaten dieting goals.

Restrained eating, more commonly referred to as "dieting", is a popular practice among young women in today's society. A recent study revealed that among a large group of female university students, 43% engaged in restrained eating, despite 78% having a healthy weight for their height (Fayet, Petocz, & Samman, 2012). Decades of research have demonstrated that individuals with eating-related anxiety, such as those with an eating disorder or engage in restrained eating, exhibit attentional biases to food stimuli. Food deprivation is a common feature of restrained eating, which is typically associated with enhanced motivation to approach food stimuli. More recently, there is emerging evidence suggesting that some restrained eaters might experience an approach-avoidance conflict with high calorie food (Ahern et al., 2010; Werthmann et al., 2015). Hence, it is possible that restrained eaters might experience different motivation towards the same food stimuli and, subsequently, show different attentional biases. Unfortunately, most studies to date have not measured approach and avoidance motivation as separate constructs, nor have they examined the extent to which motivation influences attentional biases to threat.

According to the Goal Conflict Model of Eating (Stroebe et al., 2008), restrained eaters are particularly at risk for developing an eating disorder because they are subject to a chronic conflict between two goals—one is the enjoyment of eating, and the other is the fear of weight gain. One reason why restrained eaters may want to avoid food images is the concept of "thought-shape fusion", which refers to the idea that even looking at images of high calorie food can cause some people to feel more "fat" (Coelho et al., 2012). Thought-shape fusion has been shown to be closely linked to eating pathology (Coelho et al., 2014). For those who are ambivalent towards high calorie food, it is likely that they may endorse more thought-shape fusion and engage in more restrained eating behaviours.

The current study was designed to address the following questions: (1) do restrained eaters experience significant differences in their motivation to attend to vs. avoid attending to images of high calorie food? (2) do restrained eaters exhibit significant differences in their attentional biases to threat? and (3) do ambivalent individuals engage in more restrained eating behaviours, endorse more thought-shape fusion, and experience more negative mood state as a result of viewing food images?

In Study 2, individuals who identified themselves as restrained eaters on a self-report measure underwent a passive viewing task in which they were presented with images pairs consisting of one high calorie food and one neutral object for 5 seconds. Participants were seated in front of a screen with their chin in a chin rest and instructed to look at each image pair as they wished. Their eye movements were recorded using a stationary eye tracker. Participants were then presented with a random subset of 15 food images and asked to rate for each their motivation to look and their motivation to avoid looking during the passive viewing task. Mood state was assessed before the viewing task and after the motivation ratings were taken.

We tested the following hypotheses in the current study: (1) a sample of restrained eaters could be assigned to different groups based on their motivation to attend to vs. avoid attending to food images; (2) the sample as a whole would exhibit attentional biases to threat that are different from some of the motivational groups; (3) different motivational groups would exhibit attentional biases to threat that are different from one another; and (4) relative to other groups, ambivalent individuals would report more restrained eating behaviours, thought-shape fusion, and negative mood state at the end of the study.

## 6.2 Methods

### 6.2.1 Participants

University students ($N = 251$) who scored in the top $20^{th}$ percentile of the Concern for Dieting subscale of the Restraint Scale (Herman & Polivy, 1975) were recruited from the University of Waterloo. Participants received course credits or cash remuneration (six Canadian dollars per person) in exchange for their participation. The study was advertised through an online sign-up system and posters on campus. The Concern for Dieting scale of the Restraint Scale (RS-CD) was used as it has better reliability and validity than the other subscale of the measure (Stroebe, 2008; van Strien, Breteler, & Ouwens, 2002).

Of the original 251 participants, we excluded data from two participants due to noncompliance with task instructions, 16 participants due to failed calibration of the eye tracker, seven participants due to computer difficulties (e.g., crashed data files), and one participant due to missing data. Therefore, the final sample consisted of 225 participants (35 males) with a mean age of 19.8 years ($SD = 2.4$). Participants reported an average score of 10.83 on the RS-CD ($SD = 2.23$), and a mean BMI of 23.25 ($SD = 4.07$). There were no significant differences between males and females in any subjective or behavioural measure (all $p_s > .088$). Hence, gender was not included in our data analyses. Outliers on self-report measures and eye movement indices (i.e., three standard deviations above or below the means) were corrected by replacing them with the next highest or lowest values. All participants were informed that the purpose of this study was to examine how motivation influences one's eye movements towards visual stimuli, without any explicit reference to food. Inclusion criterion (i.e., participants had to score in the top 20% on the RS-CD) was only communicated to participants upon completing the study. The protocol received ethical clearance from the Office of Research Ethics at the University of Waterloo and all participants provided informed consent.

**6.2.2 Self-Report Measures**

**6.2.2.1 Restraint Scale**

The Restraint Scale (RS; Polivy, Herman, & Warsh, 1978) was designed to identify individuals who restrict their food intake as to achieve a desired weight. The original scale includes 10 items and consists of two subscales: one measuring Concern for Dieting (RS-CD; 6 items) and the other measuring Weight Fluctuation (RS-WF; 4 items). Participants completed the RS-CD as part of the screening process and only those who scored in the top 20% (i.e., with a minimum score of 8) were invited to participate in this study. On this scale, participants reported the frequency of their concern for dieting (e.g., "How often are you dieting") by choosing one of the options provided (e.g., from "never" to "always"). A higher total score on the RS-CD represents more restrained eating. The RS has demonstrated satisfactory validity and reliability in normal-weight populations (Heatherton, Herman, Polivy, King, & McGree, 1988; van Strien, Herman, Engels, Larsen, & van Leeuwe, 2007).

**6.2.2.2 Positive and Negative Affect Schedule**

Participants completed the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) immediately before and after the Eye Movement Attention Task. The PANAS consists of 20 items measuring mood state (i.e., how the individual is feeling at the moment). This measure generates two subscales: one measuring positive affect and the other measuring negative affect (10 items per scale). Using a 5-point Likert scale (from 1 "very slightly or not at all" to 5 "extremely"), participants rated the extent to which each item was consistent with their current mood state. The PANAS has demonstrated good validity and internal consistency (Crawford & Henry, 2004). The PANAS was included to assess changes to participants' mood state after viewing food images.

**6.2.2.3 Trait Thought Shape Fusion Scale: Short Version**

Participants completed the Thought-Shape Fusion scale (TSF; Coelho et al., 2013) at the end of this study. The original TSF scale is a 34-item questionnaire that measures a general tendency towards thought-shape fusion (Shafran et al., 1999). The short version consists of 18 items from the original scale. The first 14 items measure the general concept of thought-shape fusion (i.e., likelihood, moral, and feeling aspects) and the last 4 items measure specific experiences of thought-shape fusion (i.e., frequency, impact, uncontrollability, and importance of suppressing eating-related thoughts). On a 5-point Likert scale (from 0 "not at all" to 4 "totally or always", participants rate the extent to which they agree with each item (e.g., "Just picturing myself gaining weight can really make me gain weight"). The TSF has demonstrated excellent validity and reliability in both clinical and healthy populations (Coelho et al., 2013; Coelho et al., 2014).

**6.2.2.4 Other Questions**

At the end of this study, participants were asked to answer the following question "how long has it been since you last ate", rounded to the nearest half hour. This question was included to control for the potential influence of hunger on motivation ratings and eye movements. Analyses showed no significant correlation between time since last food intake and any of the outcome measures (all $p_s$ > .107), suggesting no impact of hunger. Participants also reported their current height and weight, based on which their Body Mass Index (BMI) was calculated.

**6.2.3 Material and Stimuli**

The images for the Eye Movement Attention Task were selected from Food-pics, which is a large database of food pictures collated by Blechert, Meule, Busch, and Ohla (2014). We

selected 60 high calorie food images based on their caloric density (with a minimum of 123kcal/100g, *Mean* = 323kcal/100g, *SD* = 120kcal/100g). The selected food images were generally high in their total caloric content (*Mean* = 1134kcal, *SD* = 1502kcal) and highly palatable (*Mean* = 59.8, *SD* = 6.4), according to normative ratings provided by Food-pics. We also selected 60 neutral images that had no caloric content, including tools, household objects, and office supplies. All food images were paired with neutral images and each image pair was matched as best as possible with respect to brightness, complexity, familiarity, and recognisability, according to normative ratings provided by Food-pics. Paired-sample t-tests revealed no significant difference between food and neutral images in any of these dimensions (all $p_s$ > .245).

**6.2.4 Eye Movement Measures**

**6.2.4.1 Eye Movement Attention Task**

The Eye Movement Attention Task (EMAT; Nelson et al., 2015) is an eye-tracking task that measures attentional bias to images. In the EMAT, participants were told that image pairs would be presented on the computer screen and they were to look at these images freely. In each trial, participants had to fixate on a centrally located cross first, after which a high calorie food image was presented simultaneously with a neutral image. The image pair was displayed for five seconds, followed by a 500ms interval before the appearance of the next fixation cross.

For each participant, there were two practice trials and 60 testing trials in total. Half of the image pairs were presented side-by-side and the rest were presented one above the other, in a semi-random fashion (with no more than three trials to have the same presentation arrangement consecutively). We selected this presentation style to reduce the predictability of the image locations, such that participants would be less likely to initiate fixations towards

the left and top images first (e.g., Waechter et al., 2013). Each image (512 × 384 pixels) was displayed such that its closest edge was 80 pixels from the centre of the screen (2.7° visual angle for horizontal positioning and 2.5° visual angle for vertical positioning), on a light grey background.

**6.2.4.2 Eye-Tracking Procedure**

We used the SR Research Ltd. EyeLink 1000™ (Mississauga, Ontario, Canada) desktop-mounted eye-tracking system to record participants' eye movements during the EMAT. Participants were positioned in a chin and forehead rest and situated approximately 65 cm from a 19-inch LCD colour monitor (resolution: 1280 × 1024). Participants first underwent a process known as calibration, which required participants to gaze at nine dots on the computer monitor while the position of their eye was determined. Once the camera was calibrated, participants proceeded to the EMAT during which their eye movements were recorded.

**6.2.4.3 Eye Movement Indices**

Recorded eye movement data was coded using the EyeLink Data Viewer software (SR Research Ltd., 2015). Within each trial, we defined the following two areas of interest (AOIs) by annotating the relevant spatial region in the EyeLink Data Viewer software: (1) food image, and (2) neutral image. For each AOI, as per Nelson et al. (2015), we generated the following eye movement indices: (1) time to first fixation (TTFF), i.e., the amount of time it takes for the participant to have their first fixation on a particular AOI; (2) first fixation gaze duration (FFGD), i.e., the average length of time before the participant shifts their gaze off a particular AOI; and (3) proportion of viewing time (PVT), i.e., percentage of trial time spent on a particular AOI. These three indices allow us to examine: (1) initial orienting of attention,

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as a shorter TTFF indicates an attentional bias towards the current image; (2) maintenance of attention, as a higher FFGD indicates sustained attention towards the current image; and (3) selective attention, as a higher PVT indicates more attention being paid to the current image.

In addition, we also divided each 5000ms testing trial into ten 500ms intervals and calculated the PVT for each of the ten time intervals (for more details see Nelson et al., 2015), which allows the examination of the time-course of attentional allocation. The ten 500ms intervals are labelled as: T1 = 0-500ms, T2 = 501-1000ms, T3 = 1001-1500ms, T4 = 1501-2000ms, T5 = 2001-2500ms, T6 = 2501-3000ms, T7 = 3001-3500ms, T8 = 3501-4000ms, T9 = 4001-4500ms, and T10 = 4501 to 5000ms.

It should be noted that some of these eye tracking measures (e.g., PVT on food images vs. PVT on neutral images) are not redundant to one another, as there were additional stimuli to food and neutral images (e.g., grey space between two pictures) and participants generally spent a substantial amount of time viewing the background.


**6.2.5 Motivation Measures**

Immediately after the EMAT, participants completed a rating task in which they were presented with a selection of the images they had viewed in the EMAT. For each image, on a 9-point Likert Scale (from 1 "No motivation at all" to 9 "Very strong motivation"), participants provided two separate reports of motivation: (1) "how motivated were you to look towards this image?", i.e., approach motivation, and (2) "how motivated were you to look away from this image?", i.e., avoidance motivation. A total number of 30 images (15 food images and 15 neutral images) were randomly presented to each participant. The neutral images were used as fillers in the rating task and therefore not included in data analysis.

**6.2.6 Procedures**

Participants first completed the RS-CD online and only those with a total score of 8 (i.e., scoring in the top 20%) were invited to participate in this study. Participants were tested individually in the laboratory. Upon their arrival, participants first completed the PANAS, after which they were calibrated on the eye tracker and underwent the EMAT. In the EMAT, high calorie food images were presented on a computer screen together with neutral images and participants were asked to look at these images freely for five seconds per trial. At the same time, their eye movements were recorded using a desktop-mounted eye-tracking system. Immediately after viewing the images, participants were asked to indicate their levels of motivation for looking towards and away from randomly selected images from the EMAT. Participants then completed the PANAS and TSF, and reported time since last food intake, weight, and height. In total, the procedure lasted roughly 40 minutes.

**6.3 Results**

**6.3.1 Do Restrained Eaters Experience Significant Differences in Their Motivation to Attend to Vs. Avoid Attending to Food Images?**

In order to assess motivation to attend to and avoid attending to food images, each participant was presented with a random selection of food images from the EMAT (15 high calorie food images and 15 neutral images). For each image, participants provided two separate reports of their motivation to look towards the images (i.e., approach motivation) and motivation to look away from the images (i.e., avoidance motivation). We aggregated motivation ratings across 15 food images and calculated the average for each rating. Overall, ratings on approach and avoidance motivation were moderately negatively correlated $r = -.44$, $p < .001$, but not redundant.

To test our first hypothesis, we divided the sample into four groups based on their motivation ratings, as per Nelson et al. (2015): (1) ambivalent, i.e., those who scored 5 or above on both approach and avoidance motivation ($N = 27$); (2) engagers, i.e., those who scored 5 or above on approach motivation and below 5 on avoidance motivation ($N = 166$); (3) avoiders, i.e., those who scored 5 or above on avoidance motivation and below 5 on approach motivation ($N = 14$); and (4) indifferent, i.e., those who scored below 5 on both approach and avoidance motivation ($N = 18$). Means and standard deviations of motivation ratings for each group are presented in Table 5. Hence, our first hypothesis was confirmed: restrained eaters can be assigned to different groups based on their motivation to attend to vs. avoid food stimuli.

**Table 5. Study 2: Motivation Ratings by Group**

|  | N | Approach motivation | Avoidance motivation |
|---|---|---|---|
| All Participants | 225 | 6.29 (1.38) | 3.64 (1.43) |
| Ambivalent | 27 | 6.32 (0.90) | 5.80 (0.85) |
| Engagers | 166 | 6.76 (0.93) | 3.11 (0.93) |
| Avoiders | 14 | 3.51 (1.24) | 6.13 (0.81) |
| Indifferent | 18 | 4.12 (0.82) | 3.39 (1.30) |

Note: Standard deviations from the mean are presented in brackets.

**6.3.2 Do Restrained Eaters Exhibit Significant Differences in Their Attentional**

**Biases to Threat?**

We aimed to test the following two hypotheses: (1) the sample as a whole would

exhibit attentional biases to threat that are different from some of the motivational

groups, and (2) different motivational groups would exhibit attentional biases to threat

that are different from one another. Similar to Study 1, there were two ways to

measure attentional biases to threat in the current study. One was to aggregate eye

movement data collected in each image pair and look at the overall pattern of eye

movements. The other was to directly examine the time-course of eye movements

within each EMAT trial (e.g., proportion of viewing time). We followed both

approaches in testing each of our hypotheses.

We first aggregated eye movement data across EMAT trials and calculated the

following eye movement indices: time to first fixation (TTFF), first fixation gaze

duration (FFGD), and proportion of viewing time (PVT). Means and standard

deviations of these indices are presented in Table 6. Collectively (when all four

groups were combined), participants were significantly faster in having their first

fixations on food than neutral images, $t(225) = 13.75$, $p < .001$, and spent

significantly longer on their first fixation on food than neutral images, $t(225) = -4.04$,

$p < .001$. They also spent a greater proportion of time looking at food than neutral

images, $t(225) = -9.19$, $p < .001$. In general, our sample of restrained eaters

demonstrated facilitated attention to food images.

To examine the impact of motivation on initial orienting of attention, we

conducted a 2 (Image type: food vs. neutral) x 4 (Group: ambivalent vs. engagers vs.

avoiders vs. indifferent) mixed ANOVA on TTFF. This analysis revealed a significant

main effect of image type, $F(1, 221) = 39.32$, $\eta^2_p = .151$, $p < .001$, no main effect of

group, $F(3, 221) = 0.53$, $p = .664$, and a significant image type by group interaction, $F(3, 221) = 4.62$, $\eta^2_p = .059$, $p = .004$. Follow-up paired-sample t-tests showed that first fixations were faster towards food than neutral images for the ambivalent, $t(26) = 3.06$, $p = .005$, engagers, $t(165) = 14.00$, $p < .001$, and indifferent groups, $t(17) = 2.83$, $p = .012$, but not for the avoiders group, $t(13) = 1.13$, $p = .280$.

To examine the impact of motivation on maintenance of attention, we conducted the same 2 (Image type: food vs. neutral) x 4 (Group: ambivalent vs. engagers vs. avoiders vs. indifferent) mixed ANOVA on FFGD. We observed no main effect of image type, $F(1, 221) = 0.13$, $p = .722$, and no main effect group, $F(3, 221) = 1.25$, $p = .292$. However, there was a significant image type by group interaction, $F(3, 221) = 15.12$, $\eta^2_p = .170$, $p < .001$. Follow-up paired-sample t-tests showed that the engagers group had longer first gazes on food than neutral images, $t(165) = -10.35$, $p < .001$, whereas the avoiders group had shorter first gazes on food than neutral images, $t(13) = 2.83$, $p = .014$. In contrast, there was no significant difference in their first gaze durations towards food vs. neutral images for the ambivalent, $t(26) = -0.99$, $p = .329$, and indifferent groups, $t(17) = -0.44$, $p = .664$.

To examine the impact of motivation on selective attention, we conducted a 2 (Image type: food vs. neutral) x 4 (Group: ambivalent vs. engagers vs. avoiders vs. indifferent) mixed ANOVA on PVT. This analysis showed no main effect of image type, $F(1, 221) = 2.04$, $p = .154$, and no main effect of group, $F(3, 221) = 0.64$, $p = .591$. However, there was a significant image type by group interaction, $F(3, 221) = 17.02$, $\eta^2_p = .188$, $p < .001$. Follow-up paired-sample t-tests showed that the engagers group had higher proportions of viewing time on food than neutral images, $t(165) = -12.40$, $p < .001$, whereas the avoiders group had lower proportions of viewing time on food than neutral images, $t(13) = 2.99$, $p = .010$. In contrast, there was no significant

difference in their proportions of viewing time on food vs. neutral images for the ambivalent, $t(26) = -1.80$, $p = .084$, and indifferent groups, $t(17) = -0.92$, $p = .370$.

We then divided each 5000ms EMAT trial into ten 500ms intervals (i.e., T1-T10) and calculated the proportion of viewing time (PVT) for food and neutral images within each time interval. Means and standard errors of proportion of viewing time are presented in Table 7. Collectively (when all four groups were combined), participants demonstrated some interesting changes in their viewing pattern over the course of each EMAT trial. We conducted a 2 (Image type: food vs. neutral) x 10 (Time: T1-10) repeated measures ANOVA on PVT. Mauchly's test indicated that the assumption of sphericity had been violated for main effect of time, $\chi^2(44) = 675.24$, $p < .001$, and image type by time interaction, $\chi^2(44) = 296.46$, $p < .001$, therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon = .482$ for time, and $\varepsilon = .691$ for image type by time). This analysis revealed a significant main effect of time, $F(4.34, 972.26) = 74.80$, $\eta^2_p = .250$, $p < .001$, and a significant image type by time interaction, $F(6.22, 1393.00) = 9.04$, $\eta^2_p = .039$, $p < .001$. Follow-up paired-sample t-tests showed that participants spent significantly more time looking at neutral than food images during T1 (0-500ms), $t(224) = 5.31$, $p < .001$, and marginally more time looking at food than neutral images during T10 (4500-5000ms), $t(224) = -1.90$, $p = .059$. There was no significant difference in PVT between food and neutral images during other time intervals (all $p_s > .070$). In general, our sample of restrained eaters demonstrated attentional avoidance of food images in the first 500ms and facilitated attention to food images in the last 500ms.

Next, we examined if different motivational groups demonstrated different trends in their eye movements over the course of each EMAT trial. We first conducted a 2 (Image type: food vs. neutral) x 4 (Group: ambivalent vs. engagers vs.

avoiders vs. indifferent) x 10 (Time: T1-10) repeated measures ANOVA on proportion of viewing time. Mauchly's test indicated that the assumption of sphericity had been violated for main effect of time, $\chi^2$ (44) = 664.62, $p$ < .001, and image type by time interaction, $\chi^2$ (44) = 254.70, $p$ < .001, therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\varepsilon$ = .488 for time, and $\varepsilon$ = .744 for image type by time). This analysis revealed a significant main effect of image type, $F$ (1, 221) = 7.31, $\eta^2_p$ = .032, $p$ = .007, a significant main effect of time, $F$ (4.39, 970.50) = 31.19, $\eta^2_p$ = .124, $p$ < .001, a significant image type by group interaction, $F$ (3, 221) = 6.91, $\eta^2_p$ = .086, $p$ < .001, and a significant image type by time by group interaction, $F$ (20.08, 1479.47) = 3.70, $\eta^2_p$ = .048, $p$ < .001. However, there was no significant main effect of group, $F$ (3, 221) = 1.69, $p$ = .170, no significant group by time interaction, $F$ (13.17, 970.50) = 1.47, $p$ = .123, and no significant image type by time interaction, $F$ (20.08, 1479.47) = 0.73, $p$ = .641.

To explore this significant image type by time by group interaction, we calculated the PVT bias score by subtracting neutral images PVT from food images PVT for each participant per time interval. Hence, a PVT bias score that is significantly greater than 0 would indicate an attentional bias towards food images, whereas a PVT bias score that is significantly lower than 0 would indicate an attentional bias towards neutral images. Means and standard errors of PVT bias scores are depicted in Figure 5. For each interval within each motivational group, we performed multiple one-sample t-tests in which the PVT bias score was compared to 0 (which indicates no significant bias). The ambivalent group showed a greater PVT on neutral images during T1, $t$ (26) = -2.18, $p$ = .039, and marginally so during T8, $t$ (26) = -1.95, $p$ = .062, but no bias during other intervals (all $p_s$ > .093). The engagers group showed a greater PVT on neutral images during T1, $t$ (165) = -5.98, $p$ < .001,

but a greater PVT on food images during T2-T10 (all $p_s$ < .031). The avoiders group demonstrated a greater PVT on food images during T1, $t$ (13) = 3.27, $p$ = .006, and a greater PVT on neutral images during T6, $t$ (13) = -2.10, $p$ = .056, and T7, $t$ (13) = -2.31, $p$ = .038, but no bias during other intervals (all $p_s$ > .109). The indifferent group demonstrated a greater PVT on neutral images during T6, $t$ (17) = -2.88, $p$ = .010, and no bias during other intervals (all $p_s$ > .305).

To further explore if different motivational groups demonstrated different time courses of eye movements, we performed multiple one-way ANOVAs in which PVT bias score was tested as a function of group (ambivalent vs. engagers vs. avoiders vs. indifferent) within each time interval. We observed a significant main effect of group during T1, $F$ (3, 221) = 6.90, $\eta^2_p$ = .086, $p$ < .001, T3, $F$ (3, 221) = 2.81, $\eta^2_p$ = .037, $p$ = .040, T4, $F$ (3, 221) = 2.86, $\eta^2_p$ = .037, $p$ = .038, T5, $F$ (3, 221) = 4.25, $\eta^2_p$ = .055, $p$ = .006, T6, $F$ (3, 221) = 8.38, $\eta^2_p$ = .102, $p$ < .001, T7, $F$ (3, 221) = 3.48, $\eta^2_p$ = .045, $p$ = .017, T8, $F$ (3, 221) = 5.69, $\eta^2_p$ = .072, $p$ < .001, and T9, $F$ (3, 221) = 2.74, $\eta^2_p$ = .036, $p$ = .045. Post hoc comparisons (Tukey's HSD) showed that during T1, the avoiders group had a significantly higher PVT bias score than other groups (all $p_s$ < .047). During T4, the ambivalent group had a significantly higher PVT bias score than the avoiders group, $p$ = .036. During T5, T6, T7, and T8, the engagers group had a significantly higher PVT bias score than the avoiders group (all $p_s$ < .025). In addition, the engagers group also had a significantly higher PVT bias score than the indifferent group during T6, $p$ < .001, and the ambivalent group during T8, $p$ = .010.

Together, these results suggest that there are significant differences in their attentional biases to threat between some of the motivational groups and the sample as a whole, and between different motivational groups, thus confirming our second and third hypotheses.

**Table 6. Study 2: Eye Movement Indices by Group**

| | All Participants (N = 225) | | Ambivalent (N = 27) | | Engagers (N = 166) | | Avoiders (N = 14) | | Indifferent (N = 18) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Food | Neutral | Food | Neutral | Food | Neutral | Food | Neutral | Food | Neutral |
| TTFF (ms) | 689.18 (204.68) | 975.42 (276.25) | 709.69 (258.23) | 916.20 (218.35) | 673.28 (196.94) | 1002.49 (282.78) | 810.80 (125.14) | 903.41 (309.93) | 710.51 (214.00) | 870.61 (233.22) |
| FFGD (ms) | 317.85 (83.42) | 299.74 (77.70) | 1238.83 (408.78) | 1115.13 (446.84) | 1453.63 (419.55) | 1048.66 (352.64) | 1079.10 (421.85) | 1576.86 (408.96) | 1197.91 (336.59) | 1151.22 (363.34) |
| PVT (%) | 52.80 (10.40) | 40.33 (10.35) | 50.92 (13.28) | 42.13 (12.35) | 54.97 (8.72) | 38.34 (8.91) | 37.26 (10.94) | 54.72 (12.41) | 47.71 (6.87) | 44.78 (7.50) |

Note: Standard deviations from the mean are presented in brackets. TTFF: Time To First Fixation; FFGD: First Fixation Gaze Duration; PVT: Proportion of Viewing Time. Food: food images; Neutral: neutral images.

**Table 7. Study 2: Time-Specific Eye Movement Indices by Group**

| Index | Group | T1 | T2 | T3 | T4 | T5 | T6 | T7 | T8 | T9 | T10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PVT food images (%) | All Participants (*N* = 225) | 48.91 (4.51) | 45.46 (3.53) | 46.10 (4.02) | 46.93 (4.13) | 47.02 (4.18) | 47.40 (4.36) | 47.87 (5.10) | 48.62 (5.34) | 48.74 (5.24) | 49.64 (5.24) |
| | Ambivalent (*N* = 27) | 47.65 (4.99) | 45.56 (3.34) | 45.41 (3.20) | 47.05 (4.16) | 46.76 (3.62) | 46.94 (3.72) | 46.39 (4.24) | 46.37 (3.45) | 47.44 (4.62) | 48.97 (3.83) |
| | Engagers (*N* = 166) | 48.71 (4.27) | 45.57 (3.58) | 46.32 (4.24) | 46.88 (4.10) | 47.23 (4.40) | 47.63 (4.62) | 47.90 (5.14) | 48.85 (5.40) | 48.95 (5.39) | 49.72 (5.62) |
| | Avoiders (*N* = 14) | 51.67 (6.21) | 43.90 (3.85) | 45.06 (3.84) | 45.70 (4.03) | 45.01 (3.82) | 45.73 (3.06) | 46.17 (4.42) | 47.40 (5.08) | 48.02 (4.59) | 48.96 (4.97) |
| | Indifferent (*N* = 18) | 50.40 (3.38) | 45.44 (2.95) | 45.84 (3.13) | 48.15 (4.43) | 47.08 (2.59) | 47.24 (3.46) | 51.07 (5.25) | 50.86 (6.31) | 49.31 (5.28) | 50.45 (3.38) |
| PVT neutral images (%) | All Participants (*N* = 225) | 51.64 (5.45) | 44.79 (4.58) | 45.71 (3.69) | 46.37 (4.59) | 46.72 (4.73) | 47.16 (4.85) | 47.40 (5.09) | 47.97 (5.37) | 48.14 (5.62) | 48.99 (5.86) |
| | Ambivalent (*N* = 27) | 51.63 (7.21) | 44.63 (5.29) | 46.52 (4.11) | 45.44 (4.44) | 47.38 (5.57) | 47.51 (5.41) | 47.06 (4.92) | 48.45 (5.41) | 46.91 (3.95) | 48.31 (5.55) |
| | Engagers (*N* = 166) | 52.11 (5.12) | 44.58 (4.39) | 45.47 (3.66) | 46.14 (4.46) | 46.30 (4.34) | 46.55 (4.50) | 46.94 (4.76) | 47.35 (4.84) | 47.88 (5.45) | 48.72 (5.98) |
| | Avoiders (*N* = 14) | 46.00 (4.36) | 45.73 (4.07) | 47.02 (4.09) | 48.14 (4.18) | 48.34 (4.10) | 48.47 (3.64) | 49.31 (4.71) | 50.22 (4.88) | 50.08 (5.86) | 50.99 (6.53) |
| | Indifferent (*N* = 18) | 51.65 (3.84) | 46.25 (5.51) | 45.72 (2.67) | 48.51 (5.65) | 48.27 (6.70) | 51.19 (6.08) | 50.61 (7.12) | 51.25 (8.37) | 50.92 (7.93) | 50.93 (4.09) |

Note: Time intervals are in 500-ms segments. Standard deviations from the mean are presented in brackets. PVT: Proportion of Viewing Time.

**Figure 5. Study 2: Proportion of Viewing Time Bias Scores by Time Interval**
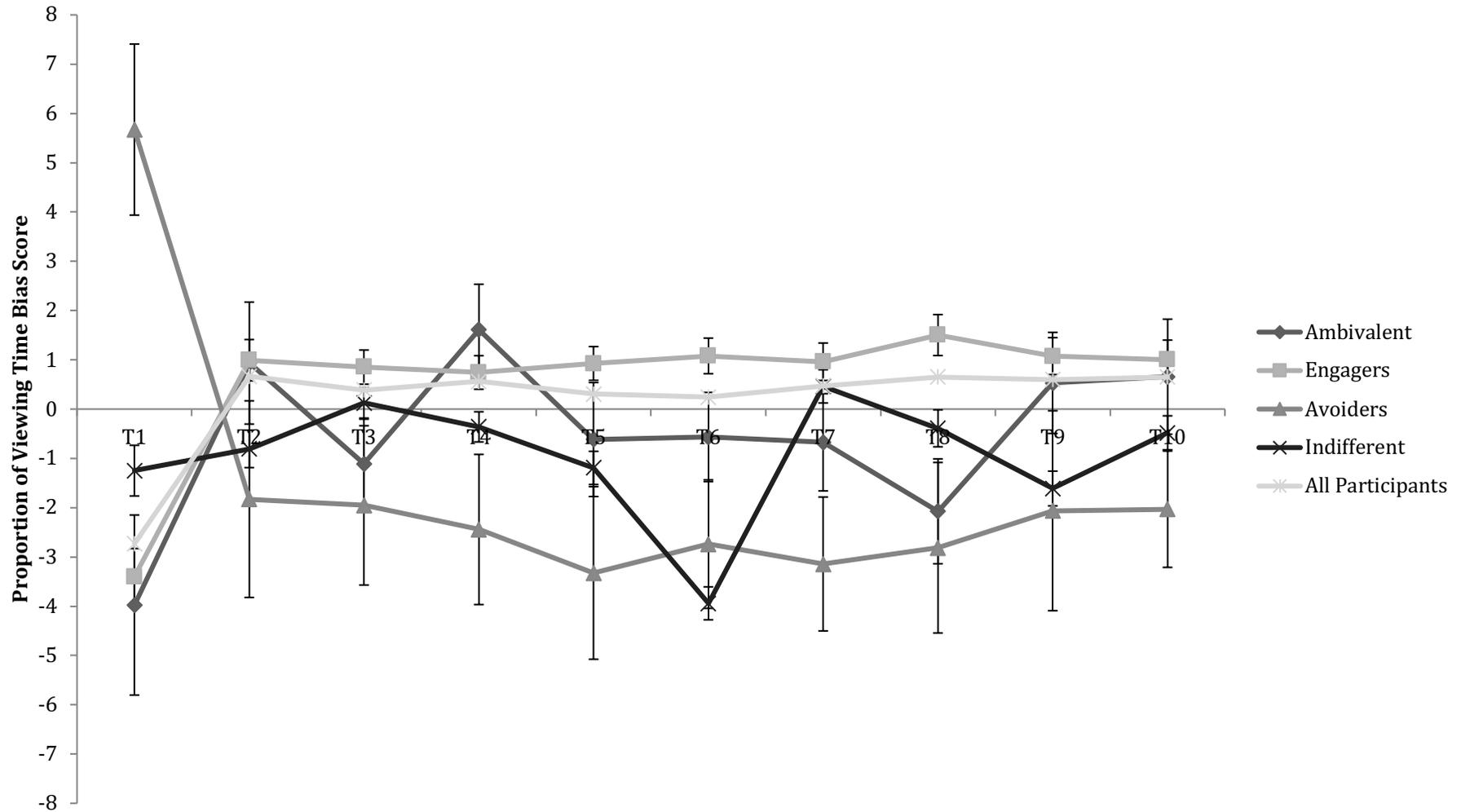


Note: Time intervals are in 500-ms segments. Error bars are ±1 standard error.

### 6.3.3 Do Ambivalent Individuals Report More Restrained Eating Behaviours, Thought-Shape Fusion, and Negative Mood State?

In the current study, restrained eating behaviours and thought-shape fusion were measured through the RS-CD and TSF, whereas mood state were measured through PANAS before and after the EMAT task. To test our third hypothesis, we conducted different analyses exploring the impact of motivation on restrained eating, thought-shape fusion, and mood state.

Means and standard deviations of self-report measures are presented in Table 8. We conducted multiple one-way ANOVAs in which Concerns for Dieting score and Thought-Shape Fusion total score were tested as a function of group (i.e., ambivalent vs. engagers vs. avoiders vs. indifferent). To rule out the possibility that different motivational groups might be different in their BMI and time since last food intake (which might in turn influence restrained eating and thought-shape fusion), we extended the same one-way ANOVA to BMI and time since last food intake. We observed a significant main effect of group for Concerns for Dieting score, $F(3, 221) = 3.52$, $\eta^2_p = .046$, $p = .016$, and Thought Shape Fusion total score, $F(3, 221) = 5.02$, $\eta^2_p = .064$, $p = .002$, but not for BMI or time since last food intake (both $p_s > .940$). Post hoc comparisons (Tukey's HSD) revealed that the ambivalent group scored higher on the Concerns for Dieting subscale and Thought Shape Fusion scale than the engagers and indifferent groups (all $p_s < .033$) but not the avoiders group (both $p_s > .165$).

To examine the impact of motivation on mood state, we conducted a mixed ANOVA, in which time (time 1 vs. time 2) was entered as the within-subject factor and group (ambivalent vs. engagers vs. avoiders vs. indifferent) was entered as the between-subject factor. For positive affect, this analysis revealed a significant main effect of group, $F(3, 221) = 3.54$, $\eta^2_p = .046$, $p = .016$, such that the engagers group reported higher positive affect than the indifferent group at both time 1 and time 2, $p = .019$. There was also a significant main effect of time, $F(1, 221) = 56.23$, $\eta^2_p = .203$, $p < .001$, such that all participants reported a

decrease in positive affect from time 1 to time 2. However, there was no significant time by group interaction, $F(3, 221) = 0.36$, $p = .784$. Means and standard errors of positive affect ratings by time are depicted in Figure 6. For negative affect, this analysis revealed a significant main effect of group, $F(3, 221) = 7.14$, $\eta^2_p = .088$, $p < .001$, such that the avoiders group reported higher negative affect than the engagers and indifferent groups at both time 1 and time 2, both $p_s < .001$. There was also a significant main effect of time, $F(1, 221) = 27.04$, $\eta^2_p = .109$, $p < .001$, such that all participants reported a decrease in negative affect from time 1 to time 2. However, there was no significant time by group interaction, $F(3, 221) = 0.24$, $p = .866$. Means and standard errors of negative affect ratings by time are depicted in Figure 7.

In summary, the ambivalent group reported more restrained eating behaviours and greater thought-shape fusion, but did not demonstrate increased negative affect as a result of viewing food images. Instead, all participants reported a significant decrease in both positive and negative affect. Hence, our third hypothesis was partially confirmed.

**Table 8. Study 2: Self-Report Measures by Group**

| | Ambivalent (N = 27) | Engagers (N = 166) | Avoiders (N = 14) | Indifferent (N = 18) | F |
|---|---|---|---|---|---|
| BMI | 23.63 (3.62) | 23.21 (4.29) | 23.21 (4.40) | 23.05 (2.23) | .09 |
| Time since last food intake (in hours) | 3.83 (3.86) | 3.80 (4.03) | 3.11 (3.20) | 3.75 (4.30) | 0.13 |
| RS-CD score | 12.00 (2.73) | 10.67 (2.13) | 11.21 (2.26) | 10.17 (1.82) | 3.52[*] |
| TSF total score | 38.37 (12.26) | 31.55 (11.89) | 30.43 (9.66) | 25.00 (9.15) | 5.35[**] |

Note: Standard deviations from the mean are presented in brackets; RRT: rhythmic response time. BMI: Body Mass Index; RS-CD: Concerns for Dieting subscale from Restraint Scale; TSF: Thought-Shape Fusion scale short version. One-way ANOVAs were performed to examine between-group differences. [*] $p < .05$, [**] $p < .01$.

**Figure 6. Study 2: Ratings on Positive Affect by Time**
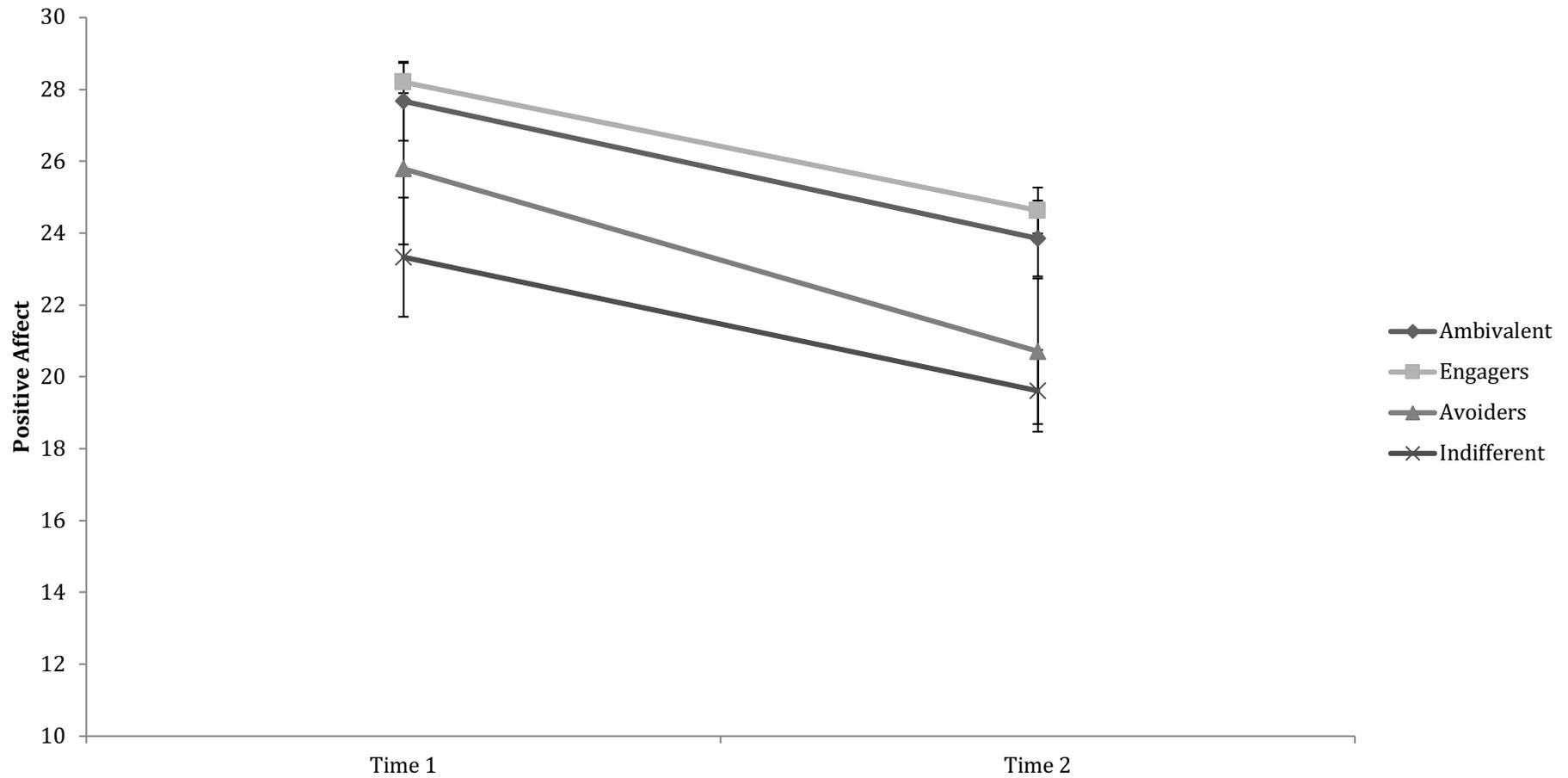


Note: For ambivalent group, $N = 27$; for engagers group, $N = 166$; for avoiders group, $N = 14$; for indifferent group, $N = 18$. Error bars are ±1 standard error.

**Figure 7. Study 2: Ratings on Negative Affect by Time**
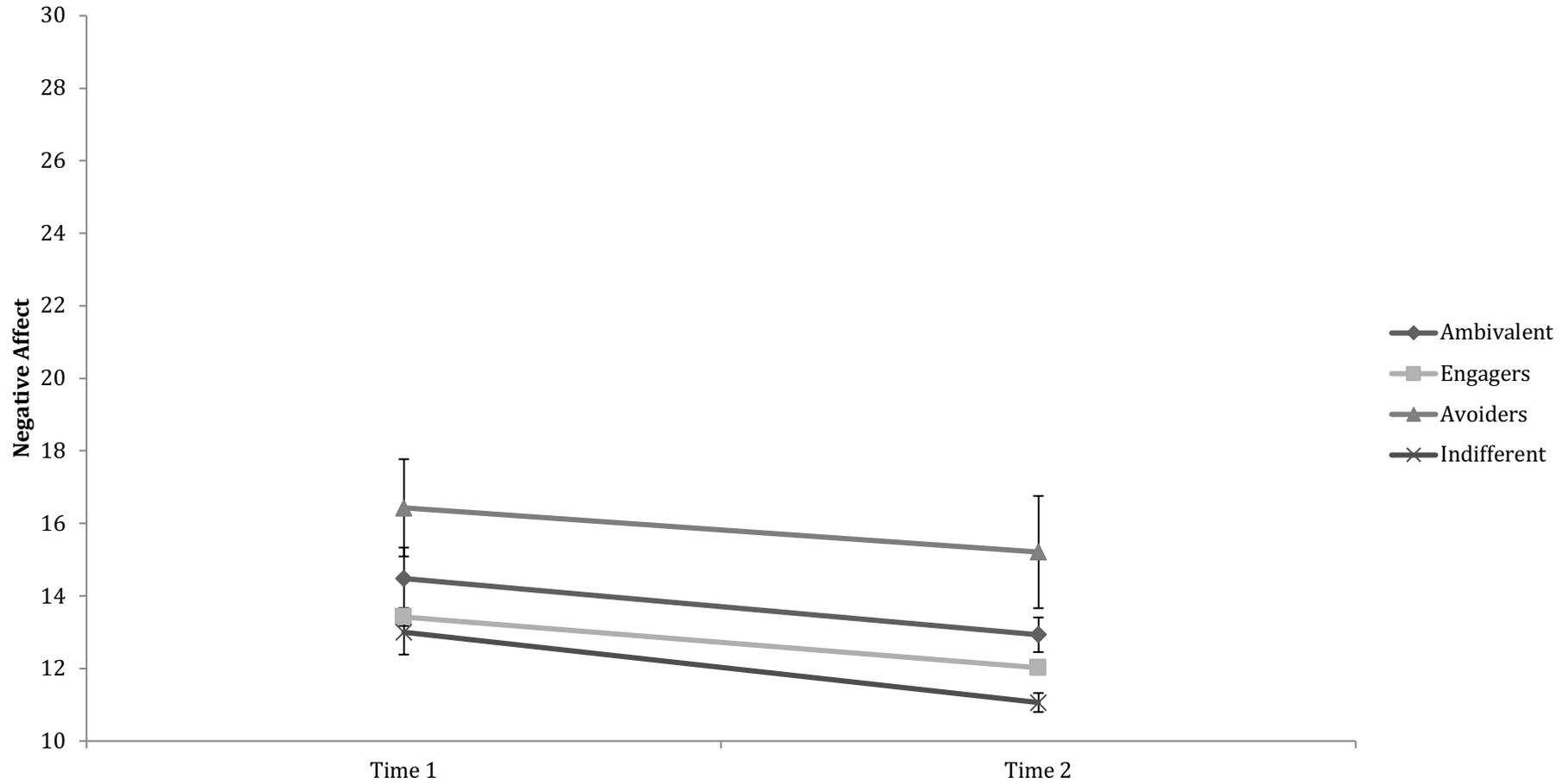


Note: For ambivalent group, $N = 27$; for engagers group, $N = 166$; for avoiders group, $N = 14$; for indifferent group, $N = 18$. Error bars are ±1 standard error.

**6.4 Discussion**

The purpose of Study 2 was to examine the impact of motivation on attentional bias to threat, and the relation between approach and avoidance motivation in the context of eating-related anxiety. Specifically, we aimed to examine: (1) if a sample of restrained eaters could be assigned to different groups based on their motivation to attend to vs. avoid attending to food images; (2) if the sample of restrained eaters would exhibit attentional biases to threat that are different from some of the motivational groups; (3) if different motivational groups would exhibit attentional biases to threat that are different from one another; and (4) if ambivalent individuals would report more restrained eating behaviours, thought-shape fusion, and negative mood state.

In general, our results provided support to the first three hypotheses and partially confirmed the last one. Participants who identified themselves as restrained eaters indeed experienced significant differences in their motivation regarding looking at or avoid looking at food images, thus confirming our first hypothesis. More importantly, different motivational groups demonstrated different attentional biases to threat, as indicated by their eye movements. Our sample, as a whole, consistently demonstrated facilitated attention to food images, which was not observed in some of the motivational groups. Specifically, the engagers group showed facilitated attention to food, the avoiders group showed attentional avoidance of food, and the ambivalent and indifferent groups mostly showed no attentional bias. With regards to time-course of eye movements, the ambivalent group started with attentional avoidance and then showed no attentional bias, the engagers group started with attentional avoidance and then switched to facilitated attention, the avoiders group started with facilitated attention and then switched to attentional avoidance, and the indifferent group mostly showed no attentional bias. Hence, our second and third hypotheses were supported. Ambivalent individuals reported more restrained eating behaviours and thought-shape fusion,

but did not experience more negative mood state at the end of the study. Therefore, our fourth hypothesis was partially supported.

The current data demonstrated that our sample of restrained eaters was not a homogenous group. Traditionally, psychological research has mostly focused on the link between restrained eating and motivation to approach food stimuli. When deprived of certain food items, participants demonstrated strong cravings for those foods (Kemps & Tiggemann, 2009; Kemps et al., 2013). However, restrained eaters may also be motivated to avoid food because of their dieting goals, thus creating an approach-avoidance conflict (Werthmann et al., 2015). In fact, it was proposed that some restrained eaters may be torn between approach and avoidance goals, which accounts for the inconsistent findings with respect to their attentional biases to food cues (Ahern et al., 2010). Indeed, the current study revealed that not every retrained eater endorsed strong motivation to approach images of high calorie food. Moreover, we observed a significant interaction between approach and avoidance motivation: some participants were low on one and high on the other (e.g., engagers or avoiders), some participants were high on both (e.g., ambivalent), and some participants were low on both (e.g., indifferent). The current study again showed that anxious individuals can be classified into four motivational groups, as suggested by Nelson et al. (2015).

Most critically, different motivational groups displayed different patterns of visual attention towards food images. In fact, motivation played a key role in determining how restrained eaters allocated their attention when confronting images of high calorie food. If we had treated restrained eaters as one homogenous group, then our conclusion would have been very different. Overall, restrained eaters had faster first fixations to food, longer first fixations on food, and a greater proportion of viewing time on food, suggesting facilitated attention to threat. However, when we divided participants based on their motivation ratings, we observed different, sometimes opposite, patterns of visual attention to food cues. The

engagers group still displayed the same facilitated attention towards food. However, the avoiders group showed attentional avoidance of food, and the ambivalent and indifferent group showed no consistent attentional bias. The same observation applied to the time course of attentional biases to threat. Restrained eaters, as a whole, displayed attentional avoidance of food during the first 500ms and facilitated attention towards food between 4500-5000ms. Only the engagers group demonstrated this avoidant-vigilant pattern in their attentional biases to food. The avoiders group showed an opposite pattern of visual attention over the time course (i.e., vigilant-avoidant), and the ambivalent and indifferent groups did not follow either an avoidant-vigilant or vigilant-avoidant pattern. These results, together with those from Study 1, have provided convincing evidence to the hypothesized moderating effect of motivation on attentional biases to threat, as proposed by Cisler and Koster (2010).

Our results also suggest that attentional biases to food cues change significantly over time, especially for the avoiders and engagers groups. Avoiders seemed to follow a vigilant-avoidant pattern in their visual attention to food images, as proposed by Mogg and Bradley (1998). On the contrary, engagers seemed to follow the opposite pattern in their visual attention to food images. It is possible that the attentional bias displayed during the first 500ms of the stimulus presentation was more driven by automatic, bottom-up processes (e.g., threat detection mechanism), whereas the attentional bias displayed during the later portions of the stimulus presentation was more driven by strategic, top-down processes (e.g., emotion regulation).

Similar to Study 1, only a minority of participants in Study 2 endorsed an ambivalent motivation towards images of high calorie food (approximately 12%). In fact, the majority of our sample was categorized as engagers (approximately 76%). This proportion is far higher than what was reported in Study 1 (approximately 19%) and by Nelson et al. (2015) (approximately 33%). Such strong motivation to look towards images of high calorie food

provides support to the hypothesis that restrained eaters have stronger cravings and are prone to overeating when exposed to palatable food (see Kakoschke, Kemps, & Tiggemann, 2015; Kemps et al., 2013). Furthermore, it should be noted that strong motivation to look towards high calorie food does not necessarily translate into strong motivation to consume high calorie food. Participants might be overly motivated to look at food images in the laboratory because there was no opportunity for them to eat the food and hence, their dieting goals were not fully activated. It is possible that if we asked participants for their motivation to eat and to restrict eating, we might observe a lower proportion of engagers and a higher proportion of ambivalent individuals. Future researchers should consider examining if there is a correspondence between approach and avoidance motivation in looking behaviours, and approach and avoidance motivation in eating behaviours.

One finding from the current study is of particular importance to clinical practice. Ambivalent individuals scored the highest on the Concerns for Dieting subscale and Thought Shape Fusion scale. Our sample consisted of individuals who scored in the top 20% on the Concerns for Dieting subscale that was administered during a screening process. The fact that some of our participants (i.e., ambivalent individuals) were more restrained than others highlights the important role ambivalence plays in eating pathology. Our result provides strong evidence to the close link between restrained eating behaviours and approach-avoidance conflict towards palatable food, as proposed by Stroebe et al. (2008).

Furthermore, there is extensive research showing that self-reported restrained eating predicts increased eating pathology (for a review, see Stice, 2002). If ambivalence is associated with more restrained eating behaviours, then this ambivalence should also predict more eating pathology. In fact, results from our study support this hypothesis: ambivalent individuals scored significantly higher than engagers and indifferent groups on the Thought Shape Fusion scale. Thought shape fusion refers to the belief that thinking about eating high

calorie food leads to perceptions of weight gain and increased body dissatisfaction (Coelho et al., 2013). A significant body of research has demonstrated that greater thought shape fusion predicts more eating pathology (see Coelho et al., 2012; Coelho et al., 2014). Hence, the current study has extended the Goal Conflict Model of Eating (Stroebe et al., 2008) by showing a close link between an ambivalent attitude towards high calorie food and cognitive distortions that are central to eating pathology.

Interestingly, ambivalent individuals did not show increased negative mood state as a result of viewing high calorie food. Instead, all participants reported a significant decrease in their positive and negative affect from the beginning to the end of the study. In Study 1, ambivalent individuals maintained their baseline levels of spider fear and negative mood state at the end of the task. However, we were not able to replicate this finding in Study 2. It is possible that differences in study design and stimuli might have contributed to different results. Relative to a live tarantula (as in Study 1), images of high calorie food might not be perceived to be as threatening (as in Study 2). High calorie food is anxiety provoking to restrained eaters because eating it can potentially lead to weight gain (Papies et al., 2008). Merely looking at food images may not carry the same emotional intensity. Therefore, we recommend that future researchers should considering using real food stimuli, e.g., a bogus taste test (see Werthmann et al., 2011).

There are several limitations to the current study. Firstly, engagers were overly represented in our sample. Despite our rather large sample size, we had fewer than 20 participants in the avoiders and indifferent groups. Hence, the size of the engagers group was almost ten times greater than the avoiders and indifferent groups. Unbalanced sample sizes might have limited the statistical power of our analyses. We believe that the over-representation of engagers might be a result of the following two limitations to our study design. One is that we recruited individuals who self-identified as restrained eaters. We were

unable to distinguish participants who were successful in restrained eating from those who were not. Some researchers proposed that the Restraint Scale does not measure actual dieting behaviours but unsuccessful dieting attempts (e.g., van Strien et al., 2007). It is possible that some of our participants had an intent to restrict but were not actively restricting food intake. This limitation can be addressed by including in-person assessment to determine if participants are currently restricting. The other limitation is that we presented our participants with images of high calorie food. As discussed earlier, participants might be highly motivated to look at high calorie food, but it does not necessarily translate into strong motivation to eat it. We recommend future researchers to use stimuli that might be more ecologically relevant (e.g., providing participants with real food). Another limitation is that we did not control for hunger in the current study. We are confident that participants' levels of hunger did not confound our results, as we measured the time since last food intake and it did not correlate with any outcome measures. However, future studies should consider actively controlling for participants' food intake prior to their participation in the laboratory (for an example, see Nijs, Muris, Euser, & Franken, 2010).

In summary, Study 2 examined the impact of motivation on attentional bias to threat, and the relation between approach and avoidance motivation in the context of eating-related anxiety. A sample of self-identified restrained eaters were divided into four different groups based on their motivation to approach and avoid images of high calorie food. Different motivational groups demonstrated different patterns of attentional biases to threat. Individuals who were ambivalent about whether to look towards or away from food images reported more restrained eating behaviours and greater thought shape fusion, both of which are closely linked to eating pathology. Ambivalent individuals, however, did not report more negative mood state as a result of viewing food images. Therefore, Study 2 provides evidence to the important role that ambivalent motivation plays in the development and maintenance of

anxiety (Gray & McNaughton, 2000). Results also support the modulating effect of

motivation on attentional bias to threat (Cisler & Koster, 2010).

## Chapter 7

### Study 3: The Impact of Brief Mindfulness Training on Attentional Scope

**7.1 Introduction**

The primary purpose of Study 3 was to examine the extent to which a single session of mindfulness meditation influences attentional scope, including the scope of perceptual attention, conceptual attention, and thought-action repertoires. There is a plethora of research showing that anxiety is characterized by a narrowed scope of attention and difficulties in expanding this narrowed scope of attention. There is also a large body of research demonstrating that mindfulness-based interventions are effective in treating anxiety. There is some emerging evidence suggesting that mindfulness can broaden one's attentional scope. Nonetheless, research on this topic is scarce and findings have been rather mixed. In addition, there are significant methodological limitations to the studies that are currently available. The present study aimed to address the following questions in a single-session experiment: (1) does brief mindfulness training improve mood state; (2) does brief mindfulness training broaden the scope of perceptual attention; (3) does brief mindfulness training broaden the scope of conceptual attention; and (4) does brief mindfulness training broaden the scope of thought-action repertoires.

Given research on this topic is still in its early stage, we decided to recruit the general population rather than anxious individuals in the current study. There are two benefits in doing so: one is that all previous studies were conducted with the general population and we would be able to compare our results directly to those that have been published, and the other is that there is a more urgent need to further research the general effectiveness of mindfulness in expanding attentional scope rather than its specificity for anxiety conditions.

In Study 3, individuals with no history of meditation practice were randomly assigned to receive 15 minutes of: mountain meditation, passive progressive muscle relaxation, or

listening to an audiobook. We decided to administer a 15-minute intervention as this was the duration of the original mountain meditation exercise developed by Kabat-Zinn (2014). Immediately before and after these activities, participants reported their mood state and completed tasks that measured their scope of perceptual attention and conceptual attention. At post-test, participants were also tested on their scope of thought-action repertoires.

We tested the following hypotheses in the current study: (1) mountain meditation would lead to more positive mood state than relaxation and control conditions; (2) mountain meditation would lead to a broader scope of perceptual attention than relaxation and control conditions; (3) mountain meditation would lead to a broader scope of conceptual attention than relaxation and control conditions; and (4) mountain meditation would lead to a broader scope of thought-action repertoires than relaxation and control conditions.

**7.2 Methods**

**7.2.1 Participants**

Undergraduate students ($N = 219$) with no prior experience of mindfulness meditation were recruited from the University of Waterloo. Participants received course credits or cash remuneration (eight Canadian dollars per person) in exchange for their participation. This study was advertised through an online sign-up system and posters on campus. Before signing up for this study, potential participants were asked if they had any prior experience of mindfulness meditation and only novices were invited to take part in this experiment. Out of the original 219 participants, data from six participants were discarded due to noncompliance with task instructions. We also discarded data from two participants who had difficulty understanding English, two participants who had difficulty staying focused, and one participant due to computer difficulties. The final sample consisted of 208 participants (59 males) with a mean age of 20.3 years ($SD = 2.4$).

Outliers on self-report and cognitive measures (three standard deviations above or below the means) were corrected by replacing them with the next highest or lowest values. Participants were randomly assigned to one of the following conditions: mindfulness meditation ($N = 71$), passive progressive muscle relaxation ($N = 71$), and audiobook ($N = 66$). There were no significant differences in age between three conditions ($p = .77$). Regardless of their group assignment, all participants were informed that the purpose of the present study was to examine the impact of different relaxation strategies on information processing, and there was no explicit reference to mindfulness meditation. The protocol received ethical clearance from the Office of Research Ethics at the University of Waterloo and all participants provided informed consent.

**7.2.2 Self-Report Measures**

**7.2.2.1 Positive and Negative Affect Schedule**

Participants completed the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) immediately before and after intervention. The PANAS consists of 20 items measuring mood state (i.e., how the individual is feeling at the moment). This measure generates two subscales: one measuring positive affect and the other measuring negative affect (10 items per scale). Using a 5-point Likert scale (from 1 "very slightly or not at all" to 5 "extremely"), participants rated the extent to which each item was consistent with their current mood state. The PANAS has demonstrated good validity and internal consistency (Crawford & Henry, 2004). The PANAS was included to assess the impact of intervention on mood state.

**7.2.3 Cognitive Measures**

**7.2.3.1 Navon Letter Task**

The Navon Letter Task (Navon, 1977) used in the present study was modeled after the work of Förster et al. (2006). In this task, a series of global letters, each comprised of small local letters was presented on the computer screen. The horizontal and vertical lines of each global letter were made up from seven closely spaced local letters. On each trial, participants were first presented with a fixation cross in the centre of the screen for 500ms. Next, a global composite letter was displayed and participants had five seconds to make a response. Participants were instructed to press the "L" key if a given stimulus contained the letter "L" and to press the "F" key if a given stimulus contained the letter "F". They were also told that the target letter ("F" or "L") would only occur at one level (either global or local). In total, each participant was given eight practice trials and 32 testing trials (half featuring a global target and half featuring a local target). There were eight different combinations: an L made of Hs, an L made of Ts, an F made of Hs, an F made of Ts, an T made of Ls, an H made of

Ls, an T made of Fs, and an H made of Fs. We followed established procedures and adjusted response times using a natural logarithm transform (see Gable & Harmon-Jones, 2010). Trials with incorrect responses (3.2% of the pre-test sample and 2.7% of the post-test sample) or with response times more than three standard deviations from the means (0.83% of the pre-test sample and 0.75% of the post-test sample) for each stimulus were removed. The number of exclusions did not vary by condition (both $p_s > .80$). We included this task to measure the scope of perceptual attention.

**7.2.3.2 Categorization Task**

The Categorization Task (Isen & Daubman, 1984) used in this study was based on the work of Smith and Trope (2006). In this task, participants were presented with a general category and then had to rate a set of items on a 10-point scale (1: *definitely does not belong to the category*; 5: *does not belong to the category, but is very similar to members of that category*; 6: *does belong to the category, but is not a very good example of it*; 10: *definitely does belong to the category*). For each trial, participants saw a general category on top of the screen, a specific item below it, and a 10-point rating scale with 1, 5, 6, and 10 labeled accordingly. Nine items were presented for each category (e.g., "vehicle"), including three excellent exemplars (e.g., "car", "bus"), three moderate exemplars (e.g., "boat", "truck"), and three weak exemplars (e.g., "feet", "tractor"). Items were selected based on Rosch's (1975) norms and as in Isen and Daubman (1984), moderate and excellent exemplars were included as fillers only. Each category always started with an excellent exemplar and the remaining items were presented in a random order. Each participant was given two categories ("furniture" and "vehicle") in the pre-test and two new categories ("clothing" and "vegetable") in the post-test. Trials with responses that went beyond the 10-point rating scale (0.61% of the pre-test sample and 0.70% of the post-test sample) were removed. The number of exclusions did not

vary by condition (both $p_s > .18$). We included this task to measure the scope of conceptual attention.

### 7.2.3.3 Twenty Statements Task

The present study employed a modified, open-ended Twenty Statement Task following the work of Fredrickson and Branigan (2005). In this task, participants were first presented with a hypothetical stressful situation (i.e., being put on an academic probation due to failing multiple courses and not being able to return to university until the next academic year). Participants were asked to imagine the scenario as vividly as possible and then list all the things they would like to do in response to this situation. Each participant was given twenty blank lines that began with "I would ____" and they were instructed to use as many as needed. Following data collection, we reviewed the qualitative data and subsequently had two independent coders classify each response as either problem solving (e.g., "visit my academic advisor") or negative reaction (e.g., "blame myself"). Inter-rater reliability (Cohen's Kappa) was 0.91. Inter-rater averages were calculated and significant discrepancies were resolved through discussion. The total number of statements participants completed was tallied, with a possible range from 0 to 20. We included this task to measure the scope of thought-action repertoires in response to a stressful event.

### 7.2.4 Intervention

### 7.2.4.1 Mindfulness Intervention

Participants in the meditation group listened to a 15-minute audio recording of "Mountain meditation" (Kabat-Zinn, 2014), in which they were instructed to imagine themselves as being a mountain while observing the many qualities of and seasonal changes to this mountain. This exercise also encouraged participants to adopt the same stance towards their

own life experiences and cultivate a sense of rootedness. This exercise was particularly designed to broaden the scope of awareness in both space (e.g., from one's individual self to a much bigger context that a mountain is situated in) and time (e.g., from one's present moment to the many seasons and changes a mountain would have experienced). It has been used extensively in Mindfulness-Based Cognitive Therapy (Segal et al., 2002) and Mindfulness-Based Stress Reduction (Kabat-Zinn, 1994). We chose the mountain meditation as our mindfulness intervention for two reasons: (1) the mountain meditation specifically targets broadening the scope of attention, and (2) almost all previous studies have studied breathing meditation, which does not specifically target broadening the scope of attention.

**7.2.4.2 Relaxation Intervention**

Participants in the relaxation condition listened to a 15-minute audio recording of "Passive progressive muscle relaxation" (Feldman, Greeson, & Senville, 2010), in which they were instructed to notice sensations of tension in various muscle groups throughout their body for 10 seconds each, and then allow these muscles to relax completely. In this exercise, participants were asked to pay attention to their muscles in an ordered structure, starting with hands and facial muscles and continuing slowly down the body. This particular exercise was a modified version of Jacobson's (1938) relaxation techniques and has been widely used as an active control condition in mindfulness research (Feldman et al., 2010). We opted for a passive version without active tensing of muscles to eliminate the potential confound of physical movement as per Feuille and Pargament (2015).

**7.2.4.3 Audiobook Control**

Participants in the audiobook condition were asked to sit quietly. The first two chapters "Loomings" and "The carpet-bag" from an audiobook version of Herman Melville's "Moby

Dick" (Wills, 2007) were then played through a pair of speakers. We used a narrated story because the extent to which it required auditory attention was comparable to the other two conditions. Moreover, asking participants to listen to an audiobook is a commonly used control condition in mindfulness research (S. Johnson, Gur, David, & Currier, 2013; Kramer, Weger, & Sharma, 2013; Xu, Purdon, Seli, & Smilek, 2017). We included this exercise as a passive control condition.

**7.2.5 Procedure**

Participants were tested individually. Upon their arrival, participants first completed the Navon Letter Task and Categorization Task, and indicated their mood state on the PANAS. Participants were then randomly assigned to one of the following interventions: a 15-minute mountain meditation, a 15-minute passive progressive muscle relaxation, or listening to an audiobook for 15 minutes, with instructions to follow along as best as they could. After intervention, the PANAS, Navon Letter Task, and Categorization Task were re-administered, and participants also completed the Twenty Statements Task. In total, the procedure lasted roughly 45 minutes.

**7.3 Results**

**7.3.1 Does Mountain Meditation Improve Mood State?**

Means and standard deviations of the positive and negative affect scores by group are presented in Table 9. To test whether mindfulness meditation improved positive mood state, we conducted a mixed ANOVA on positive affect scores, in which time (pre-test vs. post-test) was entered as the within-subject factor and group (meditation vs. relaxation vs. audiobook) was entered as the between-subject factor. We observed a significant main effect of time, $F(1, 205) = 78.95$, $\eta^2_p = .278$, $p < .001$, and a significant time by group interaction, $F(2, 205) = 17.27$, $\eta^2_p = .144$, $p < .001$, but no main effect of group, $F(2, 205) = 0.33$, $p = .721$. To understand the significant time by group interaction, we performed a paired-sample t-test on positive affect for each intervention group. This analysis showed that positive affect stayed constant for the meditation group, $t(70) = 1.32$, $p = .193$, but decreased significantly for the relaxation group, $t(70) = 4.30$, $p < .001$, and the audiobook group, $t(65) = 10.1$, $p < .001$.

To test whether mindfulness was associated with lower negative affect, we repeated this analysis on negative affect scores. We found a significant main effect of time, $F(1, 205) = 127.32$, $\eta^2_p = .383$, $p < .001$, a significant main effect of group, $F(2, 205) = 3.05$, $\eta^2_p = .029$, $p = .049$, and a significant time by group interaction, $F(2, 205) = 3.32$, $\eta^2_p = .031$, $p = .038$. Follow-up paired-sample t-tests revealed that all groups reported a significant decrease in negative affect from pre- to post-intervention (all $p_s < .001$). Follow-up one-way ANOVAs showed a main effect of group on negative affect at post-test, $F(2, 205) = 9.14$, $\eta^2_p = .089$, $p < .001$, but not at pre-test, $F(2, 205) = 1.03$, $p = .358$. Post hoc comparisons (Tukey's HSD) revealed that at post-test, both meditation and relaxation groups reported significantly lower negative affect than the control group (both $p_s < .004$). These data provided partial support for our first hypothesis.

### 7.3.2 Does Mountain Meditation Broaden the Scope of Perceptual Attention?

In this study, the scope of perceptual attention was measured through the Navon Letter Task. Faster responses to the global targets indicate a broad scope of attention, whereas faster responses to the local targets indicate a narrow scope of attention. Reaction time measures are presented in Table 9. To determine if mindfulness meditation broadened the scope of perceptual attention, we performed a mixed ANOVA on response times with time (pre-test vs. post-test) and target (global vs. local) as within-subject factors and group (meditation vs. relaxation vs. audiobook) as a between-subjects factor. There was a significant main effect of time, $F (1, 205) = 294.41$, $\eta^2_p = .590$, $p < .001$, a significant main effect of target, $F (1, 205) = 45.46$, $\eta^2_p = .181$, $p < .001$, a significant time by target interaction, $F (1, 205) = 35.11$, $\eta^2_p = .146$, $p < .001$, but no main effect of group, no time by group interaction, no target by group interaction, and no time by target by group interaction (all $p_s > .087$). In general, regardless of their assigned condition, participants responded to all targets faster during post-test than pre-test. We conducted follow-up 2 (Target: global vs. local) x 3 (Condition: meditation vs. relaxation. vs. audiobook) mixed ANOVAs and found a main effect of target at both pre-test, $F (1, 205) = 74.07$, $\eta^2_p = .265$, $p < .001$, and post-test, $F (1, 205) = 6.79$, $\eta^2_p = .032$, $p = .01$, but no main effect of group or time by group interaction at either pre-test (both $p_s > .18$) or post-test (both $p_s > .64$). Hence, all participants responded faster to global than local targets both before and after intervention, suggesting a global focus of attention at both pre- and post-test. These results do not support our second hypothesis.

**Table 9. Study 3: Changes to Mood State and Attentional Scope for All Participants**

| Measures | Meditation group ($N = 71$) | | | Relaxation group ($N = 71$) | | | Audiobook group ($N = 66$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pre-test | Post-test | Paired $t$ | Pre-test | Post-test | Paired $t$ | Pre-test | Post-test | Paired $t$ |
| Mood states | | | | | | | | | |
| Positive affect | 25.04 (6.99) | 24.15 (7.97) | 1.32 | 25.45 (5.87) | 22.42 (7.80) | 4.29[***] | 26.97 (6.90) | 20.45 (7.90) | 10.10[***] |
| Negative affect | 13.41 (3.06) | 11.28 (1.64) | 7.01[***] | 14.03 (3.90) | 10.97 (1.55) | 9.11[***] | 14.30 (4.22) | 12.50 (3.12) | 4.19[***] |
| Scope of perceptual attention | | | | | | | | | |
| Global targets RT | 771.78 (159.00) | 674.84 (111.53) | 7.32[***] | 763.08 (151.37) | 681.31 (142.08) | 6.69[***] | 788.99 (179.06) | 692.42 (144.31) | 6.99[***] |
| Local targets RT | 852.08 (202.45) | 685.43 (133.00) | 12.68[***] | 803.74 (132.58) | 688.29 (120.91) | 9.73[***] | 843.09 (206.03) | 702.95 (127.66) | 10.33[***] |
| Scope of conceptual attention | | | | | | | | | |
| $N$ of weak exemplars included | 3.34 (2.35) | 4.13 (2.55) | -4.00[**] | 4.03 (2.62) | 4.96 (2.62) | -4.47[***] | 3.58 (3.13) | 4.36 (2.52) | -3.17[**] |
| Typicality ratings of weak exemplars | 4.03 (1.29) | 4.67 (1.29) | -2.38[*] | 4.46 (1.24) | 5.11 (1.27) | -2.76[**] | 4.24 (1.59) | 4.83 (1.27) | -2.24[*] |
| Scope of action tendencies | | | | | | | | | |
| Total $N$ of statements | -- | 8.92 (3.74) | -- | -- | 8.86 (3.54) | -- | -- | 8.09 (2.93) | -- |
| $N$ of problem-solving | -- | 5.13 (2.85) | -- | -- | 4.46 (2.54) | -- | -- | 4.23 (2.24) | -- |
| % of problem-solving | -- | 61.3 (26.8) | -- | -- | 52.4 (24.2) | -- | -- | 54.2 (24.9) | -- |

Note: RT: response time, in ms; $N$: Number. Standard deviations from the mean are presented in brackets. Paired-sample t-tests were performed to examine differences between pre- and post-tests within each group; For scope of perceptual attention, t-tests were performed on logarithm-transformed response time. [*] $p < .05$, [**] $p < .01$, [***] $p < .001$.

### 7.3.3 Does Mindfulness Meditation Broaden the Scope of Conceptual Attention?

Scope of conceptual attention was assessed with the Categorization Task. A broader scope of conceptual attention is represented by two measures: a greater number of weak exemplars to be classified as "belonging to the category" (i.e., rated 6 or higher), and higher typicality ratings of weak exemplars (see Smith & Trope, 2006). Means and standard deviations of these indices are presented in Table 9. We first checked whether our items were correctly labelled as strong, moderate, or weak exemplars of the categories. A 3 (Category: strong vs. moderate vs. weak) x 2 (Time: pre-test vs. post-test) repeated-measures ANOVA revealed a significant main effect of category, $F(2, 414) = 2237.57$, $\eta^2_p = .915$, $p < .001$, such that participants indeed considered the strong items ($M = 9.58$, $SD = 0.54$) as the best exemplars, the moderate items ($M = 7.94$, $SD = 0.94$) less typical, followed by the weak items ($M = 4.57$, $SD = 1.18$).

We next examined whether intervention influenced how many of the weak items were included in the respective categories (i.e., rated 6 or higher). We performed a mixed ANOVA, in which time (pre-test vs. post-test) was entered as the within-subject factor and group (meditation vs. relaxation vs. audiobook) was entered as the between-subject factor. This analysis revealed a significant main effect of time, $F(1, 205) = 18.06$, $\eta^2_p = .081$, $p < .001$, such that all participants were more likely to include weak exemplars as belonging to the categories at post-test, but no main effect of group or time by group interaction (both $p_s > .12$). We then administered the same analysis to the actual ratings of the weak exemplars. We again observed a significant main effect of time, $F(1, 205) = 43.94$, $\eta^2_p = .176$, $p < .001$, such that all participants rated weak exemplars as more typical of the category at post-test, but no main effect of group or time by group interaction (both $p_s > .08$). These results suggest that participants in all three conditions exhibited a broadened scope of conceptual attention after intervention, thus rejecting our third hypothesis.

**7.3.4 Does Mindfulness Meditation Broaden the Scope of Thought-Action Repertoires?**

In this study, the scope of thought-action repertoires was measured using the Twenty Statements Task. A higher number indicates broader thought-action repertoires. The numbers of completed statements and the proportion of problem-solving statements are presented in Table 9. To answer this question, we conducted a one-way ANOVA in which the number of all statements, the number of problem-solving statements, and the proportion of problem-solving statements were tested as a function of group. Contrary to our hypothesis, this analysis revealed no main effect of group for the number of all statements, $F (2, 205) = 1.22$, $p = .297$, the number of problem-solving statements, $F (2, 205) = 2.30$, $p = .103$, or the proportion of problem-solving statements, $F (2, 205) = 2.43$, $p = .091$, thus rejecting our fourth hypothesis.

**7.3.5 Follow-up Analyses: Participants with an Initial Narrow Focus of Perceptual Attention**

We observed that approximately 75% of participants displayed a global focus of perceptual attention at pre-test (i.e., responded faster to global than local targets in the Navon Letter Task), which may have created a ceiling effect. We selected those who were narrowly focused at pre-test (i.e., did not demonstrate a global precedence in the Navon Letter Task, $N = 51$) and conducted the same series of analyses on this subset only. One-way ANOVAs showed that there were no significant differences between the meditation group ($N = 16$), relaxation group ($N = 19$), and control group ($N = 16$) in any of the measures administered at pre-test (all $p_s > .077$).

Changes to mood state and attentional scope measures are presented in Table 10. To examine if mindfulness meditation improved mood state, we conducted a 3 (Group: meditation vs. relaxation vs. audiobook) x 2 (Time: pre-test vs. post-test) mixed ANOVA.

For positive affect, we observed a significant main effect of time, $F$ (1, 48) = 23.52, $\eta^2_p$

= .329, $p$ < .001, a significant main effect of group, $F$ (2, 48) = 8.07, $\eta^2_p$ = .252, $p$ = .001, and

a significant time by group interaction, $F$ (2, 48) = 6.25, $\eta^2_p$ = .206, $p$ = .004. For negative

affect, we found a significant main effect of time, $F$ (1, 48) = 37.41, $\eta^2_p$ = .438, $p$ < .001, a

significant time by group interaction, $F$ (2, 48) = 3.75, $\eta^2_p$ = .135, $p$ = .031, but no main effect

of group, $F$ (2, 48) = 0.10, $p$ = .908. Follow-up paired-sample t-tests showed that positive

affect stayed constant for the meditation group, $t$ (15) = 0.91, $p$ = .379, and the relaxation

group, $t$ (18) = 1.78, $p$ = .093, but decreased significantly for the audiobook group, $t$ (15) =

5.91, $p$ < .001. In addition, negative affect remained constant for the audiobook group, $t$ (15)

= 1.62, $p$ = .126, but decreased significantly for the meditation group, $t$ (15) = 3.64, $p$ = .002,

and the relaxation group, $t$ (18) = 5.58, $p$ < .001.

To examine if mindfulness meditation broadened the scope of perceptual attention,

we administered a 2 (Time: pre-test vs. post-test) x 2 (Target: global vs. local) x 3 (Group:

meditation vs. relaxation vs. audiobook) mixed ANOVA. This analysis revealed a significant

main effect of time, $F$ (1, 48) = 45.79, $\eta^2_p$ = .488, $p$ < .001, a significant main effect of target,

$F$ (1, 48) = 25.53, $\eta^2_p$ = .347, $p$ < .001, a significant time by target interaction, $F$ (1, 48) =

6.08, $\eta^2_p$ = .112, $p$ = .017, but no main effect of group, no time by group interaction, no target

by group interaction, and no time by target by group interaction (all $p_s$ > .23). In general, all

participants responded to all targets faster during post-test relative to pre-test. Follow-up 2

(Target: global vs. local) x 3 (Group: meditation vs. relaxation. vs. audiobook) mixed

ANOVAs revealed a significant main effect of target at pre-test, $F$ (1, 48) = 76.92, $\eta^2_p$ = .616,

$p$ < .001, and a trending main effect of target at post-test, $F$ (1, 48) = 3.84, $\eta^2_p$ = .074, $p$

= .056, but no main effect of group or time by group interaction at either pre-test (both

$p_s$ > .30) or post-test (both $p_s$ > .24). Hence, all participants responded faster to local than

global targets at pre-test, and this difference was trending towards statistical significance at post-test.

For scope of conceptual attention, we first examined the impact of intervention on the number of weak exemplars that were included in the respective categories. A 3 (Group: meditation vs. relaxation vs. audiobook) x 2 (Time: pre-test vs. post-test) mixed ANOVA revealed a trending main effect of time, $F(1, 48) = 3.52$, $\eta^2_p = .068$, $p = .067$, no significant main effect of group, $F(2, 48) = 2.73$, $p = .08$, and a trending time by group interaction, $F(2, 48) = 3.04$, $\eta^2_p = .112$, $p = .057$. Follow-up paired-sample t-tests revealed that whereas those in the relaxation group were more likely to include weak exemplars after intervention, $t(18) = -2.33$, $p = .031$, the other two groups did not (both $p_s > .12$). For typicality ratings of the weak exemplars, the same mixed ANOVA revealed a significant main effect of time, $F(1, 48) = 7.58$, $\eta^2_p = .136$, $p = .008$, no main effect of group, $F(2, 48) = 1.94$, $p = .154$, and a trending time by group interaction, $F(2, 48) = 2.84$, $\eta^2_p = .106$, $p = .063$. Follow-up paired-sample t-tests revealed that while typicality ratings for weak exemplars remained constant for the audiobook group, $t(15) = 0.31$, $p = .765$, ratings increased significantly for the meditation group, $t(15) = -2.90$, $p = .011$, and relaxation group, $t(18) = -2.84$, $p = .011$.

For the scope of thought-action repertoires, a one-way ANOVA revealed a significant main effect of group for the number of problem-solving statements, $F(2, 48) = 3.69$, $p = .032$, and the proportion of problem-solving statements, $F(2, 48) = 3.29$, $p = .046$, but not for the number of all statements, $F(2, 48) = 0.36$, $p = .700$. Follow-up independent-sample t-tests showed that the meditation group reported a greater number of problem-solving statements than the relaxation group, $t(33) = 2.49$, $p = .018$, and audiobook group, $t(30) = 2.07$, $p = .047$. Similarly, the meditation group reported a higher proportion of problem-solving statements than the relaxation group, $t(33) = 2.53$, $p = .016$, and audiobook group, $t(30) = 2.07$, $p = .47$. There were no significant differences between relaxation and audiobook

groups, in either the number or proportion of completed problem-solving statements (both $p_\mathrm{s} > .83$).

**Table 10. Study 3: Changes to Mood State and Attentional Scope for Participants with an Initial Narrow Focus of Perceptual Attention**

| Measures | Meditation group ($N = 16$) | | | Relaxation group ($N = 19$) | | | Audiobook group ($N = 16$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pre-test | Post-test | Paired $t$ | Pre-test | Post-test | Paired $t$ | Pre-test | Post-test | Paired $t$ |
| **Mood states** | | | | | | | | | |
| Positive affect | 28.56 (5.50) | 27.31 (6.82) | 0.91 | 25.00 (5.63) | 22.42 (7.52) | 1.78 | 24.44 (5.27) | 16.38 (4.94) | 5.91*** |
| Negative affect | 13.75 (3.53) | 11.31 (1.62) | 3.64** | 14.84 (3.76) | 10.84 (1.17) | 5.58*** | 13.13 (4.01) | 11.88 (2.60) | 1.62 |
| **Scope of perceptual attention** | | | | | | | | | |
| Global targets RT | 804.96 (141.07) | 686.54 (104.27) | 5.04*** | 882.72 (133.65) | 749.41 (159.83) | 4.80*** | 871.73 (168.20) | 757.22 (138.21) | 2.59* |
| Local targets RT | 752.96 (140.83) | 662.19 (100.30) | 4.60*** | 820.47 (121.68) | 725.56 (120.46) | 3.64** | 787.01 (167.23) | 708.15 (106.26) | 2.36* |
| **Scope of conceptual attention** | | | | | | | | | |
| $N$ of weak exemplars included | 3.56 (2.13) | 4.81 (2.56) | -1.65 | 3.89 (2.96) | 5.47 (2.72) | -2.33* | 3.44 (2.31) | 2.81 (1.42) | 1.08 |
| Typicality ratings of weak exemplars | 3.91 (1.24) | 5.01 (1.16) | -2.90* | 4.51 (1.45) | 5.41 (1.24) | -2.84* | 4.32 (1.83) | 4.18 (1.08) | 0.31 |
| **Scope of action tendencies** | | | | | | | | | |
| Total $N$ of statements | -- | 8.25 (2.62) | -- | -- | 7.68 (2.75) | -- | -- | 7.38 (3.50) | -- |
| $N$ of problem-solving | -- | 6.00 (2.99) | -- | -- | 3.84 (2.12) | -- | -- | 3.94 (2.65) | -- |
| % of problem-solving | -- | 71.5 (21.3) | -- | -- | 51.3 (25.3) | -- | -- | 53.2 (28.1) | -- |

Note: RT: response time, in ms; $N$: Number. Standard deviations from the mean are presented in brackets. Paired-sample t-tests were performed to examine differences between pre- and post-tests within each group; For scope of perceptual attention, t-tests were performed on logarithm-transformed response time. * $p < .05$, ** $p < .01$, *** $p < .001$.

**7.3.6 Follow-up Analyses: Participants with an Initial Broad Focus of Perceptual Attention**

We also selected those who were broadly focused at pre-test (i.e., demonstrated a global precedence in the Navon Letter Task, $N = 157$) and conducted the same series of analyses on this subset only. One-way ANOVAs showed that there were no significant differences between the meditation group ($N = 55$), relaxation group ($N = 52$), and control group ($N = 50$) in any of the measures administered at pre-test (all $p_s > .101$) with the exception of positive affect, F (2, 154) = 4.05, $\eta^2_p = .050$, $p = .019$.

Changes to mood state and attentional scope measures are presented in Table 11. To examine if mindfulness meditation improved mood state, we conducted a 3 (Group: meditation vs. relaxation vs. audiobook) x 2 (Time: pre-test vs. post-test) mixed ANOVA. For positive affect, we observed a significant main effect of time, $F (1, 154) = 55.37$, $\eta^2_p = .264$, $p < .001$, a significant time by group interaction, $F (2, 154) = 11.44$, $\eta^2_p = .129$, $p < .001$, but no main effect of group, $F (2, 154) = 0.37$, $p = .695$. For negative affect, we found a significant main effect of time, $F (1, 154) = 89.57$, $\eta^2_p = .368$, $p < .001$, a main effect of group, $F (2, 154) = 4.25$, $\eta^2_p = .052$, $p = .016$, but no time by group interaction, $F (2, 154) = 0.98$, $p = .378$. Follow-up paired-sample t-tests showed that positive affect stayed constant for the meditation group, $t (54) = 1.00$, $p = .320$, but decreased significantly for the relaxation group, $t (51) = 3.93$, $p < .001$, and audiobook group, $t (49) = 8.31$, $p < .001$. Negative affect decreased significantly for all three groups (all $p_s < .001$).

To examine if mindfulness meditation broadened the scope of perceptual attention, we administered a 2 (Time: pre-test vs. post-test) x 2 (Target: global vs. local) x 3 (Group: meditation vs. relaxation vs. audiobook) mixed ANOVA. This analysis revealed a significant main effect of time, $F (1, 154) = 256.14$, $\eta^2_p = .625$, $p < .001$, a significant main effect of target, $F (1, 154) = 140.51$, $\eta^2_p = .477$, $p < .001$, a significant time by target interaction, $F (1,$

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154) = 80.56, $\eta^2_p$ = .343, $p < .001$, a borderline time by target by group interaction, $F$ (2, 154) = 2.88, $\eta^2_p$ = .036, $p = .059$. However, there was no main effect of group, no time by group interaction, and no target by group interaction (all $p_s > .14$). In general, all participants responded to all targets faster during post-test relative to pre-test. Follow-up 2 (Target: global vs. local) x 3 (Group: meditation vs. relaxation. vs. audiobook) mixed ANOVAs revealed a significant main effect of target at pre-test, $F$ (1, 154) = 247.39, $\eta^2_p$ = .616, $p < .001$, and at post-test, $F$ (1, 154) = 20.17, $\eta^2_p$ = .116, $p < .001$, but no main effect of group or time by group interaction at either pre-test (both $p_s > .18$) or post-test (both $p_s > .47$). Hence, all participants responded faster to global than local targets at both pre-test and post-test.

For scope of conceptual attention, we first examined the impact of intervention on the number of weak exemplars that were included in the respective categories. A 3 (Group: meditation vs. relaxation vs. audiobook) x 2 (Time: pre-test vs. post-test) mixed ANOVA revealed a main effect of time, $F$ (1, 154) = 14.78, $\eta^2_p$ = .088, $p < .001$, no significant main effect of group, $F$ (2, 154) = 1.92, $p = .150$, and no time by group interaction, $F$ (2, 154) = 0.70, $p = .500$. For typicality ratings of the weak exemplars, the same mixed ANOVA revealed a significant main effect of time, $F$ (1, 154) = 39.60, $\eta^2_p$ = .205, $p < .001$, no main effect of group, $F$ (2, 154) =1.81, $p = .167$, and no time by group interaction, $F$ (2, 154) = 0.86, $p = .426$.

For the scope of thought-action repertoires, a one-way ANOVA revealed no significant main effect of group for the number of all statements, $F$ (2, 154) =1.47, $p = .234$, the number of problem-solving statements, $F$ (2, 154) = 0.53, $p = .589$, or the proportion of problem-solving statements, $F$ (2, 154) = 0.79, $p = .457$.

**Table 11. Study 3: Changes to Mood State and Attentional Scope for Participants with an Initial Broad Focus of Perceptual Attention**

| Measures | Meditation group ($N = 55$) | | | Relaxation group ($N = 52$) | | | Audiobook group ($N = 50$) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pre-test | Post-test | Paired $t$ | Pre-test | Post-test | Paired $t$ | Pre-test | Post-test | Paired $t$ |
| Mood states | | | | | | | | | |
| Positive affect | 24.02 (7.07) | 23.24 (8.09) | 1.00 | 25.62 (6.00) | 22.42 (7.98) | 3.93*** | 27.78 (7.20) | 21.76 (8.25) | 8.31*** |
| Negative affect | 13.31 (2.94) | 11.27 (1.66) | 5.95*** | 13.73 (3.95) | 11.02 (1.67) | 7.35*** | 14.68 (4.25) | 12.70 (3.27) | 3.85*** |
| Scope of perceptual attention | | | | | | | | | |
| Global targets RT | 762.13 (163.77) | 671.43 (114.25) | 5.79*** | 719.36 (133.65) | 656.42 (127.80) | 4.99*** | 762.51 (175.84) | 671.69 (141.31) | 6.94*** |
| Local targets RT | 880.92 (209.43) | 692.19 (141.17) | 12.59*** | 797.63 (136.97) | 674.67 (119.32) | 9.35*** | 861.03 (215.39) | 701.28 (134.73) | 11.98*** |
| Scope of conceptual attention | | | | | | | | | |
| $N$ of weak exemplars included | 3.28 (2.43) | 3.93 (2.53) | -1.77 | 4.08 (2.51) | 4.77 (2.59) | -1.79 | 3.62 (3.37) | 4.86 (2.60) | -3.03** |
| Typicality ratings of weak exemplars | 4.06 (1.31) | 4.57 (1.32) | -2.94** | 4.44 (1.17) | 5.01 (1.28) | -3.46** | 4.22 (1.52) | 5.04 (1.27) | -4.47*** |
| Scope of action tendencies | | | | | | | | | |
| Total $N$ of statements | -- | 8.69 (3.10) | -- | -- | 9.08 (3.32) | -- | -- | 8.08 (2.34) | -- |
| $N$ of problem-solving | -- | 4.71 (2.20) | -- | -- | 4.56 (2.21) | -- | -- | 4.28 (2.03) | -- |
| % of problem-solving | -- | 58.6 (27.1) | -- | -- | 52.6 (23.8) | -- | -- | 54.8 (23.6) | -- |

Note: RT: response time, in ms; $N$: Number. Standard deviations from the mean are presented in brackets. Paired-sample t-tests were performed to examine differences between pre- and post-tests within each group; For scope of perceptual attention, t-tests were performed on logarithm-transformed response time. $^{*}$ $p < .05$, $^{**}$ $p < .01$, $^{***}$ $p < .001$.

**7.4 Discussion**

The purpose of Study 3 was to examine whether a single session of mountain meditation broadens attentional scope, as compared to relaxation and control conditions. Specifically, we aimed to examine: (1) if mountain meditation leads to more positive mood state; (2) if mountain meditation leads to a broader scope of perceptual attention; (3) if mountain meditation leads to a broader scope of conceptual attention; and (4) if mountain meditation leads to a broader scope of thought-action repertoires. Results suggest that all participants, regardless of their assigned condition, displayed a global focus of perceptual attention and a broadened scope of conceptual attention at post-test. Meditation did not lead to broader thought-action repertoires. Meditation, however, prevented positive affect from decreasing over time. Hence, our results only provided support to our first hypothesis only.

As participants from all three conditions demonstrated a global focus of perceptual attention and a broadened scope of conceptual attention at post-test, our results did not seem to support the broadening hypothesis as outlined in the mindfulness-to-meaning theory (Garland et al., 2015). However, this absence of time by group interaction might be a result of having too many participants enter the study with a global focus of perceptual attention (approximately 75% of our sample). When we administered the same analyses to participants who were narrowly focused at pre-test, we found more salient effects of mountain meditation. Meditation, as compared to relaxation and audiobook conditions, resulted in a much broader range of problem-solving action tendencies. In addition, meditation and relaxation reduced negative affect, prevented positive affect from decreasing, and broadened the scope of conceptual attention. The sample size for these analyses was quite modest (sample size for each of the three conditions ranging from 16 - 19), so these findings must be considered preliminary and modest.

In fact, the observed global precedence effect in the Navon Letter Task at both pre-test and post-test is consistent with findings from previous studies. It has been repeatedly demonstrated that healthy individuals display facilitated processing of global information in the Navon Letter Task (Andres & Fernandes, 2006; Navon, 1977). The finding that mindfulness meditation did not have any specific impact on this global precedence effect is not unique to this study. Instead, in a study conducted by Chan and Woollacott (2007), they found that both novices and meditators responded faster to global targets. Similarly, Colzato et al. (2016) found that the global precedence effect (as measured through the Navon Letter Task) was unaffected by the type of meditation. The robust presence of the global precedence effect in the Navon Letter Task among healthy individuals might have contributed to the lack of significant findings on the broadening effect of mindfulness. Results from the current study seem to confirm this hypothesis: when we excluded globally focused participants from our analysis, meditation demonstrated a greater impact on the scope of problem solving and conceptual attention. Hence, we recommend that future researchers consider recruiting participants who are likely to have a narrow focus of attention at baseline, such as individuals with anxiety disorders or high trait anxiety. Alternatively, mood induction procedures (for an example, see Nelson et al., 2015) can be used to heighten state anxiety, which has been shown to narrow attentional scope (Finucane, 2011; Finucane & Power, 2010).

Our results also suggested that the Navon Letter Task might be subject to a significant practice effect and therefore may lack reliability, which is consistent with more recent research examining responses over time (Dale & Arnell, 2013; Gerlach & Krumborg, 2014). We chose the Navon Letter Task because it is one of the most commonly used measures of attentional scope. In future studies, researchers might want to consider using other tasks to measure the scope of perceptual attention, such as the visual matching task developed by Kimchi and Palmer (1982).

Interestingly, when we excluded globally focused participants from our analysis, mountain meditation did lead to a broadened scope of problem solving in response to a stressful situation. Those who practiced mindfulness not only reported the greatest number but also the highest proportion of problem-solving action tendencies in the Twenty Statements Task. In fact, this finding is consistent with the key hypothesis highlighted in the mindfulness-to-meaning theory: mindfulness evokes a decentered, broadened mode of awareness and allows individuals to generate more adaptive appraisals of distressing events (Garland et al., 2015). Past research has focused solely on using affect-neutral measures to examine the impact of mindfulness on scope of attention (e.g., Navon Letter Task, Categorization Task, Remote Associates Task, etc.) and only some reported significant findings. Our results not only replicated this observation (i.e., the lack of significant findings in Navon Letter Task and Categorization Task), but also suggested a promising research direction. Future studies should consider utilizing attentional measures that are more ecologically valid and involve affective stimuli, e.g., Flanker Task with emotional faces (Fenske & Eastwood, 2003), Attention Cueing Task with emotional faces (Fox et al., 2001), and Gaze Navigation Task (Marguc, Forster, & Van Kleef, 2011).

The current study included a mindfulness exercise that aims at promoting a global, decentered, and metacognitive perspective, which can be quite different from typical mindfulness practices that primarily focus on breathing and bodily sensations. In this study, meditation prevented positive affect from decreasing, while passive progressive muscle relaxation and audiobook control did not. However, in a similar study (Xu et al., 2017), we compared a 10-minute breathing meditation with an audiobook control condition, and found that positive affect decreased significantly in both conditions. It is possible that different types of mindfulness practice may have different effects, as suggested by Garland, Gaylord,

and Fredrickson (2011). Mountain meditation may allow individuals to savour their positive experience by facilitating positive reappraisals of adversity.

Despite some of our insignificant results, the current study had several important implications for future research exploring the broadening effect of mindfulness. Firstly, past research has focused exclusively on the scope of perceptual attention while ignoring the scope of conceptual attention and thought-action repertoires. There is merit in considering attentional scope as a multifaceted construct and including measures that might be more ecologically relevant (e.g., our Twenty Statements Task). Secondly, it is important to adopt a pre-post study design when investigating the impact of mindfulness on attentional scope. If we had not included a pre-test measure, we would have made very different conclusions based on some of the results we observed. Lastly, it would be critical for future researchers to include both passive and active control conditions when studying the impact of mindfulness training on attentional processes. This would allow us to examine whether or not the benefits of mindfulness are due to relaxation or other cognitive processes.

There are several limitations to the current study. The first limitation is that the majority of our participants displayed a global focus of perceptual attention at pre-test, which has significantly constrained our ability to examine the extent to which mindfulness meditation helps to broaden a narrow focus of attention. Although new analyses based on those who were narrowly focused at pre-test revealed more a salient effect of mindfulness meditation, our results are still limited by the relatively small sample size. We opted for unselected, healthy individuals because research in this area is still at its initial phase and we wanted to be able to compare our results to that from previous studies. However, we do recommend future studies to focus on the broadening effect of mindfulness among anxious individuals who are more likely to display a narrow focus of attention (see Najmi et al., 2012). The second limitation is the lack of significant findings with regards to the impact of

mindfulness on the scope of perceptual and conceptual attention. Even after excluding globally focused participants from our analyses, mindfulness did not confer any advantage to relaxation in broadening conceptual attention. However, mindfulness did demonstrate advantage relative to relaxation in the Twenty Statements Task. Unlike the Navon Letter Task and the Categorization Task, the Twenty Statements Task utilized a real-life, emotionally charged example—our undergraduate participants were asked to imagine being placed on academic probation. We chose the Navon Letter Task and the Categorization Task because they were the most commonly used measures in attentional scope literature. However, our results seem to suggest that tasks that induce some level of stress might be better suited for this line of research. Finally, the current study only included one particular type of mindfulness practice, i.e., mountain meditation. It is not clear if mountain meditation is more effective than other forms of mindfulness meditation (e.g., breathing meditation) in broadening the scope of attention.

In summary, the present study examined the effect of mindfulness training on the scope of perceptual attention, conceptual attention, and thought-action repertoires. Participants from all three conditions exhibited a global focus of perceptual attention and a broadened scope of conceptual attention at post-test. Mountain meditation, however, prevented positive affect from decreasing. For those who displayed an initial narrow focus of perceptual attention, meditation broadened conceptual attention and also led to a broader scope of problem solving. Therefore, the present study provides some preliminary support to the hypothesis that mindfulness training enhances emotion regulation through broadening the scope of attention (Garland et al., 2015).

## Chapter 8

## General Discussion

**8.1 Summary of Research**

The purpose of the current research program was twofold: firstly, we aimed to explore the impact of motivation on attentional biases to threat in different domains of anxiety; and secondly, we attempted to examine the extent to which mindfulness meditation broadens attentional scope. Extensive research in the last several decades has demonstrated a close link between anxiety and a wide range of attentional processes, among which attentional bias and attentional scope are two constructs that have attracted much research attention. Anxious individuals are characterized by several types of attentional biases to threat, including facilitated attention, difficulty disengaging, and attentional avoidance. Anxious individuals are also known to have a narrow scope of attention and experience difficulties in expanding their attentional scope. More recent research has begun to show that motivation might have a modulating effect on attentional biases to threat (Cisler & Koster, 2010). Furthermore, there is preliminary evidence suggesting that anxious individuals can be separated into different groups based on their motivation to approach and avoid threat (Nelson et al., 2015). Meanwhile, there is good reason to expect that mindfulness is a promising means of broadening attentional scope, which then improves emotion regulation (Garland et al., 2015). However, research on these two topics is scarce and rather inconclusive.

The current program of research addressed these two issues in three separate studies. Study 1 explored the relation between motivation, attentional biases to a live tarantula, and anxiety in spider-fearful individuals. Study 2 examined the relation between motivation, attentional biases to images of high calorie food, and anxiety in restrained eaters. Study 3 evaluated the general effectiveness of a brief mindfulness meditation in broadening the scope of perceptual attention, conceptual attention, and thought-action repertoires in healthy

individuals. We decided to use a live spider and images of high calorie food as threat stimuli because the former signals physical threats and the latter signals threats to personal goals, thus allowing us to compare the extent to which these two stimuli elicit different motivation. It should be noted that we opted for the general population rather than anxious individuals in study 3 for two reasons: (1) it remains unclear whether or not mindfulness broadens attentional scope in the general population, let alone anxious individuals; and (2) studying the general population would allow us to compare our results to those from previous studies.

Study 1 revealed that a sample of spider-fearful individuals experienced significant differences in their motivation to pay attention to vs. avoid paying attention to a live spider. Moreover, different motivational groups demonstrated attentional biases to threat that were different from the sample as a whole and also different from one another. Particularly, the engagers group consistently showed facilitated attention to threat, whereas the avoiders and indifferent groups did not. The ambivalent group, on the other hand, displayed a sudden increase in their visual attention towards the spider in some of the segments. Interestingly, ambivalent individuals reported significantly higher levels of spider fear and negative mood state at the end of the study than all other groups.

Study 2 again demonstrated that a sample of restrained eaters experienced significant differences in their motivation to look at vs. avoid looking at food images. Different motivational group again demonstrated attentional biases to threat that were different from the sample as a whole and also different from one another. Particularly, the engagers group showed facilitated attention to threat, the avoiders group showed attentional avoidance of threat, and the ambivalent and indifferent groups mostly showed no attentional bias. With respect to the time course of visual attention, the ambivalent group started with attentional avoidance and then showed no attentional bias, the engagers group started with attentional avoidance and then switched to facilitated attention, the avoiders group started with

facilitated attention and then switched to attentional avoidance, and the indifferent group mostly showed no attentional bias. Interestingly, ambivalent individuals also reported more restrained eating behaviours and endorsed greater thought-shape fusion, both of which are closely linked to eating pathology.

Study 3 showed that all participants displayed a global focus of perceptual attention and a broadened scope of conceptual attention at post-test, regardless of which intervention they received. A brief mindfulness meditation did not broaden thought-action repertoires, as compared to relaxation and control conditions. Meditation, however, prevented positive affect from decreasing over time. For participants who showed a narrow focus of perceptual attention at pre-test, both meditation and relaxation reduced negative affect, prevented positive affect from decreasing, and broadened the scope of conceptual attention. Moreover, meditation resulted in a broader range of problem-solving action tendencies when participants encountered a hypothetical stressful situation.

Together, Study 1 and Study 2 provided strong evidence in support of the hypothesized link between motivation and attentional biases to threat among anxious individuals, as proposed by leading cognitive models of anxiety (Bar-Haim et al., 2007; Mogg & Bradley, 1998). Moreover, the current research program advanced our understanding of motivation in the context of anxiety disorders by acknowledging and examining the interaction between motivation to approach threat and motivation to avoid threat. When two samples of anxious individuals were divided into the same four motivational groups, they consistently demonstrated many meaningful and significant differences on a variety of different measures (e.g., self-report measures, response time measures, and eye movement measures). Overall, our findings provide strong support to the classification system proposed by Nelson et al. (2015).

The fact that our two-item self-report measure of motivation significantly predicted participants' eye movements towards threatening stimuli in two different contexts (i.e., both spider-related and eating-related anxiety) showed the robust modulating effect of motivation on attentional biases to threat (Cisler & Koster, 2010). Approach and avoidance motivation was associated with participants' eye movements not only in the initial time frame of stimuli presentation (e.g., probability of first fixation in Study 1, and time to first in Study 2) but also over the time course of stimuli presentation (e.g., proportion of viewing time from S1 to S10 in Study 1, and proportion of viewing time from T1 to T10 in Study 2).

Results from Study 1 and Study 2 also provide strong support to the hypothesis that approach-avoidance conflict (a.k.a., ambivalence towards threat) plays a critical role in the development and maintenance of anxiety (Gray & McNaughton, 2000; McNaughton & Gray, 2000). An ambivalent motivation towards threat was associated with sustained anxiety in spider-fearful individuals and greater eating pathology in restrained eaters. It should be noted that only a subset of our anxious participants was classified as ambivalent. Hence, our results do not support the hypothesis that ambivalence is a precursor for significant anxiety (Gray & McNaughton, 2000), as the majority of anxious participants in the current research did not endorse an ambivalent motivation towards threat. Instead, our results were in favour of Nelson et al.'s (2015) conclusion that ambivalence exacerbates and prolongs anxiety within anxious populations. We believe that ambivalence might indicate the intensity of anxiety rather than the presence of anxiety.

With regards to the broadening effect of mindfulness, evidence is far from conclusive. In fact, Study 3 showed no extra benefits of mountain meditation in broadening the scope of perceptual attention, conceptual attention, and thought-action repertoires, as compared to relaxation and control conditions. Mindfulness, however, demonstrated potentials in broadening attentional scope for those who presented with a narrow focus of perceptual

attention but not those who presented with a broad focus of perceptual attention. Such effects were strongest when participants were tested on a more ecologically valid, stress-related task. Combined, these findings offered some preliminary evidence in support of the mindfulness-to-meaning theory (Garland et al., 2015). Mindfulness might be an effective strategy in expanding one's perspective and building resources for challenging situations, which is in favour of the broaden-and-build theory (Fredrickson, 2001).

## 8.2 Theoretical and Clinical Implications

Traditionally, attentional biases to threat have been considered a unique feature that distinguishes anxious from non-anxious populations (Mathews & Mackintosh, 1998; Mogg & Bradley, 1998; Williams et al., 1988). There are generally two ways to study attentional biases to threat: one is to examine how anxious individuals process threatening stimuli differently from non-anxious individuals (e.g., Mogg et al., 1995; Mogg et al., 1992), and the other is to induce a state of anxiety and examine how anxiety influences attentional processing of threatening stimuli in non-anxious individuals (e.g., Fox et al., 2001; Nelson et al., 2015). The underlying assumption is that anxious individuals are a homogenous group who likely exhibit the same attentional biases to threat. However, the current program of research challenged this assumption and highlighted the possibility that the link between anxiety and attentional biases is much more nuanced than we previously understood.

Individuals with the same level of anxiety displayed attentional biases in different directions and with various intensities. The relation between anxiety and attentional biases was modulated by one's motivation to approach and to avoid threat. There was a significant and consistent correspondence between approach motivation and facilitated attention towards threat, and between avoidance motivation and attentional avoidance of threat. Most importantly, not all anxious individuals endorsed the same motivational state: some were

engagers, others were avoiders; some were indifferent, others were ambivalent. Different motivational states predicted different types of attentional biases to threat. If we had not measured motivation, we would have concluded that anxious individuals are characterized by either facilitated attention towards threat or no attentional bias at all. Neither of these conclusions would have been accurate. In fact, the modulating effect of motivation on attentional biases might have explained the null and at times inconsistent findings in the current literature—a hypothesis that was raised by some researchers (e.g., Ahern et al., 2010; Werthmann et al., 2015). The heterogeneity of anxious individuals, whether in their motivational states or attentional biases to threat, has been largely ignored in current theories of anxiety. The nuanced relation between motivation, attentional biases, and anxiety calls for a more integrative model.

A two-factor model of motivation has been one of the most influential theories in psychological research: rewards elicit approach motivation and punishments elicit avoidance motivation. The hypothesis that approach and avoidance motivation are two distinct systems is rudimentary to many psychological theories (Fowles, 1987; Gray, 1970; Mogg & Bradley, 1998). Despite its many benefits, this theoretical view is dualistic in nature and does not leave space for approach motivation to interact with avoidance motivation. The current program of research challenged and further expanded the two-factor model of motivation in several ways. Firstly, not all anxious individuals are predominantly avoidant of threat. In fact, the majority of our samples were either indifferent (as in Study 1) or approaching (as in Study 2) in response to threat. Secondly, a subset of our participants was highly motivated to approach and to avoid threat at the same time. In fact, these ambivalent individuals reported greater anxiety than other participants. Lastly, approach and avoidance motivation were not necessarily opposite constructs. In fact, there was no significant correlation between approach and avoidance motivation in Study 1 and a weak-to-moderate negative correlation in Study 2.

Our results suggest that there are merits in examining the interaction between approach and avoidance motivation in the context of anxiety. Within a group of anxious individuals, some might endorse an ambivalent motivation towards threat and therefore experience greater and prolonged anxiety than others. Ambivalence can be an important factor in the process of diagnosis (i.e., determining who is likely to experience heightened anxiety) and prognosis (i.e., determining who is likely to have poorer response to exposure treatment). Hence, a new model is needed to account for the important role that ambivalence plays in the development and maintenance of anxiety. Current theories, on the other hand, are rather incomplete (e.g., Gray & McNaughton, 2000) or lack generalizability (e.g., Stroebe et al., 2008).

After decades of rigorous study, it is well established that mindfulness-based interventions are an effective treatment for anxiety disorders (e.g., Hofmann et al., 2010; Vollestad et al., 2012). Research has now moved beyond the efficacy of mindfulness and into the realm of identifying its underling mechanisms. Among many models that have been proposed to date, attention regulation appears to be the most promising account (Holzel et al., 2011). Our results continued to provide support to the hypothesis that attention is the "building block" for mindfulness training (Chambers, Lo, & Allen, 2008). For those who were narrowly focused, mountain meditation broadened their scope of conceptual attention and thought-action repertoires. Most critically, this broadening effect cannot be solely explained by relaxation. Hence, our results also confirmed the theory that relaxation is a secondary feature of mindfulness but not a mechanism of action (for a review, see Baer, 2003). The current research was one of the first studies to examine the broadening hypothesis as outlined in the mindfulness-to-meaning theory (Garland et al., 2015). Although our results were modest at best, it appeared that mindfulness is potentially effective in expanding one's scope of attention, which can lead to better problem solving and more positive mood state. One unique contribution of the mindfulness-to-meaning theory is that it offers a bridge

between traditional Buddhist teachings (e.g., the transient nature of suffering, a global outlook on life) and modern scientific research (e.g., attentional scope, cognitive processing of information). Our study is the first of many steps to validate and improve this theoretical account.

The current program of research has many implications for clinical practice in the domain of anxiety disorders. Based on our results, motivation, especially ambivalent motivation, plays a crucial role in the development and maintenance of anxiety. Currently, Cognitive Behavioural Therapy is considered the gold standard treatment for anxiety disorders (for a review, see Otte, 2011). Treatment usually involves intentionally exposing anxious individuals to their perceived threatening stimuli and challenging their maladaptive interpretations (for an example, see Antony & Norton, 2008). Our studies revealed that a brief exposure did not result in fear habituation for anxious individuals who were ambivalent about whether or not to approach or to avoid threat (as in Study 1). This might potentially explain the high dropout rate for anxious individuals receiving Cognitive Behavioural Therapy (Fernandez, Salem, Swift, & Ramtahal, 2015; Hofmann & Smits, 2008). These ambivalent individuals might benefit from a more integrative approach that combines traditional Cognitive Behavioural Therapy techniques (e.g., exposure) and therapies that address ambivalence, such as Motivational Interviewing (Rollnick & Miller, 2009; Rollnick, Miller, Butler, & Aloia, 2008).

In addition, self-reports of ambivalent motivation might be an effective screening tool for identifying individuals at risk for eating disorders. Ambivalent participants endorsed more restrained eating behaviours and greater thought-shape fusion than other restrained eaters (as in Study 2). Hence, clinicians can administer either the procedure utilized in the current research (i.e., presenting clients with images of high calorie food and asking for approach and

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avoidance motivation) or a simple self-report questionnaire (e.g., Experienced Ambivalence Towards Eating scale, as in Stroebe et al., 2008).

Lastly, for anxious clients who present with a very narrow focus of attention and struggle with seeing the bigger picture, clinicians might consider administering mindfulness practices that are designed to broaden one's scope of attention, such as mountain meditation (Kabat-Zinn, 2014). Even for other types of mindfulness practices such as breathing meditation, there might be some merits in emphasizing the need to go beyond one's own existence (e.g., switching from thoughts, feelings, and bodily sensations, to a greater environment, space, and time) and see suffering in a broader perspective (e.g., painful events are rather transient).

## 8.3 Limitations and Directions for Future Research

Despite the many strengths embodied in the current program of research, there were several limitations that warrant further discussion and offer directions for future research. Firstly, motivation to approach and to avoid threat was either measured during or after the eye-tracking task, not prior to the eye-tracking task. Hence, there is a possibility that motivation ratings were influenced by a variety of other variables. For example, participants might adjust their motivation ratings based on their perception of how they behaved in the task. Those who spent a greater proportion of time looking at threatening stimuli might have inferred that they were highly motivated to approach threat. Similarly, those who paid little attention to threatening stimuli might have inferred that they were highly motivated to avoid threat. Hence, our motivation ratings and eye movement data might have been correlated measures of attention, thus explaining the moderating effect of motivation on attentional biases to threat. Furthermore, participants might gauge their motivation ratings based on their levels of state anxiety. Those who were more anxious might have reported higher motivation to avoid

threat, whereas those who were less anxious might have reported higher motivation to approach threat. The current program of research revealed significant correlations between motivation, attentional biases to threat, and mood state. However, given our study design, we were unable to specify the direction of such relations. In order to overcome this limitation, future studies can measure motivational states *a priori* and see if baseline motivation predicts subsequent attentional biases and changes in state anxiety. Future studies can also manipulate motivational states using incentives and directly measure the impact of motivation on attentional bias and state anxiety.

Secondly, the current program of research heavily relied on self-report measures in selecting eligible participants. It is possible that some of our participants might not be as anxious as they indicated on the questionnaires. For example, some might tend to generalize their fear and over-endorse negative items (e.g., afraid of everything about spiders). Some participants, on the other hand, might be tempted to present in a way that is socially desirable (e.g., dieting is usually considered appealing amongst university students). In both cases, participants would have scored higher on the screening measures but might not have experienced heightened anxiety during the study. Nonetheless, we are confident that our screening procedures were sufficient for the purposes of the current research. We selected questionnaires that are the most commonly used to measure fear of spiders (for a review, see Muris & Merckelbach, 1996) and restrained eating (for a review, see Lowe & Thomas, 2009). Both measures (i.e., Fear of Spiders Questionnaire, and Restraint Scale) have been proven to have satisfactory psychometric properties (Klein et al., 2011; Szymanski & O'Donohue, 1995). In addition, the cut-off scores used in our studies were equivalent to if not stricter than those from past studies (Hollitt et al., 2010; Rinck & Becker, 2007; Siegel & Warren, 2013; Veenstra et al., 2010). However, we do recommend that future researchers include interview-based, more objective screening procedures to verify whether or not

participants are indeed highly anxious. Such measures might include the Anxiety and Related Disorder Interview Schedule (Brown & Barlow, 2014) for spider fear and the Eating Disorder Examination (Fairburn, 2008) for restrained eating.

There are some inherent limitations to the cognitive measures we adopted in the current program of research. In Study 1 and Study 2, attentional biases to threat were measured through tracking participants' eye movements. We encountered many technical difficulties with the iView X™ head-mounted eye-tracking system (SensoMotoric Instruments, 2009), including calibration problems, low tracking ratios, and significant loss of data. On the other hand, we had fewer problems with the EyeLink 1000™ desktop-mounted eye-tracking system (SR Research Ltd., 2015). Future researchers might want to carefully consider choosing between portable and stationary eye-tracking systems: the stationary one is generally more robust in tracking eye movements, whereas the portable one permits measuring eye movements in real-life environments. In addition, it should be noted that some eye movement indices are not as reliable as others. Waechter et al. (2013) found that the reliability of eye movement indices for first fixations is poor. To account for this limitation, we paid particular attention to the proportion of viewing time and conducted time-sequence analyses based on this index. In Study 3, we used the Navon Letter Task and the Categorization Task to measure the scope of perceptual and conceptual attention. One limitation of the Navon Letter Task is that most individuals demonstrate a global focus of perceptual attention and this global precedence effect is rather robust (Andres & Fernandes, 2006). Hence, the Navon Letter Task might have limited our ability to examine the extent to which different interventions influence the scope of perceptual attention.

The current program of research is also very narrow in its scope of coverage. Study 1 and Study 2 only explored the relation between motivation and attentional biases to threat in two discreet domains of anxiety, i.e., spider-related anxiety and eating-related anxiety. Our

results might or might not be generalizable to other types of anxiety, e.g., social anxiety, generalized anxiety, and specific phobia. More research is needed to replicate and extent our findings using different sets of stimuli and appropriate populations. Study 3 examined the impact of mindfulness meditation on three facets of attentional scope, i.e., perceptual attention, conceptual attention, and thought-action repertoires. Despite our insignificant results, it remains to be seen if other types of mindfulness practice such as breathing meditation and loving-kindness meditation might have the same or less influence on attentional scope. Future researchers can also consider using other tasks to measure attentional scope, such as the Flanker Task (Eriksen & Eriksen, 1974) and the Remote Associates Task (Rosch, 1975).

Lastly, we did not limit our participants to anxious individuals in Study 3, which might have contributed to our lack of significant findings. Our rationale for recruiting general populations was that there had been limited and contradictory evidence for the broadening effect of mindfulness and the current research aimed to clarify the exact impact of mindfulness on attentional scope. By not limiting our participants to a certain population, we were able to compare our results to those from other studies. However, as demonstrated in Study 3, most participants presented with a global focus of attention at baseline and mindfulness only broadened the scope of conceptual attention and thought-action repertoires for those who were narrowly focused at pre-test. This might explain the reason why findings on this topic have been largely inconsistent. We highly recommend future researchers to continue this line of research but limit their participants to those who are more likely to display a narrow focus of attention at baseline. For example, future studies might want to follow the approach of Xu et al. (2017) and recruit participants who are high in trait anxiety. There is a possibility that the broadening effect of mindfulness, as proposed by Garland et al.

(2015), is only present for anxious individuals who have difficulties expanding their narrow attentional scope.

**8.4 Conclusion**

In summary, the current program of research indicates that anxious individuals can be divided into different groups based on their motivation to approach and avoid threat, and different motivation groups may demonstrate different types of attentional biases to threat. In addition, anxious individuals with ambivalent motivation (i.e., high motivation to approach and to avoid threat at the same time) endorse greater and prolonged anxiety. Mindfulness, on the other hand, seems to have potentials in broadening the scope of attention for those individuals who have a narrow focus of attention at baseline. Compared to relaxation and control conditions, mindfulness practice is particularly helpful for improving problem solving in stressful scenarios. Combined, the current research highlights the important role that attentional processes play in the development and maintenance of anxiety. Our results suggest that ambivalent motivation might be the key to better understanding and reducing attentional biases and anxiety, while mindfulness training might offer a promising approach to broadening the scope of attention. These findings provide important implications to both theoretical research and clinical practice in the area of anxiety disorders.

# References

Ahern, A. L., Field, M., Yokum, S., Bohon, C., & Stice, E. (2010). Relation of dietary restraint scores to cognitive biases and reward sensitivity. *Appetite, 55*(1), 61-68. doi:10.1016/j.appet.2010.04.001

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

Amir, N., Elias, J., Klumpp, H., & Przeworski, A. (2003). Attentional bias to threat in social phobia: facilitated processing of threat or difficulty disengaging attention from threat? *Behaviour Research and Therapy, 41*(11), 1325-1335. doi:10.1016/s0005-7967(03)00039-1

Anderson, B. (2011). There is no Such Thing as Attention. *Front Psychol, 2*, 246. doi:10.3389/fpsyg.2011.00246

Andersson, G., Waara, J., Jonsson, U., Malmaeus, F., Carlbring, P., & Ost, L. G. (2009). Internet-based self-help versus one-session exposure in the treatment of spider phobia: a randomized controlled trial. *Cogn Behav Ther, 38*(2), 114-120. doi:10.1080/16506070902931326

Andres, A. J., & Fernandes, M. A. (2006). Effect of short and long exposure duration and dual-tasking on a global-local task. *Acta Psychol (Amst), 122*(3), 247-266. doi:10.1016/j.actpsy.2005.12.002

Antony, M. M., & Norton, P. J. (2008). *The anti-anxiety workbook: Proven strategies to overcome worry, phobias, panic, and obsessions.* New York: Guilford Press.

Arch, J. J., Ayers, C. R., Baker, A., Almklov, E., Dean, D. J., & Craske, M. G. (2013). Randomized clinical trial of adapted mindfulness-based stress reduction versus group cognitive behavioral therapy for heterogeneous anxiety disorders. *Behaviour Research and Therapy, 51*(4-5), 185-196. doi:10.1016/j.brat.2013.01.003

Arch, J. J., Eifert, G. H., Davies, C., Vilardaga, J. C. P., Rose, R. D., & Craske, M. G. (2012). Supplemental material for randomized clinical trial of Cognitive Behavioral Therapy (CBT) versus Acceptance and Commitment Therapy (ACT) for mixed anxiety disorders. *Journal of Consulting and Clinical Psychology, 80*(5), 750-765. doi:10.1037/a0028310.supp

Armstrong, T., & Olatunji, B. O. (2013). Eye tracking of attention in the affective disorders: A meta-analytic review and synthesis. *Clinical Psychology Review, 32*(8), 704-723. doi:10.1016/j.cpr.2012.09.004

Baer, R. A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Clinical Psychology: Science and Practice, 10*(2), 125-143. doi:10.1093/clipsy.bpg015

Bar-Haim, Y. (2010). Research review: Attention bias modification (ABM): a novel treatment for anxiety disorders. *J Child Psychol Psychiatry, 51*(8), 859-870. doi:10.1111/j.1469-7610.2010.02251.x

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: a meta-analytic study. *Psychological Bulletin, 133*(1), 1-24. doi:10.1037/0033-2909.133.1.1

Barry, T. J., Vervliet, B., & Hermans, D. (2015). An integrative review of attention biases and their contribution to treatment for anxiety disorders. *Front Psychol, 6*, 968. doi:10.3389/fpsyg.2015.00968

Bateson, M., Brilot, B., & Nettle, D. (2011). Anxiety: An evolutionary approach. *Canadian Journal of Psychiatry, 56*(12), 707-715. doi:10.1177/070674371105601202

Baxter, A. J., Scott, K. M., Vos, T., & Whiteford, H. A. (2013). Global prevalence of anxiety disorders: a systematic review and meta-regression. *Psychol Med, 43*(5), 897-910. doi:10.1017/S003329171200147X

Baxter, A. J., Vos, T., Scott, K. M., Ferrari, A. J., & Whiteford, H. A. (2014). The global burden of anxiety disorders in 2010. *Psychol Med, 44*(11), 2363-2374. doi:10.1017/S0033291713003243

Beck, A. T., & Clark, D. A. (1997). An information processing model of anxiety: automatic and strategic processes. *Behav Res Ther, 35*(1), 49-58. doi:10.1016/S0005-7967(96)00069-1

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., . . . Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice, 11*(3), 230-241. doi:10.1093/clipsy.bph077

Blanchard, R. J., & Blanchard, D. C. (1990). Anti-predator defense as models of animal fear and anxiety. In P. F. Brain, S. Parmigiani, R. J. Blanchard, & D. Mainardi (Eds.), *Fear and Defence* (pp. 89-108). Chur: Harwood Academic Publishers.

Blechert, J., Meule, A., Busch, N. A., & Ohla, K. (2014). Food-pics: an image database for experimental research on eating and appetite. *Front Psychol, 5*, 617. doi:10.3389/fpsyg.2014.00617

Bodhi, B. (2011). What does mindfulness really mean? A canonical perspective. *Contemporary Buddhism, 12*(1), 19-39. doi:10.1080/14639947.2011.564813

Braboszcz, C., Cahn, B. R., Balakrishnan, B., Maturi, R. K., Grandchamp, R., & Delorme, A. (2013). Plasticity of visual attention in Isha yoga meditation practitioners before and after a 3-month retreat. *Front Psychol, 4*, 914. doi:10.3389/fpsyg.2013.00914

Brooks, S., Prince, A., Stahl, D., Campbell, I. C., & Treasure, J. (2011). A systematic review and meta-analysis of cognitive bias to food stimuli in people with disordered eating behaviour. *Clin Psychol Rev, 31*(1), 37-51. doi:10.1016/j.cpr.2010.09.006

Brown, T. A., & Barlow, D. H. (2014). *Anxiety and related disorders interview schedule for DSM-5 (ADIS-5) - adult and lifetime version: Clinician manual*. New York: Oxford University Press.

Browning, M., Holmes, E. A., & Harmer, C. J. (2010). The modification of attentional bias to emotional information: A review of the techniques, mechanisms, and relevance to emotional disorders. *Cogn Affect Behav Neurosci, 10*(1), 8-20. doi:10.3758/CABN.10.1.8

Browning, M., Reid, C., Cowen, P. J., Goodwin, G. M., & Harmer, C. J. (2007). A single dose of citalopram increases fear recognition in healthy subjects. *J Psychopharmacol, 21*(7), 684-690. doi:10.1177/0269881106074062

Bryant, R. A., & Harvey, A. G. (1995). Processing threatening information in posttraumatic stress disorder. *J Abnorm Psychol, 104*(3), 537-541.

Buckley, T. C., Blanchard, E. B., & Hickling, E. J. (2002). Automatic and strategic processing of threat stimuli: A comparison between PTSD, panic disorder, and non-anxiety controls. *Cognitive Therapy and Research, 26*(1), 97-115.

Calvo, M. G., & Avero, P. (2005). Time course of attentional bias to emotional scenes in anxiety: Gaze direction and duration. *Cognition & Emotion, 19*(3), 433-451. doi:10.1080/02699930441000157

Caparos, S., & Linnell, K. J. (2012). Trait anxiety focuses spatial attention. *Emotion, 12*(1), 8-12. doi:10.1037/a0026310

Chambers, R., Lo, B. C. Y., & Allen, N. B. (2008). The impact of intensive mindfulness training on attentional control, cognitive style, and affect. *Cognitive Therapy and Research, 32*(3), 303-322. doi:10.1007/s10608-007-9119-0

Chan, D., & Woollacott, M. (2007). Effects of level of meditation experience on attentional focus: is the efficiency of executive or orientation networks improved? *Journal of Alternative and Complementary Medicine, 13*(6), 651-657. doi:10.1089/acm.2007.7022

Chen, M., & Bargh, J. A. (1999). Consequences of automatic evaluation: Immediate behavioral predispositions to approach or avoid the stimulus. *personality and social Psychology Bulletin, 25*(2), 215-224.

Cisler, J. M., Bacon, A. K., & Williams, N. L. (2009). Phenomenological Characteristics of Attentional Biases Towards Threat: A Critical Review. *Cognit Ther Res, 33*(2), 221-234. doi:10.1007/s10608-007-9161-y

Cisler, J. M., & Koster, E. H. (2010). Mechanisms of attentional biases towards threat in anxiety disorders: An integrative review. *Clin Psychol Rev, 30*(2), 203-216. doi:10.1016/j.cpr.2009.11.003

Cisler, J. M., & Olatunji, B. O. (2010). Components of attentional biases in contamination fear: evidence for difficulty in disengagement. *Behav Res Ther, 48*(1), 74-78. doi:10.1016/j.brat.2009.09.003

Coelho, J. S., Baeyens, C., Purdon, C., Pitet, A., & Bouvard, M. (2012). Cognitive distortions and eating pathology: specificity of thought-shape fusion. *Behav Res Ther, 50*(7-8), 449-456. doi:10.1016/j.brat.2012.04.003

Coelho, J. S., Baeyens, C., Purdon, C., Shafran, R., Roulin, J. L., & Bouvard, M. (2013). Assessment of thought-shape fusion: initial validation of a short version of the trait thought-shape fusion scale. *International Journal of Eating Disorders, 46*(1), 77-85. doi:10.1002/eat.22038

Coelho, J. S., Wilson, S., Winslade, A., Thaler, L., Israel, M., & Steiger, H. (2014). Over-evaluation of thoughts about food: Differences across eating-disorder subtypes and a preliminary examination of treatment effects. *International Journal of Eating Disorders, 47*(3), 302-309. doi:10.1002/eat.22207

Colzato, L. S., van der Wel, P., Sellaro, R., & Hommel, B. (2016). A single bout of meditation biases cognitive control but not attentional focusing: Evidence from the global-local task. *Consciousness and Cognition, 39*, 1-7. doi:10.1016/j.concog.2015.11.003

Crawford, J. R., & Henry, J. D. (2004). The positive and negative affect schedule (PANAS): Construct validity, measurement properties and normative data in a large non-clinical sample. *British Journal of Clinical Psychology, 43*(Pt 3), 245-265.

D'Andrea, W., & Pole, N. (2012). A naturalistic study of the relation of psychotherapy process to changes in symptoms, information processing, and physiological activity in complex trauma. *Psychological Trauma: Theory, Research, Practice, and Policy, 4*(4), 438-446. doi:10.1037/a0025067

Dane, E. (2010). Paying attention to mindfulness and its effects on task performance in the workplace. *Journal of Management, 37*(4), 997-1018. doi:10.1177/0149206310367948

Davidson, R. J., Ekman, P., Saron, C. D., Senulis, J. A., & Friesen, W. V. (1990). Approach-withdrawal and cerebral asymmetry: emotional expression and brain physiology. I. *J Pers Soc Psychol, 58*(2), 330-341.

Derryberry, D., & Reed, M. A. (1998). Anxiety and attentional focusing: Trait, state and hemispheric influences. *Personality and Individual Differences, 25*(4), 745-761. doi:10.1016/s0191-8869(98)00117-2

Dobson, K. S., & Dozois, D. J. A. (2004). Attentional biases in eating disorders: A meta-analytic review of Stroop performance. *Clinical Psychology Review, 23*(8), 1001-1022. doi:10.1016/j.cpr.2003.09.004

Dreyfus, G. (2011). Is mindfulness present-centred and non-judgmental? A discussion of the cognitive dimensions of mindfulness. *Contemporary Buddhism, 12*(1), 41-54. doi:10.1080/14639947.2011.564815

Dunning, J. P., & Hajcak, G. (2009). See no evil: directing visual attention within unpleasant images modulates the electrocortical response. *Psychophysiology, 46*(1), 28-33. doi:10.1111/j.1469-8986.2008.00723.x

Easterbrook, J. A. (1959). The effect of emotion on cue utilization and the organization of behavior. *Psychological Review, 66*(3), 183-201. doi:10.1037/h0047707

Eastwood, J., Smile, D., Oakman, J., Farvolden, P., van Ameringen, M., Mancini, C., & Merikle, P. (2005). Individuals with social phobia are biased to become aware of negative faces. *Visual Cognition, 12*(1), 159-179. doi:10.1080/13506280444000175

Elliot, A. J., & Thrash, T. M. (2002). Approach-avoidance motivation in personality: approach and avoidance temperaments and goals. *J Pers Soc Psychol, 82*(5), 804-818. doi:10.1037/0022-3514.82.5.804

Eriksen, B. A., & Eriksen, C. W. (1974). Effects of noise letters upon the identification of a target letter in a nonsearch task. *Perception & Psychophysics, 16*(1), 143-149.

Eysenck, M. W. (1992). *Anxiety: The cognitive perspective*. Hove, England: Psychology Press.

Eysenck, M. W. (1997). *Anxiety and cognition: A unified theory*. Hove, England: Psychology Press.

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: attentional control theory. *Emotion, 7*(2), 336-353. doi:10.1037/1528-3542.7.2.336

Fairburn, C. G. (2008). *Cognitive behavior therapy and eating disorders*. New York: Guilford press.

Fairburn, C. G., Cooper, P. J., Cooper, M. J., McKenna, F. P., & Anastasiades, P. (1991). Selective information processing in bulimia nervosa. *International Journal of Eating Disorders, 10*(4), 415-422. doi:10.1002/1098-108x(199107)10:4<415::aid-eat2260100406>3.0.co;2-r

Fayet, F., Petocz, P., & Samman, S. (2012). Prevalence and correlates of dieting in college women: a cross sectional study. *Int J Womens Health, 4*, 405-411. doi:10.2147/IJWH.S33920

Feldman, G., Greeson, J., & Senville, J. (2010). Differential effects of mindful breathing, progressive muscle relaxation, and loving-kindness meditation on decentering and negative reactions to repetitive thoughts. *Behaviour Research and Therapy, 48*(10), 1002-1011. doi:10.1016/j.brat.2010.06.006

Fenske, M. J., & Eastwood, J. D. (2003). Modulation of focused attention by faces expressing emotion: Evidence from flanker tasks. *Emotion, 3*(4), 327-343. doi:10.1037/1528-3542.3.4.327

Fernandez, E., Salem, D., Swift, J. K., & Ramtahal, N. (2015). Meta-analysis of dropout from cognitive behavioral therapy: Magnitude, timing, and moderators. *J Consult Clin Psychol, 83*(6), 1108-1122. doi:10.1037/ccp0000044

Feuille, M., & Pargament, K. (2015). Pain, mindfulness, and spirituality: A randomized controlled trial comparing effects of mindfulness and relaxation on pain-related outcomes in migraineurs. *J Health Psychol, 20*(8), 1090-1106. doi:10.1177/1359105313508459

Finucane, A. M. (2011). The effect of fear and anger on selective attention. *Emotion, 11*(4), 970-974. doi:10.1037/a0022574

Finucane, A. M., & Power, M. J. (2010). The effect of fear on attentional processing in a sample of healthy females. *Journal of Anxiety Disorders, 24*(1), 42-48. doi:10.1016/j.janxdis.2009.08.005

Foa, E., & McNally, R. (1986). Sensitivity to feared stimuli in obsessive-compulsives: A dichotic listening analysis. *Cognitive Therapy and Research, 10*(4), 477-485. doi:10.1007/BF01173299

Förster, J., Friedman, R. S., Özelsel, A., & Denzler, M. (2006). Enactment of approach and avoidance behavior influences the scope of perceptual and conceptual attention. *Journal of Experimental Social Psychology, 42*(2), 133-146. doi:10.1016/j.jesp.2005.02.004

Fowles, D. C. (1987). Psychophysiology and psychopathology: A motivational approach. *Psychophysiology, 25*(4), 373-391.

Fox, E. (1993). Attentional bias in anxiety: selective or not? *Behav Res Ther, 31*(5), 487-493.

Fox, E. (2004). Maintenance or capture of attention in anxiety-related biases? In J. Yiend (Ed.), *Cognition, emotion, and psychopathol- ogy: Theoretical, empirical and clinical directions* (pp. 86-105). New York: Cambridge University Press.

Fox, E., Russo, R., Bowles, R., & Dutton, K. (2001). Do threatening stimuli draw or hold visual attention in subclinical anxiety? *Journal of Experimental Psychology: General, 130*(4), 681-700. doi:10.1037/0096-3445.130.4.681

Fredrickson, B. L. (1998). What good are positive emotions? *Review of General Psychology, 2*(3), 300-319.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology. The broaden-and-build theory of positive emotions. *Am Psychol, 56*(3), 218-226. doi:10.1037//0003-066X.56.3.218

Fredrickson, B. L., & Branigan, C. (2005). Positive emotions broaden the scope of attention and thought-action repertoires. *Cognition and Emotion, 19*(3), 313-332. doi:10.1080/02699930441000238

Friedman, R. S., & Förster, J. (2010). Implicit affective cues and attentional tuning: An integrative review. *Psychological Bulletin, 136*(5), 875-893. doi:10.1037/a0020495

Gable, P., & Harmon-Jones, E. (2010). The blues broaden, but the nasty narrows: Attentional consequences of negative affects low and high in motivational intensity. *Psychological Science, 21*(2), 211-215. doi:10.1177/0956797609359622

Gamble, A. L., & Rapee, R. M. (2010). The time-course of attention to emotional faces in social phobia. *Journal of Behavior Therapy and Experimental Psychiatry, 41*(1), 39-44. doi:10.1016/j.jbtep.2009.08.008

Garland, E. L., Farb, N. A., Goldin, P., & Fredrickson, B. L. (2015). Mindfulness broadens awareness and builds eudaimonic meaning: A process model of mindful positive emotion regulation. *Psychological Inquiry, 26*(4), 293-314. doi:10.1080/1047840X.2015.1064294

Garland, E. L., Gaylord, S. A., & Fredrickson, B. L. (2011). Positive reappraisal mediates the stress-reductive effects of mindfulness: An upward spiral process. *Mindfulness, 2*(1), 59-67. doi:10.1007/s12671-011-0043-8

Gilboa-Schechtman, E., Foa, E. B., & Amir, N. (1999). Attentional biases for facial expressions in social phobia: The face-in-the-crowd paradigm. *Cognition and Emotion, 13*(3), 305-318.

Gray, J. A. (1970). The psychophysiological basis of introversion-extroversion. *Behaviour Research & Therapy, 8*, 249-266.

Gray, J. A., & McNaughton, N. (2000). *The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system* (2nd ed.). Oxford: Oxford University Press.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. (1998). Measuring individual differences in implicit cognition: the implicit association test. *J Pers Soc Psychol, 74*(6), 1464-1480.

Gross, J. J. (1998). The emerging field of emotion regulation: An integrated review. *Review of General Psychology, 2*(3), 271-299.

Guilford, J. P. (1967). *The nature of human intelligence*. New York, NY: McGraw-Hill.

Hayes, S. C., Strosahl, K. D., & Wilson, K. G. (1999). *Acceptance and commitment therapy*. New York: Guilford Press.

Heatherton, T. F., Herman, C. P., Polivy, J., King, G. A., & McGree, S. T. (1988). The (mis)measurement of restraint: an analysis of conceptual and psychometric issues. *J Abnorm Psychol, 97*(1), 19-28.

Herman, C. P., & Polivy, J. (1975). Anxiety, restraint, and eating behavior. *Journal of Abnormal Psychology, 84*, 666-672.

Hermans, D., Vansteenwegen, D., & Eelen, P. (1999). Eye movement registration as a continuous index of attention deployment: Data from a group of a spider anxious students. *Cognition and Emotion, 13*(4), 419-434.

Hofmann, S. G., Sawyer, A. T., Witt, A. A., & Oh, D. (2010). The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. *Journal of Consulting and Clinical Psychology, 78*(2), 169-183. doi:10.1037/a0018555

Hofmann, S. G., & Smits, J. A. J. (2008). Cognitive-behavioural therapy for adult anxiety disorders: A meta-analysis of randomized placebo-controlled trials. *Journal of Clinical Psychiatry, 69*(4), 621-632.

Hollitt, S., Kemps, E., Tiggemann, M., Smeets, E., & Mills, J. S. (2010). Components of attentional bias for food cues among restrained eaters. *Appetite, 54*(2), 309-313. doi:10.1016/j.appet.2009.12.005

Holzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., & Ott, U. (2011). How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspectives on Psychological Science, 6*(6), 537-559. doi:10.1177/1745691611419671

Huntsinger, J. R. (2013). Does emotion directly tune the scope of attention? *Current Directions in Psychological Science, 22*(4), 265-270. doi:10.1177/0963721413480364

Isen, A. M., & Daubman, K. A. (1984). The influence of affect on categorization. *Journal of Personality and Social Psychology, 47*(6), 1206-1217.

Jacobson, E. (1938). *Progressive relaxation: A physiological and clinical investigation of muscular state and their significance*. Chicago: University of Chicago Press.

Johnson, D. R. (2009). Goal-directed attentional deployment to emotional faces and individual differences in emotional regulation. *Journal of research in personality, 43*(1), 8-13. doi:10.1016/j.jrp.2008.09.006

Johnson, S., Gur, R., David, Z., & Currier, E. (2013). One-session mindfulness meditation: A randomized controlled study of effects on cognition and mood. *Mindfulness*, 1-11. doi:10.1007/s12671-013-0234-6

Kabat-Zinn, J. (1990). *Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness*. New York: Delta Trade Paperbacks.

Kabat-Zinn, J. (1994). *Wherever you go, there you are: Mindfulness meditation in everyday life*. New York: Hyperion.

Kabat-Zinn, J. (2014). Guided mindfulness meditation series 2. Louisville, CO: Sounds True.

Kakoschke, N., Kemps, E., & Tiggemann, M. (2015). Combined effects of cognitive bias for food cues and poor inhibitory control on unhealthy food intake. *Appetite, 87*, 358-364. doi:10.1016/j.appet.2015.01.004

Kamphuis, J. H., & Telch, M. J. (2000). Effects of distraction and guided threat reappraisal on fear reduction during exposure-based treatments for specific fears. *Behaviour Research and Therapy, 38*(12), 1163-1181. doi:10.1016/s0005-7967(99)00147-3

Kashdan, T. B., Adams, L., Read, J., & Hawk, L., Jr. (2012). Can a one-hour session of exposure treatment modulate startle response and reduce spider fears? *Psychiatry Res, 196*(1), 79-82. doi:10.1016/j.psychres.2011.12.002

Kemps, E., & Tiggemann, M. (2009). Attentional bias for craving-related (chocolate) food cues. *Exp Clin Psychopharmacol, 17*(6), 425-433. doi:10.1037/a0017796

Kemps, E., Tiggemann, M., Martin, R., & Elliott, M. (2013). Implicit approach-avoidance associations for craved food cues. *J Exp Psychol Appl, 19*(1), 30-38. doi:10.1037/a0031626

Kerestes, R., Labuschagne, I., Croft, R. J., O'Neill, B. V., Bhagwagar, Z., Phan, K. L., & Nathan, P. J. (2009). Evidence for modulation of facial emotional processing bias during emotional expression decoding by serotonergic and noradrenergic antidepressants: an event-related potential (ERP) study. *Psychopharmacology (Berl), 202*(4), 621-634. doi:10.1007/s00213-008-1340-3

Klein, A. M., Becker, E. S., & Rinck, M. (2011). Approach and Avoidance Tendencies in Spider Fearful Children: The Approach-Avoidance Task. *J Child Fam Stud, 20*(2), 224-231. doi:10.1007/s10826-010-9402-7

Koster, E. H., Crombez, G., Verschuere, B., & De Houwer, J. (2004). Selective attention to threat in the dot probe paradigm: differentiating vigilance and difficulty to disengage. *Behav Res Ther, 42*(10), 1183-1192. doi:10.1016/j.brat.2003.08.001

Koster, E. H., Crombez, G., Verschuere, B., Van Damme, S., & Wiersema, J. R. (2006). Components of attentional bias to threat in high trait anxiety: Facilitated engagement, impaired disengagement, and attentional avoidance. *Behav Res Ther, 44*(12), 1757-1771. doi:10.1016/j.brat.2005.12.011

Kramer, R. S. S., Weger, U. W., & Sharma, D. (2013). The effect of mindfulness meditation on time perception. *Consciousness and Cognition, 22*(3), 846-852. doi:10.1016/j.concog.2013.05.008

Kuhn, M. H., & McPartland, T. S. (1954). An empirical investigation of self-attitudes. *American Sociological Review, 19*(1), 68-76.

Lavy, E., van den Hout, M., & Arntz, A. (1993). Attentional bias and spider phobia: conceptual and clinical issues. *Behav Res Ther, 31*(1), 17-24.

Linehan, M. (1993). *Cognitive-behavioral treatment of borderline personality disorder*. New York: Guilford Press.

Lowe, M. R., & Thomas, J. G. (2009). Measures of restrained eating: Conceptual evolution and psychmetric update. In D. B. Allison & M. L. Baskin (Eds.), *Handbook of assessment methods for eating behaviors and weight-related problems* (2nd ed.). Los Angeles, CA: Sage Publications, Inc.

MacLeod, C., & Mathews, A. (1988). Anxiety and the allocation of attention to threat. *Quarterly Journal of Experimental Psychology, 40*, 653-670.

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 95*(1), 15-20. doi:10.1037/0021-843X.95.1.15

Marguc, J., Forster, J., & Van Kleef, G. A. (2011). Stepping back to see the big picture: When obstacles elicit global processing. *Journal of Personality and Social Psychology, 101*(5), 883-901. doi:10.1037/a0025013

Mathews, A., & Mackintosh, B. (1998). Cognitive model of selective processing in anxiety. *Cognitive Therapy and Research, 22*(6), 539-560. doi:0147-5916/98/1200-0539$15.00/0

Mathews, A., Mogg, K., Kentish, J., & Eysenck, M. (1995). Effect of psychological treatment on cognitive bias in generalized anxiety disorder. *Behav Res Ther, 33*(3), 293-303.

McIntosh, W. D. (1997). East meets West: Parallels between Zen Buddhism and social psychology. *International Journal for the Psychology of Religion, 7*(1), 37-52. doi:10.1207/s15327582ijpr0701_5

McNaughton, N., & Gray, J. A. (2000). Anxiolytic action on the behavioural inhibition system implies multiple types of arousal contribute to anxiety. *J Affect Disord, 61*(3), 161-176.

Mikulincer, M., Kedem, P., & Paz, D. (1990). Anxiety and categorization-1. The structure and boundaries of mental categories. *Personality and Individual Differences, 11*(8), 805-814.

Mikulincer, M., Paz, D., & Kedem, P. (1990). Anxiety and categorization-2. Hierarchical levels of mental categories. *Personality and Individual Differences, 11*(8), 815-821.

Minor, H. G., Carlson, L. E., Mackenzie, M. J., Zernicke, K., & Jones, L. (2006). Evaluation of a Mindfulness-Based Stress Reduction (MBSR) program for caregivers of children with chronic conditions. *Soc Work Health Care, 43*(1), 91-109. doi:10.1300/J010v43n01_06

Mogg, K., & Bradley, B. P. (1998). A cognitive-motivational analysis of anxiety. *Behav Res Ther, 36*(9), 809-848.

Mogg, K., & Bradley, B. P. (2005). Attentional Bias in Generalized Anxiety Disorder Versus Depressive Disorder. *Cognitive Therapy and Research, 29*(1), 29-45. doi:10.1007/s10608-005-1646-y

Mogg, K., & Bradley, B. P. (2006). Time course of attentional bias for fear-relevant pictures in spider-fearful individuals. *Behav Res Ther, 44*(9), 1241-1250. doi:10.1016/j.brat.2006.05.003

Mogg, K., Bradley, B. P., & Williams, R. (1995). Attentional bias in anxiety and depression: the role of awareness. *Br J Clin Psychol, 34 ( Pt 1)*(1), 17-36.

Mogg, K., Garner, M., & Bradley, B. P. (2007). Anxiety and orienting of gaze to angry and fearful faces. *Biological Psychology, 76*(3), 163-169. doi:10.1016/j.biopsycho.2007.07.005

Mogg, K., Mathews, A., & Eysenck, M. (1992). Attentional bias to threat in clinical anxiety states. *Cognition & Emotion, 6*(2), 149-159.

Moore, A., & Malinowski, P. (2009). Meditation, mindfulness and cognitive flexibility. *Consciousness and Cognition, 18*(1), 176-186. doi:10.1016/j.concog.2008.12.008

Muris, P., & Merckelbach, H. (1996). A comparison of two spider fear questionnaires. *Journal of Behavior Therapy and Experimental Psychiatry, 27*(3), 241-244.

Murphy, S. E., Yiend, J., Lester, K. J., Cowen, P. J., & Harmer, C. J. (2009). Short-term serotonergic but not noradrenergic antidepressant administration reduces attentional vigilance to threat in healthy volunteers. *Int J Neuropsychopharmacol, 12*(2), 169-179. doi:10.1017/S1461145708009164

Najmi, S., Kuckertz, J. M., & Amir, N. (2012). Attentional impairment in anxiety: Inefficiency in expanding the scope of attention. *Depression and Anxiety, 29*(3), 243-249. doi:10.1002/da.20900

Navon, D. (1977). Forest before trees: The precedence of global features in visual perception. *Cognitive Psychology, 9*, 353-383.

Nelson, A. L., Purdon, C., Quigley, L., Carriere, J., & Smilek, D. (2014). Distinguishing the roles of trait and state anxiety on the nature of anxiety-related attentional biases to threat using a free viewing eye movement paradigm. *Cogn Emot*, 1-23. doi:10.1080/02699931.2014.922460

Nelson, A. L., Purdon, C., Quigley, L., Carriere, J., & Smilek, D. (2015). Distinguishing the roles of trait and state anxiety on the nature of anxiety-related attentional biases to threat using a free viewing eye movement paradigm. *Cogn Emot, 29*(3), 504-526. doi:10.1080/02699931.2014.922460

Nijs, I. M., Muris, P., Euser, A. S., & Franken, I. H. (2010). Differences in attention to food and food intake between overweight/obese and normal-weight females under conditions of hunger and satiety. *Appetite, 54*(2), 243-254. doi:10.1016/j.appet.2009.11.004

Ohman, A. (2005). The role of the amygdala in human fear: automatic detection of threat. *Psychoneuroendocrinology, 30*(10), 953-958. doi:10.1016/j.psyneuen.2005.03.019

Ohman, A., Flykt, A., & Esteves, F. (2001). Emotion drives attention: detecting the snake in the grass. *J Exp Psychol Gen, 130*(3), 466-478. doi:10.1037/AXJ96-3445.130.3.466

Ohman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: toward an evolved module of fear and fear learning. *Psychol Rev, 108*(3), 483-522.

Otte, C. (2011). Cognitive behavioural therapy in anxiety disorders: Current state of the evidence. *Dialogues in Clinical Neuroscience, 13*(4), 413-421.

Papies, E. K., Stroebe, W., & Aarts, H. (2008). The allure of forbidden food: On the role of attention in self-regulation. *Journal of Experimental Social Psychology, 44*(5), 1283-1292. doi:10.1016/j.jesp.2008.04.008

Paulitzki, J. R., Risko, E. F., Oakman, J. M., & Stolz, J. A. (2008). Doing the unpleasant: How the emotional nature of a threat-relevant task affects task-switching. *Personality and Individual Differences, 45*(5), 350-355. doi:10.1016/j.paid.2008.05.003

Phaf, R. H., & Kan, K. J. (2007). The automaticity of emotional Stroop: a meta-analysis. *J Behav Ther Exp Psychiatry, 38*(2), 184-199. doi:10.1016/j.jbtep.2006.10.008

Phaf, R. H., Mohr, S. E., Rotteveel, M., & Wicherts, J. M. (2014). Approach, avoidance, and affect: a meta-analysis of approach-avoidance tendencies in manual reaction time tasks. *Front Psychol, 5*, 378. doi:10.3389/fpsyg.2014.00378

Pishyar, R., Harris, L. M., & Menzies, R. G. (2008). Responsiveness of measures of attentional bias to clinical change in social phobia. *Cognition & Emotion, 22*(7), 1209-1227. doi:10.1080/02699930701686008

Pittig, A., Brand, M., Pawlikowski, M., & Alpers, G. W. (2014). The cost of fear: avoidant decision making in a spider gambling task. *J Anxiety Disord, 28*(3), 326-334. doi:10.1016/j.janxdis.2014.03.001

Polivy, J., Herman, C. P., & Warsh, S. (1978). Internal and external components of emotionality in restrained and unrestrained eaters. *Journal of Abnormal Psychology, 87*(5), 497-504.

Posner, M. I. (1980). Orienting of attention. *Quarterly Journal of Experimental Psychology, 32*(1), 3-25.

Price, T. F., & Harmon-Jones, E. (2010). The effect of embodied emotive states on cognitive categorization. *Emotion, 10*(6), 934-938. doi:10.1037/a0019809

Psychology Software Tools, I. (2007). E-prime 2.0 Professional. Pittsburgh: Psychology Software Tools, Inc.

Quigley, L., Nelson, A. L., Carriere, J., Smilek, D., & Purdon, C. (2012). The effects of trait and state anxiety on attention to emotional images: An eye-tracking study. *Cognition and Emotion, 26*(8), 1390-1411. doi:10.1080/02699931.2012.662892

Rachman, S. (1993). Obsessions, responsibility and guilt. *Behaviour Research & Therapy, 31*(2), 149-154. doi:10.1016/0005-7967(93)90066-4

Rachman, S. (2004). *Anxiety* (2nd ed.). Hove: Psychology Press.

Richeson, J. A., & Trawalter, S. (2008). The threat of appearing prejudiced and race-based attentional biases. *Psychol Sci, 19*(2), 98-102. doi:10.1111/j.1467-9280.2008.02052.x

Rinck, M., & Becker, E. S. (2006). Spider fearful individuals attend to threat, then quickly avoid it: evidence from eye movements. *J Abnorm Psychol, 115*(2), 231-238. doi:10.1037/0021-843X.115.2.231

Rinck, M., & Becker, E. S. (2007). Approach and avoidance in fear of spiders. *J Behav Ther Exp Psychiatry, 38*(2), 105-120. doi:10.1016/j.jbtep.2006.10.001

Rinck, M., Becker, E. S., Kellermann, J., & Roth, W. T. (2003). Selective attention in anxiety: distraction and enhancement in visual search. *Depress Anxiety, 18*(1), 18-28. doi:10.1002/da.10105

Rinck, M., Reinecke, A., Ellwart, T., Heuer, K., & Becker, E. S. (2005). Speeded detection and increased distraction in fear of spiders: evidence from eye movements. *J Abnorm Psychol, 114*(2), 235-248. doi:10.1037/0021-843X.114.2.235

Robertson, I. H., Manly, T., Andrade, J., Baddeley, B. T., & Yiend, J. (1997). `Oops!': Performance correlates of everyday attentional failures in traumatic brain injured and normal subjects. *Neuropsychologia, 35*(6), 747-758. doi:10.1016/s0028-3932(97)00015-8

Roemer, L., Williston, S. K., Eustis, E. H., & Orsillo, S. M. (2013). Mindfulness and acceptance-based behavioral therapies for anxiety disorders. *Curr Psychiatry Rep, 15*(11), 410. doi:10.1007/s11920-013-0410-3

Rollnick, S., & Miller, W. R. (2009). What is Motivational Interviewing? *Behavioural and Cognitive Psychotherapy, 23*(4), 325-334. doi:10.1017/S135246580001643X

Rollnick, S., Miller, W. R., Butler, C. C., & Aloia, M. S. (2008). Motivational Interviewing in Health Care: Helping Patients Change Behavior. *COPD: Journal of Chronic Obstructive Pulmonary Disease, 5*(3), 203-203. doi:10.1080/15412550802093108

Rosch, E. (1975). Cognitive representations of semantic categories. *Journal of Experimental Psychology: General, 104*(3), 192-233.

Schlund, M. W., Brewer, A. T., Magee, S. K., Richman, D. M., Solomon, S., Ludlum, M., & Dymond, S. (2016). The tipping point: Value differences and parallel dorsal-ventral frontal circuits gating human approach-avoidance behavior. *NeuroImage, 136*, 94-105. doi:10.1016/j.neuroimage.2016.04.070

Segal, Z. V., Williams, J. M. G., & Teasdale, J. D. (2002). *Mindfulness-based cognitive therapy for depression: A new approach to preventing relapse* (2nd ed.). New York: Guilford Press.

Seli, P., Carriere, J. S., & Smilek, D. (2015). Not all mind wandering is created equal: Dissociating deliberate from spontaneous mind wandering. *Psychological Research, 79*(5), 750-758. doi:10.1007/s00426-014-0617-x

Seli, P., Cheyne, J. A., & Smilek, D. (2013). Wandering minds and wavering rhythms: Linking mind wandering and behavioral variability. *Journal of Experimental Psychology: Human Perception and Performance, 39*(1), 1-5. doi:10.1037/a0030954

Seli, P., Cheyne, J. A., Xu, M., Purdon, C., & Smilek, D. (2015). Motivation, intentionality, and mind wandering: Implications for assessments of task-unrelated thought. *J Exp Psychol Learn Mem Cogn, 41*(5), 1417-1425. doi:10.1037/xlm0000116

Seligman, M. E. P. (1971). Phobias and preparedness. *Behavior Therapy, 2*(3), 307-320. doi:10.1016/S0005-7894(71)80064-3

SensoMotoric Instruments, I. (2009). iView X System Manual. Teltow, Germany: SensoMotoric Instruments, Inc.

SensoMotoric Instruments, I. (2014). BeGaze Manual. Teltow, Germany: SensoMotoric Instruments, Inc.

Shafran, R., Teachman, B. A., Kerry, S., & Rachman, S. (1999). A cognitive distortion associated with eating disorders: thought-shape fusion. *Br J Clin Psychol, 38 ( Pt 2)*, 167-179.

Shank, L. M., Tanofsky-Kraff, M., Nelson, E. E., Shomaker, L. B., Ranzenhofer, L. M., Hannallah, L. M., . . . Yanovski, J. A. (2015). Attentional bias to food cues in youth with loss of control eating. *Appetite, 87*, 68-75. doi:10.1016/j.appet.2014.11.027

Siegel, P., & Warren, R. (2013). The effect of very brief exposure on experienced fear after in vivo exposure. *Cogn Emot, 27*(6), 1013-1022. doi:10.1080/02699931.2012.756803

Slagter, H. A., Lutz, A., Greischar, L. L., Francis, A. D., Nieuwenhuis, S., Davis, J. M., & Davidson, R. J. (2007). Mental training affect distribution of limited brain resources. *PLOS Biology, 5*(6), 1228-1235.

Smith, P. K., & Trope, Y. (2006). You focus on the forest when you're in charge of the trees: Power priming and abstract information processing. *Journal of Personality and Social Psychology, 90*(4), 578-596. doi:10.1037/0022-3514.90.4.578

Somers, J. M., Goldner, E. M., Waraich, P., & Hsu, L. (2006). Prevalence and incidence studies of anxiety disorders: a systematic review of the literature. *Can J Psychiatry, 51*(2), 100-113.

SR Research Ltd. (2015). EyeLink Data Viewer User's Manual. Missisauga, Canada.

Stelter, R. (2009). Experiencing mindfulness meditation-a client narrative perspective. *Int J Qual Stud Health Well-being, 4*, 145-158. doi:10.1080/17482620903013908

Stice, E. (2002). Risk and maintenance factors for eating pathology: A meta-analytic review. *Psychological Bulletin, 128*(5), 825-848. doi:10.1037/0033-2909.128.5.825

Stroebe, W. (2008). Restrained eating and the breakdown of self-regulation. In W. Stroebe (Ed.), *Dieting, overweight, and obesity – Self-regulation in a food-rich environment* (pp. 115–139). Washington, DC: American Psychological Association.

Stroebe, W., Mensink, W., Aarts, H., Schut, H., & Kruglanski, A. W. (2008). Why dieters fail: Testing the goal conflict model of eating. *Journal of Experimental Social Psychology, 44*(1), 26-36. doi:10.1016/j.jesp.2007.01.005

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18*(6), 643-662.

Szymanski, J., & O'Donohue, W. (1995). Fear of spiders questionnaire. *Journal of Behavior Therapy and Experimental Psychiatry, 26*(1), 31-34. doi:10.1016/0005-7916(94)00072-T

Teachman, B. A. (2007). Evaluating implicit spider fear associations using the Go/No-go Association Task. *J Behav Ther Exp Psychiatry, 38*(2), 156-167. doi:10.1016/j.jbtep.2006.10.006

Teachman, B. A., & Woody, S. R. (2003). Automatic processing in spider phobia: Implicit fear associations over the course of treatment. *Journal of Abnormal Psychology, 112*(1), 100-109. doi:10.1037/0021-843x.112.1.100

Torrance, E. P. (2008). *Torrance Tests of Creative Thinking: Norms-technical manual*. Bensenville, IL: Scholastic Testing Service.

Van Bockstaele, B., Verschuere, B., Koster, E. H., Tibboel, H., De Houwer, J., & Crombez, G. (2011). Effects of attention training on self-reported, implicit, physiological and behavioural measures of spider fear. *J Behav Ther Exp Psychiatry, 42*(2), 211-218. doi:10.1016/j.jbtep.2010.12.004

van Strien, T., Breteler, M. H. M., & Ouwens, M. A. (2002). Restraint scale, its subscales concern for dieting and weight fluctuation. *Personality and Individual Differences, 33*, 791-802.

van Strien, T., Herman, C. P., Engels, R. C., Larsen, J. K., & van Leeuwe, J. F. (2007). Construct validation of the Restraint Scale in normal-weight and overweight females. *Appetite, 49*(1), 109-121. doi:10.1016/j.appet.2007.01.003

Veenstra, E. M., & de Jong, P. J. (2012). Attentional bias in restrictive eating disorders. Stronger attentional avoidance of high-fat food compared to healthy controls? *Appetite, 58*(1), 133-140. doi:10.1016/j.appet.2011.09.014

Veenstra, E. M., de Jong, P. J., Koster, E. H., & Roefs, A. (2010). Attentional avoidance of high-fat food in unsuccessful dieters. *J Behav Ther Exp Psychiatry, 41*(3), 282-288. doi:10.1016/j.jbtep.2010.02.006

Vollestad, J., Nielsen, M. B., & Nielsen, G. H. (2012). Mindfulness- and acceptance-based interventions for anxiety disorders: A systematic review and meta-analysis. *British Journal of Clinical Psychology, 51*(3), 239-260. doi:10.1111/j.2044-8260.2011.02024.x

Vrijsen, J. N., Fleurkens, P., Nieuwboer, W., & Rinck, M. (2009). Attentional bias to moving spiders in spider fearful individuals. *J Anxiety Disord, 23*(4), 541-545. doi:10.1016/j.janxdis.2008.11.002

Waechter, S., Nelson, A. L., Wright, C., Hyatt, A., & Oakman, J. (2013). Measuring Attentional Bias to Threat: Reliability of Dot Probe and Eye Movement Indices. *Cognitive Therapy and Research, 38*(3), 313-333. doi:10.1007/s10608-013-9588-2

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS Scales. *Journal of Personality and Social Psychology, 54*(6), 1063-1070.

Webb, C. M., Thuras, P., Peterson, C. B., Lampert, J., Miller, D., & Crow, S. J. (2011). Eating-related anxiety in individuals with eating disorders. *Eating and weight disorders : EWD, 16*(4), e236-e241.

Wenk-Sormaz, H. (2005). Meditation can reduce habitual responding. *Alternative therapies in health and medicine, 11*(2), 42.

Werthmann, J., Jansen, A., & Roefs, A. (2015). Worry or craving? A selective review of evidence for food-related attention biases in obese individuals, eating-disorder patients, restrained eaters and healthy samples. *Proceedings of the Nutrition Society, 74*(2), 99-114. doi:10.1017/S0029665114001451

Werthmann, J., Roefs, A., Nederkoorn, C., Mogg, K., Bradley, B. P., & Jansen, A. (2011). Can(not) take my eyes off it: attention bias for food in overweight participants. *Health Psychol, 30*(5), 561-569. doi:10.1037/a0024291

Williams, J. M., Watts, F. N., MacLeod, C., & Mathews, A. (1988). *Cognitive psychology and emotional disorders*. Chichester, England: Wiley.

Williams, J. M., Watts, F. N., MacLeod, C., & Mathews, A. (1997). *Cognitive psychology and the emotional disorders* (2nd ed.). New York, NY: Wiley.

Wills, S. (2007). *Moby Dick, or the Whale (Digical recording)*. USA: LibriVox.

Wilson, K. M., Russell, P. N., & Helton, W. S. (2015). Spider stimuli improve response inhibition. *Conscious Cogn, 33*, 406-413. doi:10.1016/j.concog.2015.02.014

Xu, M. (2014). *Connecting two opposing constructs: Mind wandering and mindfulness.* (Master of Arts), University of Waterloo, Waterloo, ON.

Xu, M., Purdon, C., Seli, P., & Smilek, D. (2017). Mindfulness and mind wandering: The protective effects of brief meditation in anxious individuals. *Consciousness and Cognition, 51*, 157-165. doi:10.1016/j.concog.2017.03.009

Yiend, J. (2010). The effects of emotion on attention: A review of attentional processing of emotional information. *Cognition & Emotion, 24*(1), 3-47. doi:10.1080/02699930903205698

Yiend, J., & Mathews, A. (2001). Anxiety and attention to threatening pictures. *The Quarterly Journal of Experimental Psychology A, 54*(3), 665-681. doi:10.1080/713755991

Yovel, I., Revelle, W., & Mineka, S. (2005). Who sees trees before forest? The obsessive-compulsive style of visual attention. *Psychological Science, 16*(2), 123-129.

Zlomke, K., & Davis, T. E., 3rd. (2008). One-session treatment of specific phobias: a detailed description and review of treatment efficacy. *Behav Ther, 39*(3), 207-223. doi:10.1016/j.beth.2007.07.003

# Appendix A

## Test Stimuli for Study 2

| Food | Neutral | Food | Neutral |
|------|---------|------|---------|
| 0128. | 1010. | 0116. | 1132. |
| 0046. | 1262. | 0491. | 1112. |
| 0022. | 1235. | 0049. | 1004. |
| 0008. | 1038. | 0510. | 1142. |
| 0025. | 1155. | 0115. | 1143. |
| 0095. | 1058. | 0042. | 1033. |
| 0110. | 1036. | 0107. | 1028. |
| 0007. | 1130. | 0313. | 1018. |
| 0020. | 1265. | 0028. | 1035. |
| 0081. | 1086. | 0474. | 1230. |
| 0053. | 1055. | 0375. | 1200. |
| 0037. | 1092. | 0286. | 1145. |
| 0048. | 1313. | 0006. | 1208. |
| 0012. | 1129. | 0125. | 1225. |
| 0089. | 1080. | 0027. | 1274. |
| 0050. | 1139. | 0140. | 1019. |
| 0040. | 1237. | 0400. | 1259. |
| 0135. | 1012. | 0083. | 1251. |
| 0061. | 1276. | 0103. | 1250. |
| 0074. | 1052. | 0289. | 1049. |
| 0143. | 1007. | 0347. | 1246. |
| 0126. | 1146. | 0122. | 1084. |
| 0013. | 1238. | 0036. | 1314. |
| 0093. | 1226. | 0001. | 1152. |
| 0174. | 1059. | 0078. | 1150. |
| 0017. | 1096. | 0016. | 1016. |
| 0055. | 1261. | 0492. | 1135. |
| 0032. | 1148. | 0002. | 1258. |
| 0167. | 1057. | 0097. | 1140. |
| 0373. | 1029. | 0159. | 1156. |

**Appendix B**

**Mountain Meditation Instructions**

This exercise is normally done in a sitting position, either on the floor or a chair, and begins by sensing into the support you have from the chair or the cushion, paying attention to the actual sensations of contact. Finding a position of stability and poise, upper body balanced over your hips and shoulders in a comfortable but alert posture, hands on your lap or knees, arms hanging by their own weight, like heavy curtains, stable and relaxed. Actually sensing into your body, feeling your feet…(pause 3 seconds) legs…(pause 3 seconds) hips…(pause 3 seconds) lower and upper body…(pause 5 seconds) arms…(pause 3 seconds) shoulders…(pause 3 seconds) neck…(pause 3 seconds) and head...(pause 5 seconds).

And when you are ready, allowing your eyes to close, bringing awareness to breath, the actual physical sensations, feeling each breath as it comes in and goes out (pause 5 seconds) letting the breath be just as it is, without trying to change or regulate it in any way (pause 5 seconds) allowing it to flow easily and naturally, with its own rhythm and pace, knowing you are breathing perfectly well right now, nothing for you to do (pause 10 seconds).

Allowing the body to be still and sitting with a sense of dignity, a sense of resolve, a sense of being complete, whole, in this very moment, with your posture reflecting this sense of wholeness…(pause 20 seconds).

As you sit here, letting an image form in your mind's eye, of the most magnificent or beautiful mountain you know or have seen or can imagine…(3 seconds), letting it gradually come into greater focus…(pause 3 seconds) and even if it doesn't come as a visual image, allowing the sense of this mountain and feeling its overall shape, its lofty peak or peaks high in the sky, the large base rooted in the bedrock of the earth's crust, it's steep or gently sloping sides…(pause 5 seconds)

Noticing how massive it is, how solid, how unmoving, how beautiful, whether from afar or up close… (pause 20 seconds). Perhaps your mountain has snow blanketing its top and trees reaching down the base, or rugged granite sides…(pause 3 seconds) there may be streams and waterfalls cascading down the slopes…(pause 3 seconds) there may be one peak or a series of peaks, or with meadows and high lakes…(pause 25 seconds).

Observing it, noting its qualities and when you feel ready, seeing if you can bring the mountain into your own body, so that your body and the mountain in your mind's eye become one. So that as you sit here, you share in the massiveness and the stillness and majesty of the mountain, you become the mountain…(pause 5 seconds).

Grounded in the sitting posture, your head becomes the lofty peak, supported by the rest of your body and affording a panoramic view. Your shoulders and arms the sides of the mountain. Your hips and legs the solid base, rooted to your cushion or your chair, experiencing in your body a sense of uplift from deep within your pelvis and spine...(pause 3 seconds).

With each breath, as you continue sitting, becoming a little more a breathing mountain, alive and vital, yet unwavering in your inner stillness, completely what you are, beyond words and thought, a centered, grounded, unmoving presence…(pause 30 seconds).

As you sit here, becoming aware of the fact that as the sun travels across the sky, the light and shadows and colours are changing virtually moment by moment in the mountain's stillness, while the surface teems with life and activity… streams, melting snow, waterfalls, plants and wildlife…(pause 5 seconds).

As the mountain sits, seeing and feeling how night follows day and day follows night. The bright warming sun, followed by the cool night sky studded with stars, and the gradual dawning of a new day…(pause 20 seconds).

Through it all, the mountain just sits, experiencing change in each moment, constantly changing, yet always just being itself. It remains still as the seasons flow into one another and as the weather changes moment by moment and day by day, calmness abiding all change…(pause 15 seconds).

In summer, there is no snow on the mountain expect perhaps for the very peak or in crags shielded from direct sunlight. In the fall, the mountain may wear a coat of brilliant fire colours. In winter, a blanket of snow and ice.

In any season, it may find itself at times enshrouded in clouds or fog or pelted by freezing rain. People may come to see the mountain and comment on how beautiful it is or how it's not a good day to see the mountain, that it's too cloudy or rainy or foggy or dark. (pause 5 seconds).

None of this matters to the mountain, which remains at all times its essential self. Clouds may come and clouds may go, tourists may like it or not. The mountain's magnificence and beauty are not changed one bit by whether people see it or not, seen or unseen, in sun or clouds, boiling or frigid, day or night. It just sits, being itself…(pause 3 seconds).

At times visited by violent storms, buffeted by snow and rain and winds of unthinkable magnitude. Through it all, the mountain sits (pause 20 seconds). Spring comes, trees leaf out, flowers bloom in the high meadows and slopes, birds sing in the trees once again. Streams overflow with the waters of melting snow.

Through it all, the mountain continues to sit, unmoved by the weather, by what happens on its surface, by the world of appearances…(pause 3 seconds) remaining its essential self, through the seasons, the changing weather, the activity ebbing and flowing on its surface…(pause 15 seconds).

In the same way, as we sit here, we can learn to experience the mountain, we can embody the same central, unwavering stillness and groundedness in the face of everything that changes in our own lives, over seconds, over hours, over years (pause 5 seconds).

In our lives, we experience constantly the changing nature of mind and body and of the outer world. We have our own periods of light and darkness, activity and inactivity, our moments of colour and our moments of drabness.

It's true that we experience storms of varying intensity and violence in the outer world and in our own minds and bodies, buffeted by high winds, by cold and rain, we endure periods of darkness and pain, as well as the moments of joy and uplift, even our appearance changes constantly, experiencing a weather of it's own…(pause 15 seconds).

By becoming the mountain, we can link up with its strength and stability and adopt them for our own. We can use its energies to support our energy to encounter each moment with mindfulness and equanimity and clarity...(pause 3 seconds).

It may help us to see that our thoughts and feelings, our preoccupations, our emotional storms and crises, even the things that happen to us are very much like the weather on the mountain. We tend to take it all personally, but its strongest characteristic is impersonal.

The weather of our own lives is not to be ignored or denied, it is to be encountered, honoured, felt, known for what it is, and held in awareness… And in holding it this way, we come to know a deeper silence and stillness and wisdom.

Mountains have this to teach us and much more if we can let it in…(pause 10 seconds). So if you find you resonate in some way with the strength and stability of the mountain in your sitting, it may be helpful to use it from time to time, to remind you of what it means to sit mindfully with resolve and with wakefulness, in true stillness…(pause 5 seconds)

So, in the time that remains, continue to sustain the mountain on your own, in silence, moment by moment, until you hear the sound of the bells…(approximately 5 minutes until sound of bells).

<center>**Appendix C**</center>

<center>**Passive Progressive Muscle Relaxation Instructions**</center>

Settle back as comfortably as you can in a comfortable chair and focus on what I am going to be telling you. I am going to be asking you to pay attention to sensations of tension in different muscle groups and then allow these muscles to relax completely, one at a time.

First, close your eyes comfortably. Now pay attention to your right fist and notice the sensations of tension there. Hold it, study the tension, study it [5 seconds], and now relax. Let your hand rest comfortably again. Notice the difference between the tension you were experiencing and the relative relaxation you feel now, and enjoy the contrast. Now, do that once again; notice the sensations of tension in your right fist. Hold it [5 seconds], and now relax, just let your hand go, getting looser and looser. Notice once again the difference between the sensation of tension and that of relaxation. [10 seconds]

Let's do that with your left fist now. Pay attention to your left fist and notice the sensations of tension there. Hold it, study the tension, study it [5 seconds], and now relax. Let your hand rest comfortably again. Notice the difference between the tension you were experiencing and the relative relaxation you feel now, and enjoy the contrast. [5 seconds]. Notice the sensations of tension in your left fist; hold it [5 seconds], and now relax, just let your hand go, getting looser and looser. Notice once again the difference between the sensation of tension and that of relaxation. [10 seconds]

Now I'd like you to pay attention to your biceps muscles on your upper arms and notice the sensations of tension there. Study the tension, hold it, study it [3 seconds] and now relax, letting go further and further. Let the sensation of relaxation flow through your arms and compare it to the tightness you felt before. [5 seconds]. Let's do that once again now; notice the sensations of tension in your upper arms. Hold that tension, study it [5 seconds] and now relax, just letting go more and more, further and further, noticing and

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remembering the difference between muscular tension and muscular relaxation. [10 seconds].

Let us now turn our attention to the muscles in your face, your forehead in particular. Notice the sensations of tension on your forehead. Hold that tension, study it, [5 seconds] and now relax, letting go, further and further. Notice the contrast between the tension and the relaxation and enjoy it. [5 seconds] Let's do that once again now. Notice the sensations of tension on your forehead. Concentrate on the tension, study it, hold it 15 seconds] and now relax. Let the muscle in your forehead go. Smooth out your forehead, let it relax and enjoy the difference between the tension you were feeling before and the relaxation you are feeling now. [10 seconds]

Now pay attention to your eyes and notice the sensations of tension there. Hold that tension, hold it, hold it [5 seconds], and now relax, let your eyes go, letting go more and more, further and further. Attend to what it feels like for your eyes to be relaxed rather than tense, and enjoy that feeling. [5 seconds] Do that once again now, notice the sensations of tension in your eyes and study that tension, study it, hold, it, and now release it, let it go as much as you can. Enjoy the feeling of relaxation. [10 seconds]

This time we're going to concentrate on your jaw. Notice the sensations of tension in your jaw. Feel the tension, feel it, study it, hold it, [5 seconds] and now relax, let go of your jaw muscles, making them as slack as you can. Study the difference between the tension that you felt and the relaxation you feel now. [5 seconds] It's time to do that again; notice the sensations of tension in your jaw. Study that tension, hold it, study it [5 seconds] and now relax, just let go further and further, more and more. Study the feeling of relaxation and enjoy it. [10 seconds]

We'll finish our focus on the facial muscles by paying attention to the lips. Notice the sensations of tension in your lips and study that tension, study it. And now relax, let go

of that tension, letting your lips and cheeks totally relax. [5 seconds] Let's do that again; notice the sensations of tension in your lips. Hold that tension, study it [5 seconds] and now release it, let go, relax your lips and cheeks. Enjoy the difference between the tension and the relaxation. [10 seconds]

Now let's turn our attention to some other large muscle groups in your body, starting with the neck. Notice the sensations of tension in your neck. Study the tension in your neck, hold it, study it [5 seconds] and now relax, let go further and further, more and more, letting your head rest comfortably now on the chair or bed. Notice the difference you feel in your neck now that it is relaxed. [5 seconds] Do that once again; notice the sensations of tension in your neck; hold it, study it, [5 seconds] and now let go, relax, let your neck relax, your head resting comfortably. [10 seconds]

Now let's concentrate on your shoulders. Notice the sensations of tension in your shoulders. Hold it, study the tension [5 seconds], and now let it go; let your shoulders go further and further, more and more. See how well you can get the tension to drain completely from them and enjoy feeling that tightness dissolves. [5 seconds] Do that once again now; notice the sensations of tension in your shoulders. Study that tension, hold it, study it, and now relax, let go, just keep letting go more and more, further and further. Let the tension wash out of your shoulders. [10 seconds]

It's time now to focus on the large muscle groups in your legs. We'll start with the lower legs. Notice the sensations of tension in your lower legs. Hold that tension, hold it, study it, [5 seconds] and now relax, let go, further and further. Feel your legs melting into the chair, every last bit of tension draining from them. Notice the difference between the tension you experienced before and the relaxation you are feeling now in your legs. [5 seconds] Let's do that again; notice the sensations of tension in your lower legs. Hold the

tension, hold it, study it, [5 seconds] and now relax, let go, further and further, more and more. [10 seconds]

Now pay attention to your thigh muscles. Notice the sensations of tension in your thighs. Hold that tension, hold it, study it, [5 seconds] and now release your thigh muscles, release the tension and let your legs become heavy against the chair or bed. Notice the difference between the tension and the relaxation and enjoy the contrast. [5 seconds] Let's do that again now; notice the sensations of tension in your thigh muscles. Hold the tension, study it, [5 seconds] and now relax, let go. Just keep letting that tension go more and more, further and further. [10 seconds]

Finally, pay attention to the muscles of your buttocks. Notice the sensations of tension in your buttocks. Noticing how the tension feels. Hold it, study it, and now let it go; relax the muscles of your buttocks, further and further more and more. [5 seconds] One more time; clench the muscles of your buttocks as hard as you can. Hold the tension and study it. Hold it, hold it, and now release it. Let the tension drain out of your buttocks and enjoy the feeling of being relaxed. [10 seconds]

Let's review the areas of your body that we have noticed the sensations of tension and relaxed. As I name each area scan it for any tension, and release the tension in the area. Hands and arms [10 seconds]. Forehead, jaw and lips [10 seconds]. Neck and shoulders [10 seconds]. Legs and buttocks. [10 seconds].

Now sit quietly for a few moments, enjoying the experience of relaxed muscles. Breathe slowly and deeply and relish the feelings of relaxation now present throughout your body. [2 minutes].

I am going to count from 5 to 1. As I count down, you should make yourself more aware and alert, ready to move on to the next activity in your day. 5…..4…..3…...2…..1 Eyes open, wide awake.