University of Alberta

Individual Differences in Emotion Regulation and Their Impact on Selective Attention

by

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A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for the degree of

Master of Science

Department of Psychiatry

Spring 2010
Edmonton, Alberta

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Dedication

To my grandfather, Dr. Lorne W. Gold, whose support and encouragement provides me the strength to achieve my goals, and whose commitment to learning has inspired generations to strive for academic excellence.

Abstract

Studies were conducted to investigate relationships between trait-emotion regulation variables (including reappraisal and suppression) and selective attention to negative emotional information. Correlation analyses of data in experiment1 showed that trait-suppression was related to early attentional avoidance of angry faces, while reappraisal showed no relationship to attention. Experiment 2 directly compared selective attention to angry faces in groups of high trait-suppressors and high trait-reappraisers. Since reappraisers are also low trait-anxious and suppressors are high trait-anxious, low emotion regulating high- and low-anxious control groups were included. Contrary to findings from experiment 1, trait-suppressors did not have lower selective attention to angry faces than low-regulating high anxious controls. Trait-reappraisers in experiment 2 showed pronounced vigilance for angry faces compared to both trait suppressors and low-regulating low anxious controls. These results suggest that trait-suppression may reduce attentional threat biases. Conversely, trait-reappraisal combined with low anxiety may allow individuals to prioritize threat in attention.

Acknowledgment

I would like to thank my supervisor, Dr. Esther Fujiwara, for her patience, guidance, and support throughout this process. I would also like to thank my examining committee members, Dr. Anthony Joyce, Dr. Serdar Dursun, and Dr. Jeff Schimel for all of their guidance and feedback.

Thank you to Dr. Patrick Davidson and Dr. Jeremy Caplan for graciously offering support and providing laboratory space for testing participants. Also thank you to Dr. Iris Mauss and Dr. Arnoud Arntz for providing materials that were used in this study. Together, their efforts made this project possible.

I would like to thank my friends and family, especially Catherine Gold, Brindy Bishop, and Joan Gold for their encouragement, patience, and understanding during this process.

Finally, I would like to thank the Canadian Institutes of Health Research for their financial support of this research.

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List of Abbreviations

AAQ	Action and Acceptance Questionnaire
ACC	Anterior Cingulate Cortex
ANEW	Affective Norms for English Words
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
BEQ	Berkeley Expressivity Questionnaire
BEQ-IS	Berkeley Expressivity Questionnaire Impulse Strength
BEQ-NEX	Berkeley Expressivity Questionnaire Negative Expressivity
BEQ-PEX	Berkeley Expressivity Questionnaire Positive Expressivity
BIDR	Balanced Inventory of Desireable Responding
DPT	Dot-Probe Task
ER-IAT	Emotion Regulation Implicit Association Task
ERQ	Emotion Regulation Questionnaire
fMRI	functional Magnetic Resonance Imaging
IAT	Implicit Association Task
IM	Impression Management
MMPI	Minnesota Multiphasic Personality Inventory
PFC	Prefrontal Cortex
RT	Reaction Time
SD	Standard Deviation
SDE	Self-Deceptive Enhancement
STAI	State Trait Anxiety Inventory
STAI-S	State Anxiety Scale
STAI-T	Trait Anxiety Scale
SOA	Stimulus Onset Asynchrony

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I. Introduction

Emotion regulation encompasses the complex set of processes through which individuals attempt to regulate the experience and expression of emotion. Social psychologist James J. Gross suggests that people use a variety of different strategies to regulate their emotions (Gross, 1998b). Two of the strategies most commonly studied are reappraisal and suppression. According to Gross (1998a), reappraisal is the cognitive re-interpretation (e.g., changing one's negative thoughts) of an emotional event with the goal of changing its emotional impact. Suppression is the behavioural inhibition of overt reactions (e.g., frowning) to an emotional experience, again with the goal of changing its impact. Previous studies suggest that the momentary use of reappraisal may be less effortful, less cognitively demanding and more effective in down-regulating negative emotions than the use of suppression (Gross, 1998a; Gross, 2002; Richards & Gross, 2000). In comparison, suppression appears to be more demanding, requiring ongoing self-monitoring with little effect on the actual experience of the emotion (Richards & Gross, 2000). The vast majority of previous research has studied the influence of momentary, *instructed* use of emotion regulation strategies on the emotional experience and concomitant cognition. To complement and extend these findings, this thesis examined the cognitive consequences of trait emotion regulation. Although theoretical accounts of emotion regulation (Gross, 1998b) refer to attention as a main determinant and/or consequence of regulating emotions, the connection between attention and emotion regulation is not entirely clear. The following literature review examines possible associations between emotion and attention, and explores the current understanding of the role emotion regulation plays in moderating the connection between emotion and attention. I begin with an explanation of the term "emotion".

II. Literature Review

1. Emotion

Unlike other human behaviour, the concept of "emotion" is difficult to define clearly and concisely. This struggle may partly stem from the diverse nature of emotions: Emotions can be positive or negative, mild or intense, can arise unexpectedly or in response to specific internal or external stimuli, and can vary between individuals. Some theories (Gross & Thompson, 2007; Lazarus, 1982) now define emotion through several core features, which may or may not be evident in any given scenario, but whose presence increases the likelihood that an emotion will be generated. Using Gross and Thompson's (2007) conceptualization of emotion, I will define the term "emotion" using several core features of emotional events. Gross and Thompson's model of emotion will be presented and discussed afterwards[1].

1.1. Core Features of Emotion

Gross and Thompson (2007) suggest three core features of emotion that serve as sufficient, but not necessary, conditions for the experience of emotions in humans. First, a stimulus or event is more likely perceived as emotional when the individual perceives it as relevant to his or her own goals. These goals may be enduring (e.g., survival) or transient (e.g., getting to work on time), conscious (e.g., planning a trip) or unconscious (e.g., avoiding threat), central to one's self-image (e.g., being a musician) or peripheral (e.g., lighting a candle). Regardless of the nature of the goal, it is the meaning of the goal to the individual that raises the likelihood that a stimulus will be perceived as emotionally relevant (Gross & Thompson, 2007). Second, emotions are multifaceted and involve experiential,

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[1] In the sections that follow, stimuli and events will frequently be described in terms of their emotional *valence* and/or *arousal* value. Emotional valence refers to the positivity or negativity of a stimulus, event or emotion. For example, happiness is a positively valenced emotion while sadness is a negatively valenced emotion. Emotional arousal refers to the strength of the emotional response. For example, a film depicting a bloody murder is likely to be more arousing than a film depicting a verbal disagreement between two people. Notice that for both instances, the events in the film would likely elicit negatively valenced emotions and but their associated arousal differs.

behavioural, and physiological changes (Mauss, Levenson, McCarter, Wilhelm, & Gross, 2005). Importantly, the subjective experience of emotion is so closely tied to our understanding of emotion that the colloquial use of the terms “emotion” and “feeling” are often not distinguishable. Importantly, while emotions make us *feel* something, they also make us *do* something (Frijda, 1986). This impulse to act (or not act) is associated with changes in the autonomic system that provides metabolic support for a behavioural response (e.g., fight or flight response) to the emotion (Lazarus, 1982). Third, the changes that accompany emotions are generally involuntary but remain flexible in nature. For example, although the presence of threat may induce an autonomic response accompanied by the urge to flee the situation, we are able to calm ourselves and control our behavioural responses through the use of a number of different strategies (i.e., by distracting ourselves from the threat). Thus, emotions possess an imperative quality, which allows them to interrupt ongoing cognitive and behavioural activities and force themselves into our awareness (Frijda, 1986). However, once the emotion is generated it can be modulated by a number of internal and external processes that can then alter the resulting behavioural and physiological responses (Gross & Thompson, 2007).

In summary, according to Gross and Thompson (2007), the sufficient conditions for emotion are that an event is perceived as relevant to an individual’s needs or goals, and is accompanied by physiological, experiential, and behavioural changes that result in an action impulse. These physiological, experiential, and behavioural responses are most often elicited involuntarily but are nonetheless flexible to change through internal or external mechanisms. Within this definition lies the notion that any core feature, on its own, is sufficient to elicit emotion, but the potential for emotion increases with the presence of more of these core features.

1.2. Models of Emotion

The majority of the models of human emotion comprise a stimulus, an appraisal, and a physiological and behavioural response (Fridja, 1986; Gross &

Thompson, 2007; Lazarus, 1982); however, there has been debate surrounding the sequencing of these elements in the generation of emotion. Over 100 years ago William James (James, 1884), and independently Carl Lange (Lange, 1885) proposed a model of emotion now known as the James-Lange theory of emotion. This model suggests autonomic responses (i.e., arousal) within an individual are evoked first and are then appraised and interpreted as being the emotion. To illustrate this model, consider the individual who is walking through the forest and comes across a bear. According to the James-Lange model of emotion, the situation might provoke autonomic (e.g., perspiration) and behavioural (e.g., run away) responses, which lead to the appraisal "I am perspiring (autonomic) and running (behavioural), I must be afraid". In contrast, the Cannon-Bard model of emotion (Cannon, 1927) suggests that events and stimuli are first evaluated for their relevance to the individual's needs and goals. Those stimuli that are perceived as being significant to the individual's goals are then appraised as emotional. These appraisals in turn give rise to the physiological and behavioural responses, which are associated with emotion. For example, I see a bear in the woods, the bear is a threat to my survival, I experience fear, I begin to perspire and I run. Thus, certain physiological and behavioural responses may either lead to the perception of an event as emotional, or the perception of emotion may lead to emotion-specific physiological and behavioural responses. In a more reciprocal manner, Schachter and Singer (1962) conceptualized emotion as being a person-situation interaction in which an individual uses cognitive appraisals of physiological and environmental cues simultaneously to determine the presence of emotion. For example, I see a bear *and* I am perspiring, I must be afraid. An emotion model suggested by James J. Gross (2002) and further developed in Gross and Thompson (2007) also conceptualizes emotion as a person-situation interaction. Importantly, Gross' model has served as the foundation for the growing body of literature on emotion regulation and will serve as the foundation for this thesis.

Gross and Thompson (2007) argue that emotions stem from person-situation interactions that guide attention, have specific meaning to an individual, and give rise to a coordinated and flexible multisystem (experiential, physiological, and behavioural) response. Figure 1 depicts the sequence of emotional processing outlined by Gross and Thompson's "modal model" of emotion. In this model, the sequence begins with a stimulus or event which may be either internal (i.e., mental representations or thoughts) or external (e.g., a car accident). Both internal and external stimuli are attended to in various ways (discussed in greater depth in section II-2), which initiates an appraisal of the familiarity, valence, and goal relevance of the stimulus or event (Ellsworth & Scherer, 2003). According to Gross and Thompson it is the individual's appraisal of the stimulus or event as emotional that invokes behavioural, physiological, and experiential responses (i.e., action impulse).

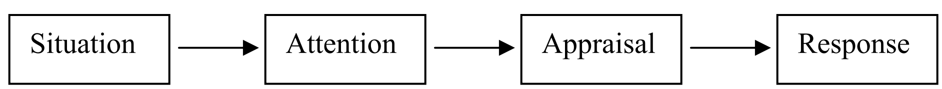

Figure 1. Gross and Thompson's (2007) "modal model" of emotion.

Thus, within a situation, the first step in the emotion generation process concerns attention. I will discuss emotion-attention interactions in detail in the following sections (sections II-2 through II-2.2.3).

2. Emotion and Attention

For most people, emotional events are difficult to ignore. Consider, for example, the difficulty many drivers experience in resisting the urge to glance at a car accident on the side of the road, or the difficulty of maintaining focus on a task immediately following an argument with a friend. The mechanisms underlying the link between emotion and attention may lie in the special role that both emotion and attention play in prioritising information-processing (Oatley & Johnson-Laird, 1987). Not all stimuli are processed in the same way. Instead, humans prioritise information such that some information is ignored in favour of more elaborate processing of other information (e.g., longer processing time, more in depth processing; James, 1890). Evolutionary theories (e.g., Arnold, 1960; Ellsworth & Scherer, 2003; Smith & Kirby, 2001; Smith & Lazarus, 1990) suggest that the mechanisms underlying the prioritisation of information-processing resources evolved in the human brain in such a way to ensure that those aspects of the environment that are most important to the organism are provided more cognitive resources. But which stimulus features signal 'importance'?

Emotional significance serves as a clear signal of 'importance' to an organism. As discussed previously, many definitions of emotion are in some way linked to the concept of goal-relevance and motivation (e.g., Arnold, 1960; Ellsworth & Scherer, 2003; Smith & Kirby, 2001; Smith & Lazarus, 1990). For example, according to Gross and Thompson (2007) a stimulus or event is regarded as emotional when it has the possibility of either promoting or impeding a person's goals. Evolutionary theory (see Ohman, 1986; Smith & Lazarus, 1990) predicts that these goals should be inherently tied to the individual's well-being and reproductive fitness (e.g., obtaining food and water, protecting offspring). Because emotional significance serves as a means of labelling stimuli and events as 'important', emotional significance should also play a substantial role in guiding attention. The following sections examine whether attention is necessary for the perception of emotion, and whether/how the emotional connotation of to-be-processed information guides attention.

2.1. Does Emotional Encoding Require Attentional Resources?

One approach researchers have used in examining the link between emotion and attention is to ask whether the perception of emotion is reliant on attentional resources. A crucial question is whether emotional information can be processed in the absence of attentional resources. Traditionally, preattentive processing has been conceptualised as an early stage of information processing that is relatively fast and occurs prior to attentional selection or conscious awareness (Compton, 2003). Evidence from numerous behavioural, psychophysiological, and neuroimaging studies has supported the notion of preattentive emotional processing. Such evidence comes, for example, from studies employing affective priming paradigms. In such paradigms, an emotional stimulus is presented for a set duration of time, and is followed by the presentation of a neutral stimulus. The participants' task is to rate the emotional valence of the neutral stimulus only. Affective priming results indicate that the emotional valence of the initial stimulus exerts an influence over participants' judgments of the subsequent neutral stimuli. That is, the neutral stimulus is judged more negatively or positively when preceded by an emotional prime than when preceded by a neutral prime (e.g., Murphy and Zajonc, 1993; Rotteveel, de Groot, Geutskens, & Phaf, 2001). Affective priming allows researchers to present emotional stimuli for an indeterminate amount of time prior to the onset of neutral stimuli. By altering the presentation duration of the initial emotional stimulus, one can infer the amount of time required to encode the valence of the initial stimuli (i.e., by comparing the valence judgements across neutral probe items preceded by emotional primes of different durations). An important implication of affective priming results is that the valence of emotional stimuli can influence one's subsequent judgments even when the emotional primes are presented for very short periods of time, outside of conscious awareness. For example, in one study, Murphy and Zajonc (1993) presented participants with an emotional face for the subliminal exposure duration of 4 milliseconds (ms), immediately followed by the presentation of an unemotional Chinese ideograph. Murphy and Zajonc's (1993) results showed that even though participants did not report seeing an emotional face, the emotional valence of the face influenced participants' subsequent value judgments of the Chinese ideographs (see also Murphy, Monahan, & Zajonc, 1995). In line with these findings, subsequent research has also demonstrated that emotional stimuli that are not consciously perceived can exert an impact on subsequent evaluative judgments (Rotteveel et al., 2001). Several additional studies (for a review see Pratto, 1994) have provided evidence that participants are able to make accurate valence judgments of subliminally presented emotional words at greater-than-chance levels. Together, these studies suggest that humans are able to encode and make judgments of emotional valence very early in the attentional process, even prior to their conscious perception.

Along a similar line of research, a number of studies have provided psychophysiological evidence for emotional encoding in the absence of conscious perception. For example, Ohman and colleagues (Esteves, Dimberg, & Ohman, 1994; Ohman & Soares, 1993; Ohman & Soares, 1998) measured the autonomic responses of participants as they were presented with fear conditioned visual stimuli that were backward-masked[2] to prevent their conscious perception. These studies were able to demonstrate that the presentation of fear conditioned stimuli could evoke autonomic responses even when they were not consciously perceived.

Although the studies reviewed thus far have supported the notion that emotional information can be processed without conscious awareness, they do not directly speak to whether such processing is independent of attentional resources. It is conceivable, for example, that even without conscious awareness, emotional processing could demand some minute fraction of attention. Additionally, studies that have directly examined whether processing emotional information relies on attention have presented somewhat discrepant results. Several studies have addressed this question by using visual search paradigms. For example, Treisman and Gelade (1980) suggested that stimulus features that are processed preattentively will be processed in a parallel manner and, for example, create the impression that they “pop out” of a visual search array. In contrast, those stimulus features that do require attentional resources for processing can be identified only by serial search of each individual stimulus within the array. If this is true, then as the number of items in a visual search array increases, the time required to identify stimulus features that demand attentional resources would also increase, whereas the time required to identify preattentively processed features would remain the same. This assumption has been confirmed, for example, by Ohman, Flykt, and Esteves (2001). They found that the time to detect a fear-relevant

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[2] Backward masking refers to impaired performance on some judgment of a target stimulus when it is followed closely by a second non-target (mask) stimulus. The goal of backward masking is to interrupt information processing of the target stimulus (Francis, 2003).

stimulus within an array of neutral distractors was not influenced by the number of distractors. Therefore, detecting fear-relevant stimuli here seems not to rely on attentional resources and may instead be a preattentive process. Additionally, Eastwood, Smilek, and Merikle (2001) found that angry schematic faces produced a significantly more marked pop-out effect than happy schematic faces, when presented in an array of neutral distractors (see also Hansen & Hansen, 1988, Hansen & Hansen, 1994). These findings suggest that a pop-out effect may be specific to threatening emotional information rather than pertaining more generally to any positive or negative material.

Other studies have used dual-task methods to examine the reliance of emotion perception on attentional resources. In dual-task paradigms, participants are required to perform two tasks simultaneously. Performance on one task serves as the dependent measure, while the second task is more or less attention-demanding and serves as a distractor. In a dual task paradigm, secondary tasks that are attention-demanding will be in competition for attentional resources to perform the primary task, if it does require attention. In contrast, if the primary task is attention-independent, performance should not be affected by the attentional requirements of the secondary task. For example, in one study Vroomen, Driver, and de Gelder (2001) had participants judge the emotional quality of a voice while simultaneously viewing emotional faces. Judgments about the valence of the voice were found to be influenced by the associated facial expression. Importantly, the influence of the facial expression was unaffected by the introduction of an additional (i.e., third) task – in this study, summing digits and counting zeros in a string of numbers. The authors therefore argued that the valence of the facial expressions was processed without placing demands on attentional resources.

Several neuroimaging studies have also presented evidence on this issue, although with mixed results. For example, in one functional magnetic resonance imaging (fMRI) study (Vuilleumier, Armony, Driver, & Dolan, 2001), participants were administered a task in which they were required to make match/no-match decisions about fearful and neutral facial stimuli presented at target locations while irrelevant fearful and neutral facial stimuli were being presented at non-target location. This study found an increase in amygdala activity in response to fearful faces that was independent of whether the fearful face was presented at the attended or unattended locations. The amygdala is a brain region associated with early emotion processing (for reviews, see Armony & LeDoux, 2000; Lang, Davis, & Ohman, 2000). The finding that the amygdala response to fearful faces was unaffected by attention seems to emphasize that emotion processing does not rely on attentional resources.

Another recent fMRI study (Hsu & Pessoa, 2007) examined the influence of attentional load on processing of emotional faces using a dual task paradigm. In their study, participants were required to find target letters among several distinct non-target letters (high attentional load; example ‘X’ out of ‘H, U, M, Y, X, W’) or among identical non-target letters (low attentional load; example ‘X’ out of ‘O, O, O, X, O, O’). On each experimental trial, two identical fearful-face distractors appeared in unattended locations on the screen. Hsu and Pessoa, (2007) found that weaker amygdala responses were evoked by the fearful-face distractors as the attentional load of the target detection task increased. Thus, instead of emotion processing being independent from attentional resources, these findings suggest that emotion processing may indeed be influenced by the amount of available attentional resources. As such, these results imply that even at the neural level, emotional processing is reliant on attentional resources, at least to some extent. Methodological issues may have contributed to the disparity in results between the two fMRI studies. Specifically, it has been suggested that different types of non-emotional tasks modulate amygdala responses, especially in a suppressive manner (Drevets & Raichle, 1998). In Hsu and Pessoa’s (2007) study, responses evoked in the amygdala on ‘high attentional load’ control trials (when no face distractors were present) were weaker than during the ‘low attentional load’ control trials, suggesting that suppressed amygdala activation in attentional load trials may have been at least partly confounded by the effects of the main task. In contrast, in Vuilleumier’s (2001) study, the main task (match/no match) did not differ between attend and unattend conditions, providing a cleaner comparison.

In summary, although the evidence is somewhat varied, many studies have demonstrated that even in the absence of conscious awareness, exposure to emotional stimuli can produce physiological and behavioural responses that are different from those to neutral stimuli. Using dual-task paradigms, some studies have produced evidence for a modulation of emotion processing by the presence or absence of attentional resources. However, it is important to note several issues that arise in addressing the question of resource-dependence. First, although some methods may allow examining the extent to which emotion processing relies on attentional resources, it is considerably more difficult to design a task that can provide evidence for the complete absence of attentional resources during emotion processing. In the attention literature, stimulus features are not typically categorised as being resource-independent versus resource-dependent, but rather are conceptualised as falling along a continuum of attentional requirements (i.e., more or less attention-demanding; Eastwood et al., 2001). The reason for this is that there is no clear means of delineating resource-independent and resource-dependent processes and similarly, differentiating clearly between conscious and unconscious information processing (Reingold & Merikle, 1993). In the case of dual-task paradigms, there are some limitations that are important to note. Specifically, although interference between tasks may be interpreted as a competition for common resources, a lack of interference is much more difficult to interpret (Compton, 2003). Perhaps one task is resource-independent, affording ample resources to accomplish another task. Alternatively, it may be that both tasks are resource-dependent but do not draw on a common resource pool. As a third alternative, the two tasks might draw from a common resource pool that is adequate to support both tasks. Therefore, while results that indicate a modulation of emotion processing through the *presence* of attentional resources are easily interpreted, results from dual task paradigms that indicate a modulation of emotion processing through the *absence* of attentional resources are much more difficult to interpret.

That this review has focused on studies supporting the notion that some aspects of emotion processing can occur preattentively should not imply that all aspects of emotional processing occur outside of conscious awareness. Indeed, emotional stimuli and events are often processed at a conscious level, and there they seem most susceptible to regulatory processes. For example, in their affective priming study, Rottveel, et al., (2001) reported that the influence of an emotional stimulus on subsequent emotional judgments of neutral stimuli was stronger when the presentation of the emotional stimulus was outside of participants' conscious awareness, as compared to when participants were aware of the emotional stimulus (see also Bornstein & D'Agostino, 1992; Fox, 2002; MacLeod & Rutherford, 1992; Murphy & Zajonc, 1993). Rottveel et al., (2001) suggested that when participants were consciously aware of the presence of an emotional stimulus, they might strategically regulate its influence on their emotional responding. The regulation of emotional responding will be discussed in greater depth in sections II-3.0 through II-3.1.2b of this literature review.

2.2. How Does Emotion Guide Selective Attention

Attention broadly refers to the process by which cognitive resources are allocated to various stimuli within the environment (Deutsch & Deutsch, 1963). There is a limit to the amount of information a human being can attend at any one time. Thus, the brain selects information from the environment for further processing such that some information is ignored in favour of more elaborate processing of other information (James, 1890). The mechanism through which this selection occurs is called *selective attention* (Deutsch & Deutsch, 1963). Since selectivity implies one stimulus is being attended more while others are being attended less, two possible mechanisms of attentional prioritising can occur in selective attention: Attention can either be drawn towards a stimulus (*vigilance*) or away from a stimulus (*avoidance*). In addition, the term *attentional orienting* refers to a mechanism where attention is reflexively and unintentionally directed to certain information. Its counterpart, *attentional disengagement,* refers to a mechanism of shifting attention away from a previously attended stimulus. More explicitly, humans may be vigilant for emotional (as compared to neutral) information, reflexively orient their attention to the location where emotionally significant events happen, and/or have a hard time disengaging their attention from those events once they have attended them.

As outlined in detail above (section II-2.1) emotional information can be processed on a preattentive stage. Therefore, emotionally significant stimuli may be prioritised in attention and receive further processing (e.g., Ohman, 1997; Robinson, 1998). There are many experimental paradigms with which emotion influences on selective attention can be studied. The following sections (II-2.2.1 through II-2.2.3) will focus on the most extensively used paradigms to examine emotion/selective attention interactions: The emotional Stroop task and the emotional dot-probe task. After a description of the task features I will review evidence for individual differences influencing performance in these paradigms.

2.2.1. Emotional Stroop Task

In the emotional Stroop task (Williams, Mathews, & McLeod, 1996), emotional and neutral words are presented in different ink colours on a computer screen or cards. The participants' task is to name the colour of each word and ignore the word meaning. The speed with which participants are able to colour-name the emotional words as compared to neutral words is examined. The time difference between emotional and neutral word colour naming is the emotional Stroop interference, an index showing to what extent emotional word meanings are able to capture and hold attention longer than neutral word meanings. In other words, interference in the emotional Stroop task is assumed to reflect an automatic vigilance for emotional information that interferes with performance on the main colour-naming task. Studies using emotional Stroop paradigms have consistently reported increased colour-naming latencies for emotional as compared to neutral words in both healthy and pathological populations (for a review see Williams et al., 1996). These findings are usually interpreted as evidence for the prioritization of emotional information in attention (e.g., Ray, 1979; MacLeod & Rutherford, 1992; Williams & Broadbent, 1986).

Some researchers (e.g., de Ruiter & Brosschot, 1994) have questioned the assumption that interference effects in the emotional Stroop reflect vigilance for emotional information. Instead, several alternative interpretations have been offered. For example, Williams and colleagues (1996) suggest that interference effects might be a result of priming[3] by one word on subsequent presentations of words in the same theme (e.g., negative emotion; Warren, 1972). That means, emotional Stroop effects would be inflated by the fact that naming latencies for emotional words, all belonging to an implicit category of “emotional” and presented in blocks, are often compared to naming latencies to unrelated neutral words (i.e., words that do not belong to any semantic category). To remedy this confound, several studies (e.g., Mogg & Bradley, Williams, & Mathews, 1993; Mogg, Kentish, & Bradley, 1993; Foa, Ilai, McCarthy, Shoyer, & Murdock, 1993) have used categorised neutral word sets (e.g., furniture) instead of random neutral words, along with emotional words. Each of these studies found significant emotional Stroop interference effects, suggesting that the higher colour-naming interference in emotional words is not simply a result of priming effects. Williams and colleagues also suggested that emotional Stroop interference may be due to repetition effects. The vast majority of emotional Stroop studies use small word sets (e.g., 12 emotional and 12 neutral) that are repeated numerous times throughout the task. However, studies that have used larger word sets with only a single presentation (e.g., Gotlib & Cane, 1987; Gotlib & McCann, 1984) have also reported emotional Stroop interference effects. Thus, repetition effects also cannot be the main reason for interference in the emotional Stroop task. Finally, Williams and colleagues suggested that emotional Stroop interference might result from participants forming an interpretation of the experiment's purpose and consciously attending emotional words accordingly. However, several studies have shown that emotional Stroop interference can be found using short presentation times that limit conscious awareness of the materials, and do not give participants time to consciously alter their behaviour (e.g., Mogg, Bradley, Williams, & Mathews, 1993; Mogg, Kentish, & Bradley, 1993). Thus, despite

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[3] For example, priming by a word within a single category (e.g., negative emotional words such as ‘evil’) increases the likelihood of recognizing (and therefore attending) subsequently presented words from the same category (e.g., ‘anger’), thus increasing interference effects for words within the same category.

debate surrounding the correct interpretation of interference effects in the emotional Stoop, evidence suggests that emotional Stoop interference does not reflect priming effects, repetition effects, or conscious efforts by the participant to alter their behaviour in support of the experimental hypotheses.

One important feature of the emotional Stroop paradigm is that it examines only non-spatial influences of emotion on attention. In other words, this task measures the extent to which the emotional meaning of a stimulus influences attention to other stimulus features within the same spatial location. As a result, the emotional Stroop task cannot examine the direction of possible attentional shifts (i.e., vigilance versus avoidance of emotional information, attentional orienting versus disengagement) that may underlie interference effects. Instead, cueing paradigms such as the dot-probe task (discussed in section II-2.2.2) are better suited to exploring such attentional shifts.

2.2.2. Emotional Dot-Probe Task

The emotional dot-probe task is one of the best known cueing paradigms to investigate spatial selective attention. In this task, participants are presented with two stimuli simultaneously (e.g., on either side of a fixation point) for a set period of time (stimulus exposure duration). The stimuli disappear from view, and a target (the “dot-probe”) then follows unpredictably in the location of one or the other stimulus. The participants’ task is to respond to the dot-probe as quickly and accurately as possible. This task assumes that individuals will be faster to respond to targets replacing previously attended stimuli as compared to targets replacing unattended stimuli, because of the added time required to shift one’s attention across the computer screen (to the unattended location; for a review see Frewen, Dozois, Joanisse, & Neufeld, 2008). Previous research with the dot-probe paradigm has generally demonstrated response time facilitation (i.e., shorter reaction time) to the dot- probe when it followed a negative stimulus. In their seminal study MacLeod, Mathews, and Tata (1986) found that when one of two words was emotionally valenced, for example, “death”, and the other word was neutral, for example, “table”, participants were faster to respond to the dot-probe when it later appeared in the location of "death" rather than "table". These findings were taken as evidence that emotional stimuli are generally better able to capture attention than are neutral stimuli.

In the emotional dot-probe task, the response times to emotion-congruent trials (i.e., trials in which the dot appears in the same location of a previously presented emotional stimulus) and emotion-incongruent trials (trials in which the dot appears in the opposite location of the previously presented stimulus) can be calculated and compared. Results are then usually reported as *attentional bias scores,* based on subtracting response times in emotion-congruent from those in emotion-incongruent trials. A positive value indicates attentional vigilance whereas a negative value indicates attentional avoidance (Yiend & Mathews, 2005). One of the most important features of the emotional dot-probe task is the interval between the appearance of the stimulus and target (stimulus onset asynchrony, SOA). The dot-probe can be thought of as taking a snapshot of attention at the point of the SOA. For example if the dot-probe appears 250 ms after the onset of the stimulus, then the response time to the dot-probe reflects the location of attention (either toward or away from a stimulus) at 250 ms. Several studies have examined the impact of altering the SOA (e.g., Derryberry & Reed, 2002; McCabe & Toman, 2000) and have found evidence for shifts of attention both toward (i.e., vigilance) and away from (i.e., avoidance) emotional stimuli across the timeline of attention. These findings suggest that conclusions regarding the direction of attention (i.e., vigilance or avoidance of emotional information) are reliant on SOA. Thus, in contrast to the emotional Stroop task, the dot-probe task allows researchers to examine the direction of attentional shifts either toward (vigilance) or away from (avoidance) emotional information at different points along the timeline of the attentional process.

2.2.3. The Impact of Individual Differences on Attention/Emotion Interactions

Apart from emotion generally guiding attention, a number of personality factors play a crucial role in mediating the relationship between attention and emotion. An early example of how personalised information can mimic emotional prioritisation in attention comes from Moray's (1959), finding that a person's own name can capture and direct attention. This phenomenon – known as the "own name effect" – is often taken as early evidence for the role of personal meaning in guiding the focus of selective attention (Robinson, 1998). Thus, attentional biases may be strongest for those stimuli and events that are most personal and closely related to an individual's concerns (e.g., MacLeod & Rutherford, 1992; Mathews & Klug, 1993). Individual differences affecting the strength of the emotion-attention interaction have been observed with both the emotional Stroop task and the emotional dot-probe task. Indeed, Williams et al.'s (1996) review on emotional Stroop studies that were conducted between 1970 and 1996 concludes that the majority of emotional Stroop effects may have emerged within pathological conditions and with the usage of idiosyncratic stimuli. Therefore, most applications of the emotional Stroop paradigm are concerned with psychopathology and individual differences in mental disorders that affect attention, e.g., various anxiety disorders which consistently seem to produce larger emotional Stroop effects than their healthy counterparts (e.g., Martin, Williams, & Clark, 1991; Mathews & Klug, 1993; Mathews & MacLeod, 1985; Mogg, Mathews, & Weinman, 1989). While high trait-anxiety within the normal range also increases emotional Stroop effects, results are more variable (e.g., MacLeod & Rutherford, 1992; Mogg, & Marden, 1990; Richards, French, Johnson, Naparstek, & Williams, 1992).

Similarly, since the initial attentional dot-probe study by McLeod et al. (1986), one of the most important findings has been that individual differences play an important role in moderating the direction and strength of attentional bias scores. For example, the majority of research using this paradigm has found that high trait anxious individuals are more likely than low trait anxious individuals to show an attentional bias towards threatening stimuli (for reviews, see Frewen et al., 2008; Mineka, Rafaeli, & Yovel, 2003; Williams et al., 1996). Interestingly, individual differences in trait anxiety seem to exert a greater impact on the ability to *disengage* attentional resources from the location of a threatening stimulus, than on the speed of *orienting* attention toward the stimulus location. To illustrate, Fox Russo, Bowles, and Dutton (2001) presented angry, happy, and neutral faces as cues to a target location in a dot-probe task. On invalid trials (i.e., face and dot-probe appear in different locations), high anxious individuals took longer to respond to the dot-probe when the invalid cue was an angry face as compared to when the invalid cue was either a happy or a neutral face, indicating prolonged attentional disengagement. This pattern was not observed in low anxious individuals. Importantly, high anxious participants were not faster to respond to the dot-probe when it followed in the same location as angry faces as compared to when it followed happy or neutral faces (attentional orienting). These results suggest that anxiety is associated with a tendency to dwell on (i.e., difficulty in disengaging attention), rather than to quickly orient toward, threatening stimuli such as angry facial expressions.

In summary, these findings suggest that to the extent that a group of individuals share similar emotional characteristics (e.g., anxiety), similar attentional biases are likely to be observed among those individuals. Along the same line of reasoning, to the extent that there are individual differences in emotional characteristics among people (e.g., high versus low trait anxiety), differences in attentional biases related to those concerns are also likely to be observed.

3. Emotion Regulation

The previous section examined how attention is influenced by emotional connotation of to-be-processed information, how emotional stimuli capture or hold attention more so than do neutral stimuli and how individual differences influence the strength of attention modulation by emotion. If the emotionality of a stimulus influences the way it is attended, and if characteristics of the perceiver influence the (unconscious or conscious) perception of what is emotional, then changes in an individual's emotional responses to stimuli should in turn be reflected in changes in attentional patterns. However, little is known about how attentional biases for emotional information interact with a person's attempt to modulate their emotional responses to stimuli.

The modulation of emotions, or emotion regulation refers to the processes by which people influence which emotions they have, when they have them, and how they experience and express their emotions (Gross, 1998b). As mentioned, Gross and Thompson's (2007) "modal model" defines emotion as a person-situation interaction that guides attention, has specific meaning to an individual, and gives rise to a coordinated and flexible multisystem response. The emotion-generative process is viewed as being both linear and unidirectional (see Figure 2a). However, once a situation is appraised as emotionally significant, the resulting experiential, physiological, and behavioural changes that make up the emotional response in turn alter the initial situation. The resulting situation can then itself be evaluated for emotional significance (Figure 2b). In this way, emotions are generated through a dynamic process that involves multiple components (i.e., an event, attention, appraisal, responses), and evolves over time (Gross, 1998b; Gross & Thompson, 2007). According to Gross (2002), because emotions involve multiple components and unfold over time, emotion regulation should involve changes in the relationship between the experiential, physiological, and behavioural responses across the time-course of the emotion (e.g., physiological responses in the absence of behavioural responses), with the goal of changing the "emotion dynamics" (i.e., latency of response, magnitude of arousal, duration of arousal; Thompson, 1990).

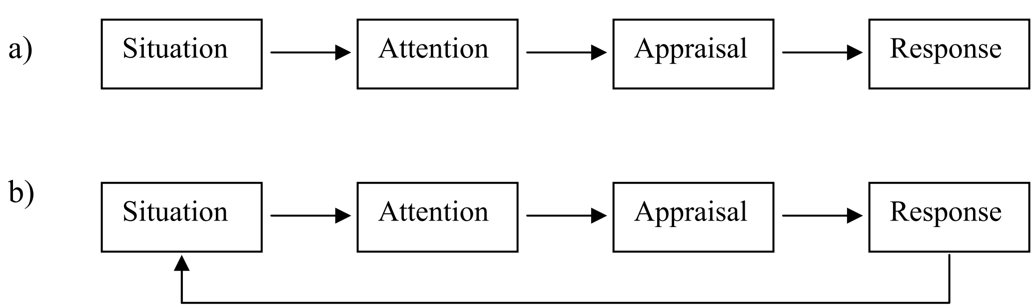

Figure 2. A process model of emotion.

According to Gross' (1998b) process model of emotion regulation (shown in Figure 3), emotion regulation strategies can be differentiated by the point in the emotion generative process at which they exert their initial impact. It is important to note that Gross' (1998b) model represents a highly simplified version of emotion regulation. A more comprehensive model should account for the possibility that emotion regulation does not occur in a linear fashion along the timeline of emotion (as Gross' model suggests), but rather that different emotion regulation strategies may be activated concurrently, with each strategy influencing the experience and expression of emotion, and thus interact with each other throughout the process of regulating emotion.

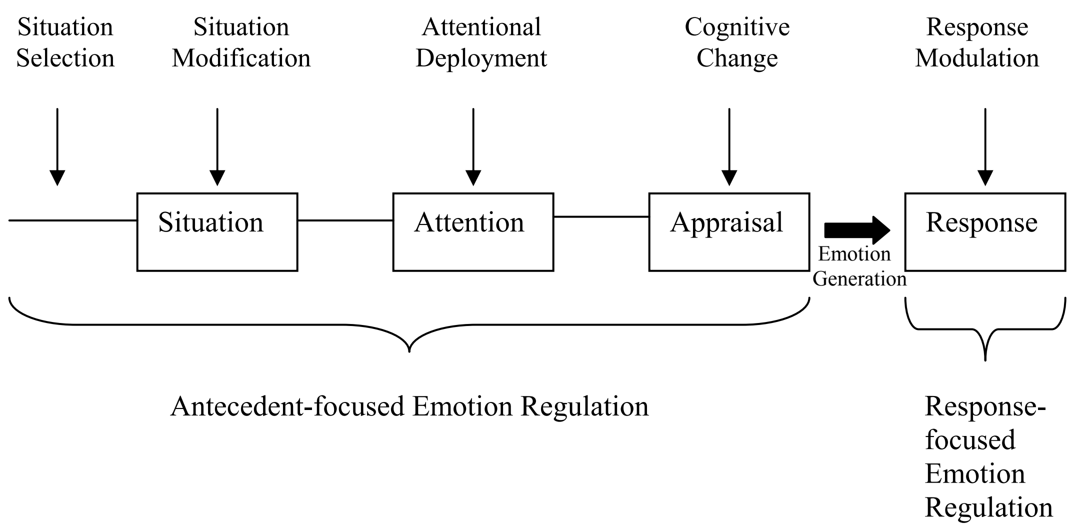

Figure 3. Gross' (1998b) process model of emotion regulation with five families of emotion regulation strategies.

At the broadest level, Gross (1998b) distinguishes between antecedent- and response-focused emotion regulation strategies. Antecedent-focused emotion regulation strategies refer to those strategies that can be employed prior to fully experiencing an emotion (i.e., before the emotion becomes active and changes our behavioural and physiological responding). An example of antecedent-focused emotion regulation is thinking of an upcoming exam as an opportunity to learn more about a topic and gauge your progress in a course, as opposed to thinking of it as a stressful event that determines your worth as a student. Response-focused emotion regulation strategies refer to those strategies that are employed once an emotion is already being experienced, and has activated behavioural and physiological changes. An example of response-focused emotion regulation is holding back tears when receiving sad or frustrating news.

Within these two broad categories of emotion regulation, Gross (1998b) suggests five smaller families of emotion regulation strategies (for a more detailed discussion on these strategies, see Gross, 1998b; Gross & Thompson, 2007). The first of the antecedent-focused emotion regulation strategies is situation selection, which refers to either approaching or avoiding certain situations or stimuli in order to regulate emotions. Once a situation has been selected, an individual can then use situation modification, which refers to active attempts to alter the selected situation so as to limit, intensify, or maintain its emotional impact. Within every situation, there are numerous aspects which can either be attended or ignored. Attentional deployment is an emotion regulation strategy in which a person selects which aspects of the situation they will attend in order to circumvent, increase, or maintain an emotional response. Once a person has attended a particular situation, the event is appraised to determine its emotional significance. Cognitive change (also commonly referred to in the emotion regulation literature as "reappraisal") refers to selecting which of many possible meanings will be attached to the attended aspect of a situation. The personal meaning that is attached to a situation can, in turn, elicit emotion effects and determines whether a situation will be prioritised in attention. Therefore, situational meaning should also be central to determining whether and which experiential, behavioural, and physiological emotion responses will be generated. Once an emotion is already underway and experiential, behavioural, and physiological responses have been elicited, individuals can use response-focused emotion regulation strategies to alter their emotional response. Specifically, response modulation (e.g., suppression) refers to attempts made by an individual to influence on-going emotional responding.

3.1. Consequences of Emotion Regulation

In recent years, many studies have examined whether there are differences in the affective and cognitive consequences of different emotion regulation strategies, using both experimental and individual-differences study designs. To date, the vast majority of emotion regulation research has focused on cognitive reappraisal and expressive suppression, possibly due to the ease with which these strategies can be experimentally manipulated and instructed in a laboratory setting. In the following, I will first review effects of reappraisal and suppression on the experience of emotion itself by addressing both experimental findings and individual differences findings. Next, I will review cognitive consequences of reappraisal and suppression, again in experimental studies that manipulated both strategies, and in studies that compared individual differences in reappraisal and suppression.

3.1.1. Emotional Consequences of Reappraisal and Suppression

One of the prime goals of emotion regulation is to modify an emotional response. According to Gross (1998b) reappraisal is a form of emotion regulation that is evoked early on in the emotion generation process, altering the emotion before experiential, behavioural, and physiological responses are elicited. In contrast, suppression is evoked later in the emotion-generative process, once experiential, behavioural, and physiological changes have already occurred. Given that reappraisal and suppression are activated at different points along the timeline of the unfolding emotion, it seems possible that the use of reappraisal and suppression might have differential consequences for the emotional response.

3.1.1a. Experimental Manipulation of Reappraisal and Suppression and Effects on Emotion

Lazarus and colleagues were among the first to provide evidence that cognitive reappraisal may influence emotional responding (Lazarus & Opton, 1966). For example, in one study, participants watched a filmed circumcision (Lazarus & Alfert, 1964). While viewing the film, half of the participants heard a soundtrack designed to minimize the negative emotional impact of the film by rejecting the notion that the surgery involved pain and instead emphasizing the joyful aspects of the ritual. The other half of the participants heard no soundtrack at all. Compared to the no soundtrack condition, participants who heard the soundtrack had lower skin conductance responses (i.e., physiological levels of arousal) and higher self-reported pleasant mood ratings. These findings suggest that leading participants to interpret a potentially distressing situation in a positive light decreases physiological and experiential emotional responding.

The physiological and experiential consequences of expressive suppression have also been investigated. For example, Gross and Levenson (1997) examined the affective consequences of suppressing sadness. In this study, participants were asked to inhibit behavioural expressions of emotion while viewing film clips known to elicit sadness. Results showed that suppressing sadness led to increased sympathetic activation of the cardiovascular system (as indexed by changes in finger pulse amplitude, finger temperature, and pulse transit times to the finger and ear) without affecting participants' self-rated experience of sadness. Similarly, Harris (2001) found that suppressing behavioural expressions of embarrassment led to increased blood pressure responses, but did not impact self-reported experiences of embarrassment. These findings suggest that the instructed use of suppression does not have an impact on the actual emotional experience, and may have reinforcing rather than dampening effects on the physiological responses associated with negative emotion. Thus, according to Gross and supported by evidence from Gross and Levenson (1997) as well as Harris (2001), the expressive suppression of negative emotions decreases neither physiological responding nor the actual experience of negative emotions (but see McCanne & Anderson, 1987; Stepper & Strack, 1993; Strack, Martin, & Stepper, 1988 for possible contrary evidence in the domain of positive emotion suppression and experience[4]). In summary, studies examining the experiential and physiological consequences of reappraisal and suppression have provided some evidence that reappraisal may result in decreased physiological

[4] Studies have shown that holding a rigid neutral facial expression while reading funny cartoons did in fact decrease self-reported ratings of amusement (McCanne & Anderson, 1987; Strack et al., 1988). Similarly, suppressing behavioural expressions of pride (i.e., puffing up the chest) decreased self-reported feelings of pride in a study by Stepper and Stack (1993). Together, these findings suggest that suppressing positive emotion-expressive behaviour may indeed result in marked decreases in *positive* emotion experience (e.g., amusement), contrary to suppressing reactions to negative emotional stimulation.

and experiential negative emotional responding, while suppression appears to have limited effects on negative emotion experience.

In a direct comparison of reappraisal and suppression and their emotional consequences, Gross (1998a) showed participants a short film clip of an arm amputation that was known to elicit disgust. Prior to viewing the film, participants were administered instructions associated with one of three experimental conditions. Participants were instructed either to watch the video in such a way that an observer would not know what they were feeling (suppress condition), to watch the film with the detached interest of a medical professional (reappraise condition), or to simply watch the film (control condition). Gross (1998a) found that participants in the suppress condition showed decreased disgust-expressive behaviours, increased sympathetic activation, and no change in disgust self-ratings as compared to controls. Like suppression, participants in the reappraise condition showed decreased disgust-expressive behaviour as compared to controls. Unlike suppression however, participants in the reappraise condition did not show increased sympathetic activation as compared to controls. Also unlike suppression, participants in the reappraise condition had lowered self-reported experiences of disgust. These findings are in line with previous research examining the affective consequences of reappraisal (e.g., Lazarus & Alfert, 1964) and suppression (e.g., Gross & Levenson, 1997) and suggest that while reappraisal leads to decreases in the experience and expression of negative emotion, suppression may decrease only the expression of negative emotion without having any effects on the subjective emotion experience and even increase physiological responding.

Gross (2001) suggested that findings that favour the effectiveness of reappraisal as compared to suppression as an emotion regulation strategy might be explained by examining the point along the emotion-generative process at which each emotion regulation strategy exerts its first impact. He argued that because reappraisal occurs early in the emotion-generative process this strategy may be able to halt the emotion before it is fully activated. By contrast, suppression may occur much later in the emotion generating process, after emotional responding is already fully activated. As a result, suppression is able to alter the expression of emotion but is less effective in altering the actual experience of emotion.

It is important to note that Gross's (1998b) model of emotion regulation conceptualizes emotion as simple, linear, and causal. Although the limitations of this process model (Gross, 1998b; Ochsner & Gross, 2004) explicitly state that regulation strategies act continuously along the timeline of an unfolding emotion, the explanation given in all the studies reviewed here assumes that for each emotion regulation strategy there is a specific point along the timeline of the unfolding emotion at which it is activated, and that the emotion response is the end point for emotion regulation. Recently, one research group (Sheppes & Meiran, 2007) has begun to address this limitation by examining the consequences of reappraisal when initiated at *different* points along the emotion timeline. In one study, participants were shown a sad film. The film depicted Holocaust survivors who had been abandoned by their families only to end up in mental institutions. Subtitles containing instructions to regulate emotion were embedded at three points during the film: in advance, early in the film, or late in the film. Some of the participants received instructions to adopt a neutral attitude toward the film by thinking about the film in such a way that they did not feel any emotion at all (reappraise). Others received instructions to simply watch the film and allow themselves to experience any emotions that might arise while viewing the film (control/unregulated). Sheppes and Meiran found that reappraisal was more effective when initiated early relative to late in the film (i.e., the emotional experience). However, their results further suggested that even when initiated late, recovery from negative mood by reappraisal may be possible if the emotion regulation period was long enough. Regardless of the point of initiation, reappraisal was found to result in observable decrements in self-reported negative emotion experience as compared to the unregulated control group.

Several recent neuroimaging studies (for a review see Ochsner & Gross, 2008) have also presented evidence bearing on the issue of the divergent effects of reappraisal and suppression on the experience and expression of emotion. For example, in one study (Phan, Fitzgerald, Nathan, Moore, Uhde, & Tancer, 2005) participants were instructed to either maintain the negative emotions evoked by viewing aversive pictures or to down-regulate their emotions by reappraising the meaning of the pictures. This study found that the voluntary use of reappraisal activated dorsal portions of the prefrontal cortex (PFC; implicated in working memory and selective attention), ventral portions of the PFC (implicated in response inhibition), dorsal portions of the medial PFC (implicated in reflecting on affective states of oneself or others), and dorsal portions of the anterior cingulate cortex (ACC; implicated in conflict detection and resolution). Additionally, activity within the dorsal ACC was inversely related to the self-reported experience of negative emotion whereas activity in the amygdala was positively related to emotional experience. Thus, this study found that reappraisal was associated with increased activity in several regions of the PFC as well as the ACC, suggesting that reappraisal requires some degree of cognitive effort.

Furthermore, Ohira et al. (2006) compared brain activity associated with the instructed use of reappraisal and suppression over the course of viewing negative emotional film clips. Ohira and colleagues (2006) found that for reappraisal, early engagement of the PFC produced decreased amygdala activity over time, whereas for suppression, late engagement of the PFC produced increased amygdala activity over time. These findings suggest that reappraisal and suppression may engage similar control systems, but at different times. This study suggests that the down-regulation of emotion-associated brain activity (i.e., amygdala) is more successful after reappraisal than suppression. Interestingly, the results of both studies point to the idea that reappraisal might not be as effortless as suggested by Gross (1998b), since more activity (rather than less) in the ACC and PFC seems necessary for down regulation of the emotion experience and/or amygdala activity.

3.1.1b. Individual Differences in Reappraisal and Suppression and Effects on Emotion

The experimental findings described in the previous section clearly show differential affective consequences associated with reappraisal and suppression.

The question remains: Will stable individual differences in the habitual use of these two emotion regulation strategies also result in differential affective consequences? Individuals who habitually suppress should, by definition, show less negative emotion-expressive behaviour in everyday life. Given the varying effects of suppression on emotion experience for negative versus positive emotions, it can further be assumed that individuals who habitually suppress emotion should have similar levels of negative emotion experiences as non-suppressors, but fewer positive emotion experiences. In contrast, individuals who habitually reappraise should have lower negative emotion expression and fewer negative experiences.

In order to assess stable individual differences in suppression and reappraisal Gross and John (2003) developed the Emotion Regulation Questionnaire (ERQ). In their study, participants were asked about their habitual use of suppression and reappraisal. Additionally, participants rated their general level of emotion experience and expression using the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), and indicated how much they generally experienced and expressed six discrete positive emotional states (e.g., joy, love) and six discrete negative states (e.g., sadness, anger). Finally, Gross and John (2003) obtained peer ratings of the participants' general level of emotion expression using the same discrete measure. In line with the predictions outlined above, suppression was associated with lower levels of positive emotion experience and expression. Additionally, suppression was associated with lesser negative emotion expression. Findings regarding the influence of suppression on negative emotion experience was mixed; with some participants reporting no effects of suppression on emotion experience, and others reporting increases in negative emotion. By contrast, reappraisal was associated with lower levels of negative emotion experience and expression, and higher levels of positive emotion experience and expression. For both suppression and reappraisal, self- and peer reports of emotion expression converged with the results from previous experimental studies showing that both reappraisal and suppression decreased observable emotion expression (Gross & Levenson, 1997).

In addition, a recent fMRI study (Drabant, McRae, Manuck, Hariri, & Gross, 2009) showed that, much like the fMRI findings for instructed reappraisal, trait differences in reappraisal were associated with decreased activation in emotion sensitive brain regions such as the amygdala and increased activation in prefrontal control regions in response to negative emotional stimuli. Unlike instructed suppression, these researchers found no significant positive relationship between trait suppression and activity in the amygdala or prefrontal regions. Together with the experimental results described in the section II-3.2.1, these findings suggest that suppression and reappraisal have divergent and partly opposing consequences on experiential, physiological, and neurological levels.

3.1.2. Cognitive Consequences

Previous sections of this review have shown that emotion can influence on-going cognitive processes (e.g., selective attention). Given that the primary goal of emotion regulation is to alter or maintain positive and negative emotional states (Gross, 1998b; Gross, 2002; Parrott, 1993), and that reappraisal and suppression differ in their consequences for emotional responding (Gross & Levenson, 1997), it seems likely that the use of suppression and reappraisal might also have differential consequences for concomitant cognitive processes.

As outlined above (section II-3), according to Gross (1998b) suppression is a form of emotion regulation that occurs late in the emotion-generative process and requires ongoing self-monitoring and self-corrective action throughout an emotional event. Such constant monitoring may require continuous cognitive resources that would reduce the resources available for other cognitive processes (e.g., attention, memory). By contrast, if reappraisal is evoked early on, before the emotion is able to fully impact physiological and behavioural responding, reappraisal should not require the continuous self-regulatory effort that is required by suppression. Thus, reappraisal should have less impact on concomitant cognitive processes than suppression.

3.1.2a. Experimental Manipulation of Reappraisal and Suppression and Effects on Cognition

In one series of studies, Richards and Gross (2000) examined the cognitive consequences of the instructed use of reappraisal and suppression. As a target cognitive function, they chose memory. In their first study, participants were shown a short film known to elicit negative emotion, depicting an argument between a husband and wife that was witnessed by their young child. Half of the participants were instructed to watch the film in such a way that an observer would not know what they were feeling (suppress condition), while the other half of participants were instructed to simply watch the film (control condition). To assess the cognitive impact of suppression a surprise cued memory recognition test for both auditory and visual details of the film was administered following the film viewing. In line with Gross' (2002) suggestion that suppression should result in impairments in concomitant cognition, Richards and Gross found that the use of suppression resulted in observable decrements in memory performance as compared to memory in the control condition.

In a follow-up study, Richards and Gross (2000) examined the cognitive consequences of both reappraisal and suppression. In this study, participants were shown a series of slides depicting medical accidents that were known to elicit negative emotion. Each slide was further accompanied by auditory information that described the slide. As in their previous study, some participants were instructed to watch the slides in such a way that an observer would not know what emotions they might be feeling (suppress condition). Others were instructed to view the slides with the detached interest of a medical professional (reappraise condition). Others were simply instructed to watch the slides (control). After viewing, participants were administered a memory test in which participants were asked to write down the information associated with each slide as it was presented a second time. In line with their first study, Richards and Gross found that suppression led to measurable decrements on the verbal memory test as compared to controls. By contrast, reappraisal had no impact of verbal memory. Together, these findings suggest that suppression, but not reappraisal, leads to impairments in concomitant cognition, in this case explicit memory.

A subsequent study by Dillon, Ritchey, Johnson, and LaBar (2007) has replicated and extended these findings. Here, participants were instructed to enhance, maintain, or decrease their emotions through the use of either reappraisal or suppression while viewing aversive and neutral pictures. Following encoding of the pictures, participants were administered surprise explicit (free recall) and implicit memory tests (perceptual priming: categorization task in which priming was inferred when participants required less time to categorize studied compared to novel pictures). In line with Richards and Gross' (2000) findings, Dillon and colleagues (2007) found that suppressing emotionally expressive behaviour impaired performance on free recall. By contrast, using reappraisal to enhance emotion experience improved performance on free recall. However, using reappraisal to decrease emotion had varying effects: reappraising aversive pictures improved free recall performance while reappraising neutral pictures was found to impair performance on free recall. Emotion regulation did not impact implicit memory. Together with findings from Richards and Gross, these results suggest that emotion regulation impacts explicit, but not implicit memory processes. With respect to explicit memory, down-regulation of negative emotion by suppression, but not reappraisal, seems to lead to later memory impairments.

Similar to Sheppes and Meiran (2007), Sheppes and Meiran (2008) instructed participants to initiate emotion regulation at a later time point during the unfolding of an emotional event, and in this experiment, studied cognitive consequences of late-onset emotion regulation. Participants were shown a sad film depicting Holocaust survivors who had been abandoned by their families and ended up in mental institutions (see Sheppes & Meiran, 2007). Subtitles containing instructions to regulate emotion were embedded approximately half-way through the film. Some of the participants received instructions to adopt a neutral attitude by thinking about the film in such a way that they did not feel any emotion at all (reappraise condition). Others received instructions to divert their attention from the emotion of the film by thinking about neutral thoughts (distraction condition). Following the viewing, participants were administered two tests. The first was a standard Stroop test to assess depletion of self-control resources. The Stroop task requires that an individual inhibit the prepotent response (i.e., reading the word) in order to respond correctly (i.e., ink-color). Individuals with depleted self-control resources have greater difficulty inhibiting the prepotent response of reading the word itself, as reflected in longer colour-naming latencies (see Inzlicht & Gutsell, 2007). The second task was a surprise cued recognition memory test that covered events from the film that had occurred both before and after emotion regulation onset. Interestingly, late reappraisal resulted in decrements in self control resources (longer colour-naming response latencies on the Stroop task). Additionally, late distraction but not reappraisal impaired memory performance. Sheppes and Meiran (2008) suggest that late reappraisal requires the individual to overcome a natural and previously well-established tendency of prioritising the emotional content of the situation in information processing (see literature review section II-2) resulting in a depletion of self-control resources. Additionally, according to Sheppes and Meiran's (2008) interpretation, because reappraisal may require attention to the emotional situation to transform well established emotional interpretations into unemotional ones, memory was not impacted by reappraisal. Distraction, in contrast, requires diverting attention away from the emotional situation, e.g., by saturating the working memory with neutral contents. As a result, memory for the emotional situation will be impaired (Sheppes & Meiran, 2008). In summary, results from experimental studies suggest that while suppression is cognitively costly, reappraisal appears to have much less of an impact on concomitant cognitive processes, (e.g., explicit memory).

3.1.2b. Individual Differences in Reappraisal and Suppression and Effects on Cognition

While research examining the cognitive consequences of emotion regulation using an individual differences approach are rather limited, in one study, Richards and Gross (2000) examined the influence of stable individual differences in reappraisal and suppression on memory. Their goal was to examine whether individual differences in emotion regulation have the same consequences on memory as instructed reappraisal and suppression use. In their study, Richards and Gross measured individual differences in the habitual use of reappraisal and suppression using the Emotion Regulation Questionnaire (Gross & John, 2003). Additionally, memory was assessed using one subjective and one objective test of memory. The subjective measure was a self-report questionnaire of memory for conversations (Herrmann & Neisser, 1978). The objective measure was a free-recall test for episodes of emotion regulation that occurred over a 2-week period that had been recorded daily in diary form. Richards and Gross found that individuals who scored higher on suppression self-reported having worse memory than those who scored lower on suppression. Additionally, high suppression scorers performed less well on the objective memory test than low suppression scorers. By contrast, individual differences in reappraisal had no impact on either self-reported or objective memory. Importantly, these memory findings remained significant when controlling for social desirability (using the Marlowe-Crowne Social Desirability Scale; Crowne & Marlowe, 1960) a measure of desirable responding in which an individual consciously or unconsciously answers self-report measures such that they endorse only positive traits). These findings support the results of the experimental studies, and suggest that while suppression is cognitively costly, reappraisal may result in less cognitive cost.

In another study, Richards and Gross (2006) observed spontaneous expressive suppression during a film depicting a surgical procedure, and later assessed memory for the film. Their results suggested that greater suppression was associated with decreases in memory performance for the events of the film. A follow-up study by the same group examined the effects of four types of emotion regulation on memory for the events of a film depicting a marital conflict: Dispositional (trait) suppression, instructed (state) suppression, as well as trait and instructed self-distraction. Distraction entails the use of intentional attempts to not think about the emotional event to down regulate negative emotions. The results of this study found that both spontaneously occurring and experimentally induced suppression were associated with impaired memory for the events of the film. These effects were similar to the effects of dispositional and experimentally induced self-distraction. Together these studies mirror findings from experimental research examining the cognitive costs of emotion regulation and suggest that while suppression is cognitively costly, reappraisal may have much less of an impact on cognitive processes such as memory.

4. Summary

An extensive literature suggests that cognition is influenced by the emotional connotation of to-be-processed information. Emotional events, especially negative emotional events, orient, attract and/or capture attention more so than neutral facts. Evidence comes from studies using the emotional Stroop paradigm (Pratto and John, 1991; Mathews & MacLeod, 1985) and the emotional dot probe paradigm (Mathews et al., 1986), both suggesting that emotional information is subject to attentional biases and prioritised processing. Several person variables influence such biases. For example, high trait-anxious people show exaggerated biases towards negative information (e.g., Fox et al., 2001; Fox, Russo, & Dutton, 2002). However, little is known about how attentional biases may interact with a person's attempt to modulate their emotional responses. Recent theories on emotion regulation suggest that there may be differences in the cognitive costs of certain regulative strategies. For instance, it has been suggested that suppression is linked to cognitive and behavioural cost (e.g., incomplete down-regulation of emotion, high physiological arousal despite conscious down-regulation attempts, and emotional memory impairment, e.g., Gross & John, 2003; Richards & Gross, 2000). In contrast, reappraisal is thought to be associated with genuine reductions in (negative) emotion experience and related physiological responses, without impairing emotional memory (e.g., Gross & John, 2003; Richards & Gross, 2000; Richards & Gross, 2006).

Two aspects of emotion-cognition interactions in the context of emotion regulation have not been studied well: First, although memory seems sensitive to some types of emotion regulation, little is known about attention. Secondly, in addition to instructed use of emotion regulation strategies, we know little about effects of trait-emotion regulation on cognition. Thus, the following studies investigated relationships between trait-emotion regulation variables (including reappraisal and suppression) along with other relevant personality variables (anxiety, defensiveness) in their impact on selective attention to negative emotional information (assessed with an emotional dot-probe task). Because the human face serves as a particularly interesting and meaningful cue for emotion in humans, angry and neutral human faces were chosen as stimuli for this set of studies.

III. Experiment 1

The aim of this experiment was to examine the relationship between trait-emotion regulation (including reappraisal and suppression) and selective attention to emotionally negative information (assessed with an emotional Stroop and an emotional dot-probe task). My review of the literature on the relationship between emotion and attention (section II-2) has shown that emotion can influence on-going cognitive processes (e.g., selective attention). Given that one of the prime goals of emotion regulation is to modify an emotional response (Gross, 1998b; Gross, 2002; Parrott, 1993), it seems likely that the down regulation of an emotional response might also result in an attenuation of the consequences for concomitant cognitive processes (e.g., selective attention). Therefore it was hypothesized that:

1. Trait emotion regulation will be correlated with better attentional control (i.e., away from negative materials), whereas a trait emotion expression will be correlated with worse attentional control.

Additionally, a review of the literature on emotion regulation (section II-3) has shown that that while suppression is cognitively costly, reappraisal appears to have less of an impact on concomitant cognitive processes, (e.g., memory). Gross (1998b) has suggested that the divergent impact of suppression and reappraisal on concomitant cognitive processes may be accounted for by differences in the cognitive effort required by each strategy. Specifically, suppression likely requires a constant outlay of cognitive resources (i.e., self-monitoring and self-corrective action) throughout an emotional event that reduces the resources available for other cognitive processes (e.g., attention, memory). By contrast, reappraisal cuts the emotion off early and as a result should not require the same continuous self-regulatory effort that is required by suppression. Although attention is a cognitive process that has not yet been well studied in the context of emotion regulation, it seems likely that, similar to memory, selective attention might also be negatively impacted by the use of more effortful emotion regulation strategies (suppression) as compared to less effortful emotion regulation strategies (reappraisal). In addition, as outlined in section II-2.2.3, highly emotional individuals (e.g., those with high trait anxiety e.g., Williams et al., 1996, or psychopathology e.g., Martin et al., 1991) have more pronounced selective attention biases towards negative materials. Suppression (both as a momentary strategy of emotion regulation or as a stable trait) is not effective in actual down-regulation of acute negative emotional experiences (e.g., Gross and Levenson, 1997; see sections II-3.1.1a through II-3.1.1b). In contrast, acute and chronic reappraisal seems more successful in actual down-regulation of negative emotionality (see sections II-3.1.1a through II-3.1.1b). Assuming then that attention biases towards negative information reflect trait emotionality, it was hypothesized that:

2. Trait-suppression will be correlated with worse attentional control (i.e., away from negative materials). This means suppression scores will be positively correlated with attentional bias scores.
3. Trait-reappraisal will be correlated with better attentional control away from negative materials. This means reappraisal scores will be negatively correlated with attentional bias scores.

1. Method

1.1. Participants

A total of 121 undergraduate students (40 male and 81 female) were recruited through the University of Alberta Department of Psychology undergraduate research pool. The mean age of participants was 19.44 years (*SD* = 2.21, range = 17–33 years). Each participant received partial course credit toward a research participation requirement of their introductory psychology course. Participants who omitted responses on one or more of the questionnaires were excluded. In total, 104 participants (38 male and 65 female; mean age 19.39, *SD* = 2.04, range = 17-33 years) were included in the final sample of this study.

1.2. Materials

To examine the relationship between selective attention and trait-emotion regulation along with other relevant personality variables, three measures of selective attention and six separate personality measures were used. Section III-1.2.1 provides a detailed description of the selective attention measures used in this experiment. Section III-1.2.2 provides details of the six personality measures.

1.2.1. Measures of Selective Attention

Selective attention was assessed using an emotional Stroop task and two dot-probe tasks. Sections III-1.2.1a and III-1.2.1b describe, in detail, the stimuli and design of the emotional Stroop task used in this experiment. Sections III-1.2.1.c and III-1.2.1d describe the stimuli and design of the dot-probe tasks used in this experiment.

1.2.1a. Emotional Stroop Task Stimuli

Word stimuli were selected with the aim of creating neutral and negatively valenced emotional word categories. Selection of negative and neutral word stimuli was based on valence ratings from a normed word database containing emotional and neutral words (Affective norms for English words [ANEW];

Bradley & Lang, 1999). Valence is rated in the ANEW list on a 1-9 scale where higher valence scores define positively valenced words, scores between 4 and 6 define neutral words, and lower scores define negatively valenced words (Siegle, 1994). In total, 24 negatively valenced words, and 24 neutral words were selected from the ANEW word list such that each individual neutral word stimulus had a valence score between 4 and 6, and each negative word stimulus had a valence score less than 3.15. Mean valence scores for the neutral and negative word lists were 4.99 (SD = 0.23), and 2.29 (SD = 0.53) respectively. Additionally, with a third study in mind (not reported in this thesis), a second emotional word category was added, comprising words of potential salience to borderline personality disorder patients (i.e., words related to rejection; Arntz, Appels, & Seiswerda, 2000). Twenty-four borderline-salient words were selected to match an English translation of the original Dutch word list created and provided to me by Arntz and colleagues (2000).

The three lists (i.e., neutral, negative, BPD-salient words) were matched for mean word frequency (Kucera-Francis written word frequency according to the MRC Psycholinguistics database; Kucera & Francis, 1967), and number of letters. There were no significant differences in word frequency ($F[2, 34] = 0.26$, $p = .77$), or number of letters ($F[2, 46] = 2.78$, $p = .07$) across the three word lists. The final words are listed in Table 1.

Table 1

Emotional Stroop word items listed by category for Experiment 1

Neutral	Negative	Borderline-salient
Thermometer	Accident	Powerless
Scissors	Cancer	Helpless
Bandage	Infection	Victim
Ankle	Paralysis	Pitiful
Abdomen	Deformed	Weak
Elbow	Delayed	Punishment
Stomach	Sickness	Worthless
Kneecap	Disease	Useless
Finger	Bankrupt	Malicious
Foot	Ulcer	Distrust
Gauze	Messy	Hopeless
Sling	Broken	Vulnerable
Stool	Rotten	Desperate
Cabinet	Morbid	Incompetent
Table	Intolerant	Deceit
Curtains	Burial	Nasty
Microwave	Headache	Hostile
Stove	Stingy	Rejection
Chair	Starving	Guilty
Icebox	Greedy	Damned
Kettle	Impotent	Treason
Dishwasher	Disaster	Unfaithful
Utensil	Bloody	Malevolent
Appliance	Petty	Wicked

1.2.1b. Emotional Stroop Task Design

The 24 words in each category were presented in sets of 12 words (2 neutral, 2 negative and 2 borderline-salient word-sets were presented; Table 2). Each of these sets was printed on white 8.5 x 11 inch paper. Words were displayed on each card within a grey box, and were written in lower case Arial 24 point font and approximately 0.75 cm high. Words were coloured either red, blue, green, or yellow. Each individual word set was presented twice during test administration. In each presentation, the words within each set remained constant however, the ordering of the words within each set changed. Additionally, the colour associated with each word differed between presentations.

Twelve cards (4 negative, 4 borderline-salient, and 4 neutral cards), each containing 12 words were constructed in this way. Additionally, a control card was printed and contained 12 coloured blocks; three each of red, blue, green, and yellow presented in a randomised order. Each block was approximately 1 cm (height) x 5 cm (width). The order of card presentation is listed in Table 3.

Table 2

Emotional Stroop word sets for Experiment 1

Neutral	Negative	Borderline-salient
	Set 1	
Thermometer	Accident	Powerless
Scissors	Messy	Helpless
Bandage	Paralysis	Victim
Ankle	Rotten	Weak
Elbow	Morbid	Punishment
Stomach	Petty	Worthless
Gauze	Broken	Useless
Finger	Sickness	Malicious
Abdomen	Starving	Distrust
Kneecap	Greedy	Hopeless
Sling	Impotent	Vulnerable
Foot	Disaster	Desperate
	Set 2	
Cabinet	Cancer	Incompetent
Microwave	Burial	Deceit
Stove	Infection	Nasty
Curtains	Intolerant	Hostile
Chair	Deformed	Rejection
Icebox	Delayed	Guilty
Dishwasher	Disease	Damned
Kettle	Bankrupt	Treason
Utensil	Ulcer	Unfaithful
Table	Headache	Malevolent
Stool	Stingy	Wicked
Appliance	Bloody	Pitiful

Table 3

Emotional Stroop card description and order of presentation for Experiment 1

Order of Presentation	Card Description
1	Control (colour words)
2	Control (colour boxes)
3	Neutral set 1
4	Negative set 1
5	Borderline-salient set 1
6	Neutral set 2
7	Borderline-salient set 2
8	Negative set 2
9	Negative set 2
10	Neutral set 2
11	Borderline-salient set 2
12	Negative set 1
13	Borderline-salient set 1
14	Neutral set 1

1.2.1c. Dot-Probe Task Stimuli

Stimuli were drawn from several standardised databases containing photographs of emotional facial expressions and normative data (NimStim Database[5]; Ekman & Friesen, 1975; Lyons, Akamatsu, Kamachi, & Gyoba, 1998). The three databases were pooled to yield a total of 137 photographs which were reduced with the goal of obtaining 36 faces with an unambiguously angry emotional expression and 36 faces with a neutral expression. The following steps were taken to accomplish the selection: First, 10 student judges rated each of the 137 photographs on two 7-point Likert scales for how angry they thought the facial expression was (1 = *neutral*, 7 = *very angry*), and whether they thought the face was expressing any emotion at all (1 = *not at all emotional*, 7 = *very emotional*). Faces were presented in random order. Mean anger and emotion scores were calculated for each individual face (see Appendix A). The 36 photos with the lowest scores on both scales (i.e., “I do not think this face is angry” and

[5] Development of the MacBrain Face Stimulus Set was overseen by Nim Tottenham and supported by the John D. and Catherine T. MacArthur Foundation Research Network on Early Experience and Brain Development. Please contact Nim Tottenham at tott0006@tc.umn.edu for more information concerning the stimulus set.

“I do not think this face is expressing any emotion at all”) were selected to serve as neutral face stimuli. The 36 photos with the highest scores on both scales (i.e., “I think this face is very angry” and “I think this face is expressing emotion”) were selected to serve as threat (anger) face stimuli. The selected angry faces had a mean anger rating of 5.0 (SD = 1.2; lowest anger rating: 3.09), and a mean emotion rating of 4.5 (SD = 1.4; lowest emotionality rating: 3.79). Neutral faces had a mean anger rating of 1.6 (SD = 0.8; highest anger rating: 2.01) and emotionality rating of 1.8 (SD = 1.0; highest emotionality rating: 2.11). Face types differed significantly between in anger ratings ($t[70] = 25.92$, $p < .001$) and in emotionality ratings ($t[70] = 25.83$, $p < .001$).

In the dot-probe task, the photographs were presented side-by-side in pairs of two different individuals: one photograph depicted an angry expression and the other a neutral expression. All photographs measured 198 pixels (height) x 140 pixels (width). Each facial expression when displayed on the screen measured 45 x 30 mm (subtending a visual angle of 1.9º horizontally and 2.9º vertically); the distance between the inner edges of a pair of faces was 64 mm (subtending a visual angle of 2.0º). The dot-probe stimulus was a small white dot with a diameter of 2 mm (subtending a visual angle of 0.1º) displayed on a contrasting black screen. An additional 20 neutral face pairs were prepared as practice items.

1.2.1d. Dot-Probe Task Design

Two versions of the task were constructed using Inquisit software for Windows XP (Inquisit, 2007). Each dot-probe task consisted of 20 practice trials and 288 experimental trials. The experimental trials included only angry-neutral pairs. Half of the angry faces were presented on the right side and half on the left side. There were equal numbers of trials where the dot-probe appeared in the previous location of a neutral face or an angry face. In this way, there was no predictive relationship between angry face position and dot-probe position. Each trial started with a central fixation cross for 500 ms, which disappeared to be replaced by a pair of faces, one appearing on the right side of the computer monitor and one appearing on the left. The pair of faces subsequently disappeared after a 200 ms interval in one version of the task (DPT_{200}), or a 1000 ms interval in a second version (DPT_{1000}). Following the disappearance of the faces, the dot-probe appeared in exactly the same location as either the angry face or the neutral face. In both task versions, the dot-probe remained on the screen until a response was made or until 2000 ms had passed. Participants pressed either the '5' or '2' key on the number pad of the computer keyboard with the index (2 key) and middle finger (5 key) of their dominant hand to indicate the position of the probe (5 = right, 2 = left). Standard written instructions requested that participants respond as quickly and accurately as possible. Reaction times were electronically recorded. The interval between responses for one trial to presentation of the following trial was 1000 ms.

Each task version comprised 4 blocks of 72 trials. Each face stimulus was presented twice per block, for a total of 8 presentations of each face stimulus in each version of the experiment. For each SOA (200 ms or 1000 ms), trials within the blocks were presented in a random order. See Figure 4 for an example trial.

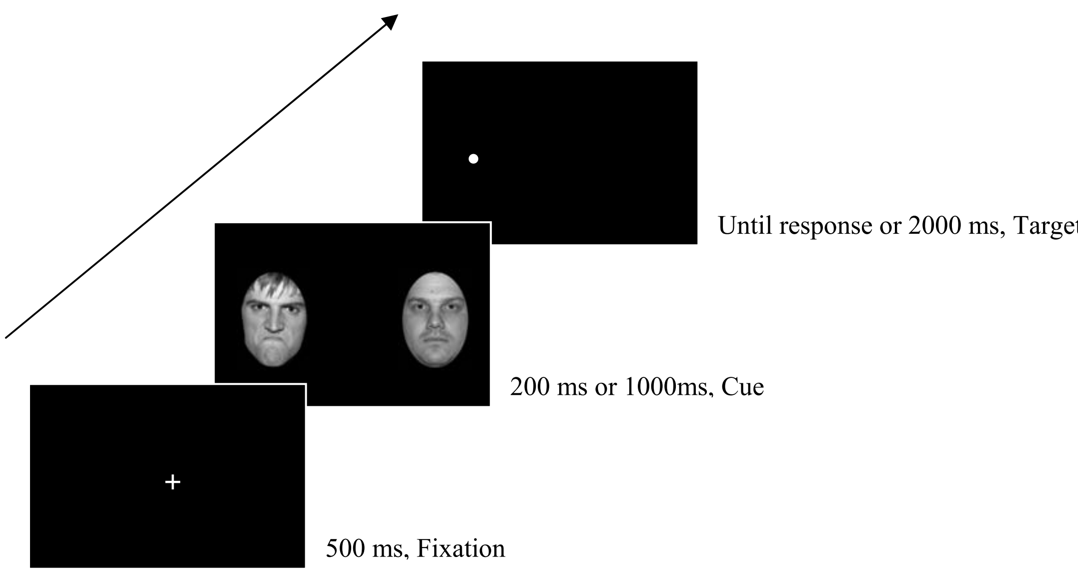

Figure 4. Diagram of an angry-congruent trial in the emotional dot-probe task of experiment 1.

1.2.2. Personality Measures

Sample means and standard deviations (*SD*) for all personality measures described here are listed in Appendix B.

1.2.2a. Implicit Emotion Regulation: The Emotion Regulation Implicit Association Test

Implicit emotion regulation was assessed using the Emotion Regulation Implicit Association Test (ER-IAT; Mauss, Evers, Wilhelm, & Gross, 2006). Conventionally, Implicit Association Tests (IATs) are thought to measure the relative strength of association between pairs of concepts. In the administration of an IAT, participants are asked to rapidly classify individual stimuli into one of four distinct categories using only two responses. In this way, the task forces the pairing of concepts. The underlying assumption of the IAT is that responses will be faster and more accurate when categories sharing a response also share pre-existing associations (i.e., association strength is idiosyncratic to the participant), as compared to when they are not or even negatively associated for any given participant.

In the ER-IAT, stimuli comprise words from the four categories ‘emotion control’, ‘emotion expression’, ‘good’, and ‘bad’ (see Table 4 for a list of the items by category) presented on a PC laptop with Inquisit software for Windows XP (Inquisit, 2007). The ER-IAT consists of five blocks (see Figure 5 for an overview). Blocks 1, 2, and 4 serve as practice blocks (20 trials per block) in which participants categorise words into two categories by pressing one of two buttons on a computer keyboard: Good/Bad or Emotion Control/Emotion Expression. In the first critical Block 3, participants categorise items into the two combined categories Emotion Control & Good or Emotion Expression & Bad (20 practice and 40 critical trials). In the second critical Block 5, participants again categorise items into two combined categories Emotion Control & Bad or Emotion Expression & Good.

Table 4

Words used in the ER-IAT with categories Emotion Control/Emotion Expression and Good/Bad in Experiment 1

Emotion Control	Emotion Expression	Good	Bad
Controlled	Expressive	Pleasant	Unpleasant
Calm	Emotional	Good	Bad
Inhibit	Reveal	Gold	Gloom
Contain	Disclose	Honour	Filth
Control	Express	Lucky	Rotten

Critically, slowed responding to the combined categories is thought to reflect pre-existing association strength between the construct “good” or “bad” and “emotion control” or “emotion expression”. Only the test trials were used in the scoring of reaction time data (as suggested by Greenwald, Nosek, & Banaji, 2003). First, trials with latencies over 10,000 ms were excluded from the scoring procedure. Standard deviations in latencies across both the practice and test trials were computed for each participant. Average latencies of all trials were then divided by the *SD*s. Average latencies in the first critical block (block 3) were subtracted from average latencies in the second critical block (block 5) to yield the final IAT scores. Higher IAT scores reflect a more positive implicit evaluation of emotion regulation relative to emotion expression (Mauss et al., 2006). According to Mauss and colleagues (2006), the ER-IAT has good internal consistency with a Cronbach alpha coefficient of 0.86 across all items. Test-retest reliability across an interval of 3 months is 0.68. The ER-IAT has good convergent-discriminant validity. For example, ER-IAT scores correlate negatively with explicit measures of trait positive and negative emotion expression (Berkeley Expressivity Questionnaire; Gross & John, 1997), and are positively associated with explicit measures of emotion regulation such as the Emotion Regulation Questionnaire. Thus, individuals scoring high on the ER-IAT (i.e., individuals with a positive implicit evaluation of emotion regulation) are also more likely to self-report as being low in emotion expressivity and high in emotion regulation.

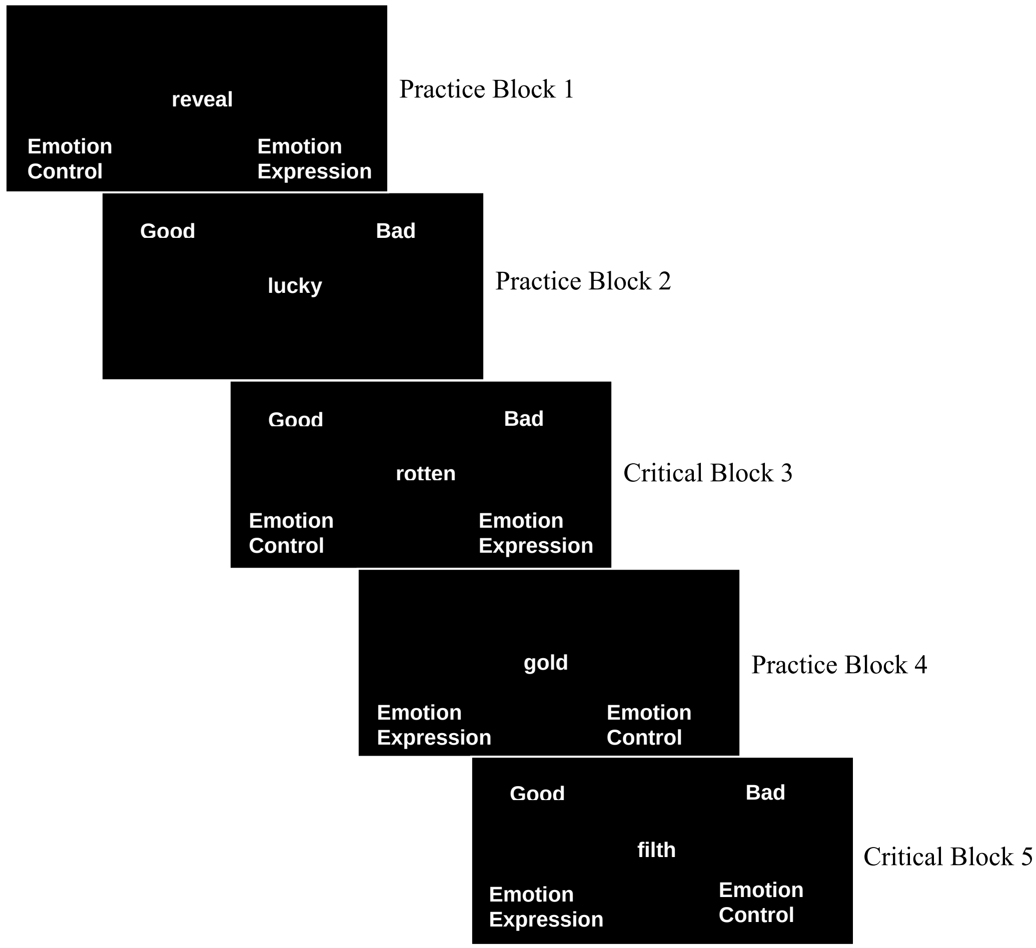

Figure 5. Emotion Regulation – Implicit Association Task Blocks 1 through 5. In practice Block 1, participants categorise words as belonging to either the category Emotion Control or Emotion Expression. In practice Block 2, participants categorise words as Good or Bad. In critical Block 3, participants categorise items into the combined categories Good & Emotion Control or Bad & Emotion Expression. In practice Block 4, participants again categorise words as Emotion Expression or Emotion Control words. This Block is similar to practice Block 1 with the exception that Emotion Expression is now on the left and Emotion Control is now on the right of the screen. In critical Block 5, participants categorise words into the combined categories Emotion Expression & Good or Emotion Control & Bad.

1.2.2b. Explicit Emotion Regulation: The Emotion Regulation Questionnaire

Emotion regulation was further assessed using Gross and John’s (2003) Emotion Regulation Questionnaire (ERQ; see Appendix C). In contrast to the ER-IAT as an implicit emotion regulation measure, the ERQ is a 10-item self-report measure of the two emotion regulation strategies ‘Reappraisal’ and ‘Suppression’. Questions consisting of statements about the subjective experience and expression of positive and negative emotions are answered on 7-point Likert scales (1 = *strongly disagree*, 7 = *strongly agree*). The ERQ has good internal consistency, with Cronbach alpha coefficients of 0.79 and 0.73 for the Reappraisal and Suppression scales, respectively. Test-retest reliability has been established across 3 months and averaged 0.69 for both scales (Gross & John, 2003). Reappraisal and suppression scores were obtained by determining the mean score of the items associated with each scale.

1.2.2c. Emotion Expression: The Berkeley Expressivity Questionnaire

Emotion expression was assessed using the Berkeley Expressivity Questionnaire (BEQ; Gross & John, 1997; see Appendix D). The BEQ is a 16-item self-report measure of the strength of emotional response tendencies and the degree to which emotional impulses are expressed in overt behaviour. The BEQ has strong psychometric properties and provides scores on three subscales: Positive and Negative Expressivity (BEQ-PEX and BEQ-NEX), which represent the degree to which positive and negative emotions are expressed behaviourally, and Impulse Strength (BEQ-IS), which represents the general strength of emotional response tendencies (Gross & John, 1997). The BEQ consists of statements pertaining to these three subscales. The BEQ-PEX is a 4-item scale comprised of items related to the expression of positive emotions (e.g., "when I am happy, my feelings show"), the BEQ-NEX is a 6-item scale comprised of items related to the expression of negative emotions (e.g., "I sometimes cry during sad movies"), and the BEQ-IS scale is a 6-item scale comprised of questions related to the individuals' perceived strength of emotional responding (e.g., "I experience my emotions very strongly"). Ratings are made on 7-point Likert scales (1 = *strongly disagree*, 7 = *strongly agree*). Scores for the subscales were obtained by determining the mean weighted score for the scale items. Three of the 6-item BEQ-NEX scale were reverse scored and were converted prior to calculating the mean score for this scale. The BEQ has good internal consistency, with Cronbach alpha coefficients of 0.86 for the total BEQ, and 0.70, 0.70, and 0.80 for the three subscales, respectively (Gross & John, 1997). All subscales correlate approximately 0.50 with one another. The relation between the subscales suggests that people with strong emotional impulses are more likely to express both positive and negative emotions, and that people who express positive emotions are also more likely to express negative emotions.

1.2.2d. Anxiety

Anxiety was assessed using the State-Trait Anxiety Inventory (STAI; Spielberger, 1983). The STAI is a 40-item self-report measure that is designed to assess the level of the temporary condition of state anxiety and the more generalized quality of trait anxiety in both clinical and normal populations. The State Anxiety (STAI-S; see Appendix E) scale consists of 20 statements that probe the current experience of anxious feelings (e.g., “I am tense”). Ratings are made using a 4-point Likert scale (1 = not at all, 4 = very much so). The Trait Anxiety (STAI-T; see Appendix F) scale also consists of 20 statements and addresses the long-term frequency of anxious feelings (e.g., “I feel nervous and restless”). Ratings are, again, made using a 4-point Likert scale (1 = *almost never*, 4 = *almost always*). The STAI has good internal consistency (STAI-S: $r = 0.92$, STAI-T: $r = 0.90$) and good construct validity. For example, STAI-S scores have been found to be higher in stressful situations and lower following relaxation and STAI-T scores have been found to be stable over time and not influenced by increases in stress (Spielberger, 1983).

The state and trait anxiety scales are comprised of items addressing both the *presence* and *absence* of anxiety. As a result, approximately half of the items in both STAI- S and STAI-T scales are reverse scored prior to calculating final STAI scores. Scores for the STAI-S and STAI-T scales were obtained by determining the sum of the individual items of the scale.

1.2.2e. Desirable Responding

Desirable responding was assessed using Paulhus’ (1991) Balanced Inventory of Desirable Responding (BIDR; see Appendix G). The BIDR is a 40-item self-report measure of two constructs, self-deceptive enhancement (SDE; the tendency toward a positively biased understanding of the self; for example "My first impression of people usually turns out to be right") and impression management (IM; deliberate positively biased presentation of the self to others; for example "I have never dropped litter on the street"). The 20-item SDE scale (items 1-20) and the 20-item IM scale (items 21-40) are answered on 7-point Likert scales ranging from *not true* to *very true*. The scale has good internal consistency and convergent-discriminant validity. Cronbach alpha coefficients are 0.80 for the total BIDR, and in the range of 0.70 to 0.82 for SDE and 0.80 to 0.86 for IM (Paulhus & Ried, 1991). The SDE subscale has demonstrated associations with other measures of defense mechanisms (repression, distancing, self-controlling) and measures of adjustment (neuroticism, depression, social anxiety; Paulhus & Ried, 1991). External raters (i.e., friends and family) of high SDE scorers perceive these individuals as less well-adjusted than high SDE scorers perceive themselves to be. The IM subscale has demonstrated associations with traditional "lie scales" (e.g., from the Eysenck Personality Questionnaire [Eysenck, 1988] and the Minnesota Multiphasic Personality Inventory [Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989] and measures of social desirability (e.g., Marlow-Crowne Scale; Paulhus & Ried, 1991). A social approval motive is regarded as critical to high IM scores. More simply, while the SDE subscale evaluates an unconscious positive bias in responses with the aim of protecting self-esteem, the IM subscale evaluates a conscious positive bias in responses with the aim of making a favourable impression on others (Stober, Dette, & Musch, 2002). For each BIDR subscale, continuous scores were computed by reverse scoring negatively worded items, and then summing the scores of all items. Total BIDR scores were computed by summing IM and SDE subscale scores.

1.2.2f. Acceptance and Action

The Acceptance and Action Questionnaire (AAQ; Hayes et al., 2004; see Appendix H) is a self-report measure that is designed to assess a high need for emotional and cognitive control, avoidance of negative private events and an inability to take needed action in the face of negative private events. The AAQ is comprised of 16 statements that are ranked on 7-point Likert scales ranging from *never true* to *always true*. The AAQ has two subscales: Experiential Willingness (AAQ-Willingness) and Experiential Action (AAQ-Action). Experiential Willingness is a 7-item subscale that assesses the individual's willingness to accept undesirable thoughts and feelings (i.e., "It's OK for me to have thoughts and feelings that I don't like"). Experiential Action is a 9-item subscale that assesses the individual's willingness to act in a manner that is consistent with their goals and values (i.e., "I work towards things I value, even though at times I feel uncomfortable or uncertain"). Higher scores on the AAQ reflect greater experiential avoidance and immobility. In contrast, low scores reflect greater acceptance and action. The scale has good internal consistency, with a Cronbach alpha of 0.70. The AAQ also has good convergent-discriminant validity and has demonstrated associations with other measures of coping including the White Bear Suppression Inventory, the Thought Control Questionnaire, and the Dissociative Experiences Scale. Test-retest reliability (measured over 4 months) was found to be 0.64 (Hayes et al., 2004). In order to obtain scores for the Experiential Willingness, and Experiential Action scales, the four negatively worded items on each scale were reverse scored. The items within each scale were summed and divided by the total number of scale items.

1.3. Procedure

Each participant completed a total of twelve personality measures and three experimental tasks (Table 5). Participants completed all measures and tasks individually in quiet, moderately-lit surroundings. During the dot-probe task participants sat approximately 90 cm from the computer monitor. To limit confounds arising from the order of questionnaire and task administration, participants completed the questionnaires and experimental tasks in one of four fixed orders (Table 6). The STAI-S questionnaire was administered at three points during the experimental procedure; prior to beginning the experimental tasks, midway through the experiment, and again on completion of the experimental tasks. Participants were administered the ER-IAT prior to beginning the experimental tasks. Half of the participants completed the Stroop task prior to the dot-probe tasks, while remaining participants completed the dot-probe tasks followed by the Stroop task. Each participant completed the two versions of the dot-probe task (DPT_{200} and DPT_{1000}) in succession. Presentation of the two task versions was counterbalanced to control for practice effects and habituation.

Table 5

Personality measures and experimental tasks in Experiment 1

Personality measures	
	Emotion regulation measures
	ER-IAT
	Reappraisal (ERQ-Reappraisal)
	Suppression (ERQ-Suppression)
	Emotion expression measures
	Negative expressivity (BEQ-NEX)
	Positive expressivity (BEQ-PEX)
	Impulse strength (BEQ-IS)
	Anxiety measures
	State anxiety (STAI-S)
	Trait anxiety (STAI-T)
	Desirable responding measures
	Impression management (BIDR-IM)
	Self-deceptive enhancement (BIDR-SDE)
	Acceptance and action measures
	Experiential willingness (AAQ-Willingness)
	Experiential action (AAQ-Action)
Experimental tasks	
	Stroop
	Dot-probe
	DPT_{200}
	DPT_{1000}

The STAI-T, AAQ, ERQ, BEQ, and BIDR were administered after completion of the experimental tasks. Participants were also administered a brief demographic questionnaire (age, gender, handedness). Finally, a stimulus emotion rating task was administered in which participants rated the amount of anger and emotionality in each of the angry and neutral faces from the dot-probe task. Faces were presented in a randomised order. Ratings were made on 7-point Likert scales for how angry the facial expression was (1 = *neutral*, 7 = *very angry*), and whether the face was expressing any emotion at all (1 = *not at all*, 7 = *emotional*).

Table 6

Fixed task sequences for Experiment 1

Sequence 1 (n = 30)	Sequence 2 (n = 30)	Sequence 3 (n = 30)	Sequence 4 (n = 31)
STAI-S	STAI-S	STAI-S	STAI-S
ER-IAT	ER-IAT	ER-IAT	ER-IAT
Stroop	DPT_{1000}	Stroop	DPT_{200}
STAI-S	DPT_{200}	STAI-S	DPT_{1000}
DPT_{200}	STAI-S	DPT_{1000}	STAI-S
DPT_{1000}	Stroop	DPT_{200}	Stroop
BEQ	BIDR	STAI-T	AAQ
BIDR	STAI-T	BEQ	ERQ
ERQ	ERQ	AAQ	BIDR
STAI-T	AAQ	ERQ	BEQ
AAQ	BEQ	BIDR	STAI-T
STAI-S	STAI-S	STAI-S	STAI-S
Demographic questions	Demographic questions	Demographic questions	Demographic questions
Stimulus Rating	Stimulus Rating	Stimulus Rating	Stimulus Rating

2. Results

2.1. Emotional Stroop

Each participant's mean and standard deviation in colour-naming latencies were computed for each word category (neutral, negative, borderline-salient). Normalised scores were computed for each participant by dividing their mean colour-naming latencies for each word category by their word-naming latency on the control card (naming of coloured blocks).

To test whether negative (and borderline-salient) words interfered more than neutral words with the colour-naming task, the effect of word category on response latency was tested in a within-subjects analysis of variance (ANOVA). The within subjects factor, the word category, had three levels: neutral, negative, and borderline-salient. The dependent variable was the normalised colour-naming latencies for each category. There was a significant effect of word category, $F[2, 236] = 49.86$, $p < .001$, partial $\eta^2 = .30$.

The mean normalised response latencies were longer for negative (M = 1.29, SD = 0.19) and borderline-salient (M = 1.21, SD = 0.18) words than for neutral (M = 1.18, SD = 0.16) words. The mean difference between conditions was 0.10 for negative versus neutral words, and 0.03 for borderline-salient versus neutral words. The effect size for negative words was moderate (d = 0.59), while the effect size for borderline-salient words was small (d = 0.09). Paired *t*-tests showed that the differences between conditions were significant for both the negative versus neutral ($t[118] = 8.88$, $p < .001$), and borderline-salient versus neutral ($t[118] = 2.99$, $p < .005$) pairings. Additionally, mean normalised response latencies were longer for negative words as compared to borderline-salient words. The mean difference between conditions was 0.072. The effect size was moderate (d = 0.39). A paired *t*-test showed that the difference between negative versus borderline-salient was significant ($t[118] = 7.36$, $p < .001$).

Two Stroop colour-naming interference scores were calculated for each participant. First, each participant's normalised neutral colour-naming latency score was subtracted from their normalised negative colour-naming latency score to yield an interference score for the negative word category. Second, an interference score for the borderline-salient word category was calculated by subtracting each participant's normalised neutral colour-naming score from their normalised borderline-salient colour-naming score. These interference scores reflect the extent to which negative and borderline-salient words hold attentional resources, with greater positive interference scores reflecting greater interference by emotional as compared to the neutral words. Inference scores were subsequently used to examine the extent to which the personality variables measured in this experiment predict performance on the emotional Stroop.

2.2 Dot-Probe

The data analyses for the dot-probe tasks were based on reaction times (RTs) for correct responses. Data from error trials were discarded and not analysed further. Three different methods of removing outlier responses were compared. The aim was to elucidate the expected face x probe interaction using the most conservative method of outlier removal possible (i.e., and preserve as much data as possible).

2.2.1. Median Scores Data Preparation Method (most conservative)

Reaction times less than 200 ms or more than 2000 ms were excluded. Since medians are less affected by extreme scores than means, no further outliers were excluded. Median scores for each dot-probe condition ($Angry_{left}Probe_{left}$, $Angry_{right}Probe_{right}$, $Angry_{left}Probe_{right}$, $Angry_{right}Probe_{left}$) were calculated for each participant. The percentage of data lost owing to errors was 2.0% in DPT_{200_med} and 1.8% in DPT_{1000_med}; and the percentage of data excluded due to reaction times below 200 ms or above 2000 ms was 0.7% in DPT_{200_med} and 0.6% in DPT_{1000_med}.

2.2.2. Two Standard Deviations-Data Preparation Method (least conservative)

Reaction times less than 200 ms or more than 2000 ms were excluded, and the mean and *SD*s across all trials were calculated for each participant. Reaction times more than 2 *SD*s above each participant's mean were excluded. For each participant, mean scores for each dot-probe condition ($Angry_{left}Probe_{left}$, $Angry_{right}Probe_{right}$, $Angry_{left}Probe_{right}$, $Angry_{right}Probe_{left}$) were calculated by averaging the remaining (non-excluded) latency scores within each condition. The mean percentage of data excluded due to outliers was 4.5% and 4.6% in DPT_{200_2SD} and DPT_{1000_2SD}, respectively.

2.2.3. Three Standard Deviations-Data Preparation Method (moderately conservative)

Reaction times less than 200 ms or more than 2000 ms were excluded, and the mean and *SD*s across all trials were calculated for each participant. Reaction times more than 3 *SD*s above each participant's mean were excluded. For each participant, mean scores for each dot-probe condition ($Angry_{left}Probe_{left}$, $Angry_{right}Probe_{right}$, $Angry_{left}Probe_{right}$, $Angry_{right}Probe_{left}$) were calculated by averaging the remaining (non-excluded) latency scores within each condition. The mean percentage of data excluded due to outliers was 1.8% and 1.9% in DPT_{200_3SD} and DPT_{1000_3SD}, respectively.

2.2.4. Analysis of Dot-Probe Detection Latencies

The resulting data set from each of the three data preparation methods (median, 2*SD*s, and 3*SD*s) were entered into separate (DPT_{200}, DPT_{1000}) 2 x 2 repeated measures ANOVAs with two within-subjects factors: Angry face position (right, left) and probe position (right, left), resulting in a total of six ANOVAs. For all three methods of data preparation (median, 2*SD*, and 3*SD*), there were no significant main effects of either face position or probe position in either of the two versions of the task (see Table 7**)**, indicating that RTs did not differ significantly with either angry face position or probe position. The most conservative "median method" yielded a significant two-way interaction of face position x probe position in the DPT_{1000} task, but not in the DPT_{200} task (see Table 7). In contrast, the less conservative "2*SD*" and "3*SD*" methods of outlier removal yielded significant two-way interactions of face position x probe position in both dot-probe versions (see Table 7). Because the 3*SD* version of outlier removal retained more data than the 2*SD* version, the 3*SD* version of the data set was used for all further analyses.

Table 7

Outcome of the analyses of variance for three versions of data preparation used in Experiment 1

Model		F	*p*	Partial Eta Squared
DPT_{200_med}	Face	0.19	0.67	0.00
	Probe	0.28	0.60	0.00
	face*probe	0.83	0.37	0.01
DPT_{200_2SD}	Face	0.27	0.60	0.00
	Probe	0.02	0.88	0.00
	face*probe	4.58	0.03	0.04
DPT_{200_3SD}	Face	0.07	0.79	0.00
	Probe	0.03	0.88	0.00
	face*probe	4.06	0.04_8	0.03
DPT_{1000_med}	Face	0.28	0.60	0.00
	Probe	0.01	0.94	0.00
	face*probe	13.00	0.00	0.10
DPT_{1000_2SD}	Face	0.13	0.72	0.00
	Probe	0.01	0.92	0.00
	face*probe	11.38	0.00	0.09
DPT_{1000_3SD}	Face	0.04	0.85	0.00
	Probe	0.200	0.66	0.00
	face*probe	14.28	0.00	0.11

The significant two-way interactions of face position x probe position in both dot-probe versions using the 3*SD* method are shown in Figure 6 (DPT_{200_3SD}: $F[1, 120] = 4.06, p < .05$; DPT_{1000_3SD}: $F[1, 120] = 14.28, p < .001$). To clarify these interactions, four paired t-tests were carried out for each of the dot-probe versions. The level for statistical significance was adjusted as this set of analyses involved four comparisons (i.e., $p < .05/4 = 0.0125$; Bonferroni-correction). For

DPT_{200_3SD}, all follow-up t-tests were non-significant. For DPT_{1000_3SD}, both left and right probes were detected significantly faster when they occurred in the same location as angry faces rather than neutral faces (left probe: 455 ms vs. 460 ms; $t[120] = -2.64$, $p < .01$; right probe: 454 ms vs. 459 ms; $t[120] = 2.56$, $p < .05$). Thus, for both DPT_{200_3SD} and DPT_{1000_SD} there was a significant interaction between face and probe side indicating a significant advantage in detection of probes following angry compared to neutral faces. These differences were found to be significant in post-hoc testing for DPT_{1000_3SD}, but not DPT_{200_3SD}.

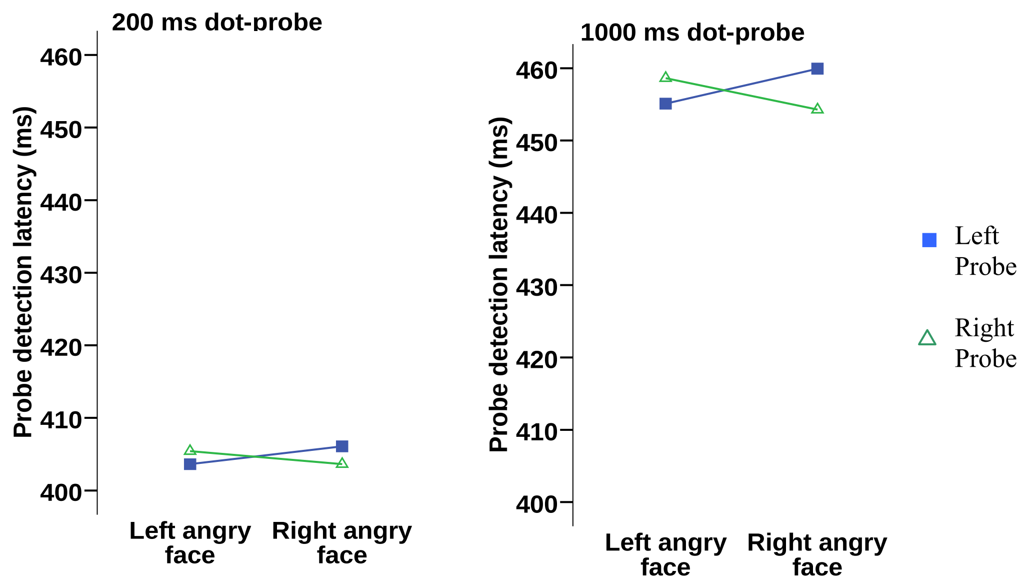

Figure 6. Mean RTs (ms) to probes illustrating interaction of face position X probe position.

Attentional bias scores were then calculated by subtracting the mean RT when the probe was in the same position as the angry face from the mean RT when the probe was in a different position from the angry face (MacLeod & Mathews, 1988).

$$\text{Attentional Bias Score} = \tfrac{1}{2}[(ArPl + AlPr) - (ArPr + AlPl)]$$

Where A = angry face, P = probe, r = right, and l = left. Summarizing the angry-face x probe interaction, positive values of the attentional bias scores reflect faster responses to probes that replace angry rather than neutral faces, consistent with vigilance for angry faces relative to neutral faces. Conversely, negative attentional bias values reflect avoidance of angry faces. Attentional bias scores for each participant were calculated separately for each of the two versions of the dot-probe task. These attentional bias scores were subsequently used to examine the extent to which the personality variables measured in this experiment predict performance (attentional bias scores) in the dot-probe tasks.

2.3. Personality

The aim of this experiment was to examine the relationships between six personality measures and performance on three measures of selective attention (DPT_{200}, DPT_{1000}, and the emotional Stroop). Notably, a number of the personality measures administered in this experiment are themselves correlated (Appendix I for a summary of correlations), and can thus be organised in groups such that all measures within each group are correlated with each other, and measures from different groups are not correlated. An exploratory factor analysis is one method of accomplishing such grouping, and was employed to reduce the number of variables to compare to the experimental measures in this experiment (thereby reducing the number of necessary correlations/comparisons and improving the statistical power of this experiment).

2.3.1. Factor Analysis

The 12 personality variables were submitted to an exploratory factor analysis using principal axis factoring and employing an orthogonal rotation. The minimum criterion for inclusion of an item on each factor was that the loadings of the variables onto a factor should be 0.3 or greater. Factors with Eigenvalues > 1 were extracted (Kaiser, 1960). This factor analysis yielded four factors with Eigenvalues ranging from 1.08 to 3.03, which accounted for 52.51% of the total variance. The varimax rotated factor solution and the respective loadings of the twelve personality variables onto the factors are listed in Table 8.

The first factor explained 20.39% of the total variance and was termed “non-defensive anxiety”. Here, state and trait anxiety (STAI) loaded positively onto this factor along with Impulse Strength (BEQ). Additionally, several measures of defensiveness (BIDR Self-Enhancement, and AAQ Action and Willingness scales) loaded negatively onto this factor. The second factor explained 19.43% of the total variance. For ease of interpretation, the loadings on this factor were reversed and the factor was termed “Suppression factor”. Emotional expressivity (BEQ Positive Expressivity, Negative Expressivity, and Impulse Strength scales) loaded negatively onto this factor and ERQ-Suppression loaded positively onto this factor. The third factor explained 8.46% of the total variance and was termed “reappraisal”. It consisted only of ERQ-Reappraisal. The fourth and weakest factor explained 4.24% of the total variance and was termed “automatic emotion regulation” with the ER-IAT and a measure of defensiveness (BIDR Impression Management) loading positively onto this factor and state anxiety (STAI-S) loading negatively onto this factor.

Table 8

Varimax rotated factor loadings for the personality measures in Experiment 1

	Factor loadings	Variance explained (%)
Non-defensive anxiety factor		20.39
STAI trait anxiety	0.87	
STAI state anxiety	0.62	
BIDR self-enhancement	-0.65	
AAQ action	-0.58	
AAQ willingness	-0.48	
BEQ impulse strength	0.41	
Suppression factor		19.43
BEQ negative expressivity	-0.88	
BEQ positive expressivity	-0.76	
BEQ impulse strength	-0.61	
ERQ suppression	0.75	
Reappraisal factor		8.46
ERQ reappraisal	0.94	
Automatic emotion regulation factor		4.24
ER-IAT	0.48	
BIDR impression management	0.33	
STAI state anxiety	-0.31	
	Total variance explained =	52.51

2.4. Personality and Attention

Regression analyses were then used to examine the relationship between these factors summarizing the personality measures and performance on the three measures of selective attention (DPT_{200_3SD}, DPT_{1000_3SD}, and the emotional Stroop). Specifically, regression analyses were carried out using the four orthogonal factors from the factor analysis as predictors and attention scores as dependent variables.

2.4.1. Personality and Emotional Stroop

Each of the four factors from the factor analysis were entered in two separate regression analysis using the negative Stroop interference score and the borderline-salient interference score as the dependent variables. Using the enter method, no significant models emerged (negative interference score: F [4, 97] = 0.75, $p = .56$; borderline-salient interference score: F [4, 97] = 0.96, $p = .44$) indicating that there was no significant relationship between the personality factors and Stroop interference scores.

2.4.2. Personality and Dot-Probe

Each of the four factors from the factor analysis were entered in two separate regression analyses using the enter method: first with dependent variable DPT_{200_3SD} bias score, and then with dependent variable DPT_{1000_3SD} bias score. No significant models emerged for either the DPT_{200_3SD} or DPT_{1000_3SD} regression analyses (DPT_{200_3SD}: $F[4, 99] = 0.97$, $p = .43$; DPT_{1000_3SD}: $F[4, 99] = 0.18$, $p = .95$) indicating that the personality factors were not related to performance on the selective attention tasks administered in this experiment. Although the absence of a significant model precluded further analyses, an examination of the t-values for the regression coefficients (Table 9) did show a trend that the Suppression factor may be related to performance on DPT_{200} task ($t[102] = 1.90$, $p = .06$). In order to further explore this possibility, a regression analysis was carried-out using the DPT_{200_med} bias scores (see section III-2.2.1) instead, since this scoring methods preserved more data and possibly, important information from extreme scoring subjects that may have been deleted in the 3SD method.

In this analysis, a significant model did emerge ($F[4, 99] = 2.92$, $p < .05$) in which the Suppression factor predicted performance on the DPT_{200_med} task ($t[103] = 3.39$, $p < .005$). Specifically, lower scores in the Suppression factor (greater emotional expressivity) were found to be associated with a greater vigilance for negative emotional information. In order to clarify this effect, a median split was used to group participant data in to individuals scoring high and low on the Suppression factor. This allowed a direct comparison of the DPT_{200_med} bias scores in individuals high and low in the use Suppression factor. Participant data with factor scores above 0.04 on the Suppression factor were categorised as ‘Low Suppression’ (Low-S) while participant data with scores less than or equal to 0.04 on the Suppression factor were categorised as ‘High Suppression’ (High-S). The DPT_{200_med} bias scores in the Low and High suppression groups were then contrasted against each other and against zero (i.e., no attentional bias) using *t*-tests. The results revealed that the low suppression group ($M = 5.85$, $SD = 8.51$) was significantly more vigilant for angry faces than the high suppression group ($M = -3.38$, $SD = 13.09$) ($t[103] = -4.26$, $p < .001$). The low suppression group showed significant vigilance for angry faces ($t[51] = 4.95$, $p < .001$), while the high suppression group showed no significant bias either toward or away from angry faces ($t[51] = -1.86$, $p = .07$), although a trend towards attentional avoidance was obvious (see Figure 7).

Table 9

The unstandardised and standardised regression coefficients for DPT_{200} and DPT_{1000} bias score regression analyses in Experiment 1

	Variable	Unstandardised coefficients B	Unstandardised coefficients SE B	Standardised coefficient (β)	t	*p*
DPT_{200_3SD} bias score	Non-defensive anxiety factor	-0.51	1.33	-0.04	-0.38	.70
	Suppression factor	2.43	1.28	0.19	1.90	.06
	Reappraisal factor	0.24	1.25	0.02	0.19	.85
	Automatic emotion regulation factor	-0.80	2.02	-0.04	-0.40	.69
DPT_{1000_3SD} bias score	Non-defensive anxiety factor	-0.51	1.42	-0.04	-0.36	.72
	Suppression factor	0.97	1.36	0.07	0.72	.48
	Reappraisal factor	0.13	1.33	0.01	0.10	.92
	Automatic emotion regulation factor	-0.76	2.14	-0.04	-0.36	.72

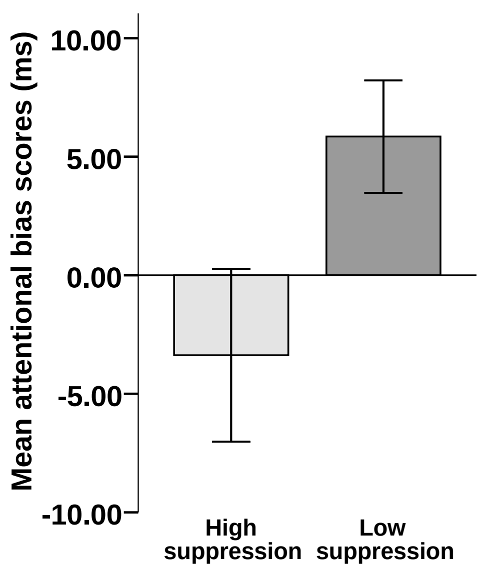

Figure 7. Mean attentional bias scores (in ms) for angry faces presented in the DPT_{200} task, for low and high suppression groups. Error bars represent 95% confidence intervals.

2.5. Stimulus Rating

Mean ratings on the 'anger' and 'emotionality' scales for each of the faces in the dot-probe task were calculated by averaging the scores within each face condition (angry or neutral). In total, four means (angry face-anger, angry face-emotionality, neutral face-anger, and neutral face-emotionality) were calculated for each participant.

As expected based on the prior stimulus selection, the angry face set was rated as being more angry (M = 4.08, SD = 0.97), and more emotional (M = 4.32, SD = 1.12) than the neutral face set (anger rating: M = 1.40, SD = 0.43; emotionality rating: M = 1.91, SD = 0.72). The mean difference between conditions was 2.68 for the anger rating, and 2.41 for the emotionality rating of angry versus neutral faces. The effect sizes for the anger and emotionality ratings between emotional face conditions were large (anger rating: d = 0.87; emotionality rating: d = 0.83). Paired t-tests showed that the emotional face conditions were significantly different from each other in both anger (t[119] = 33.98, $p < .001$), and emotionality ratings (t[119] = 25.29, $p < .001$).

To evaluate whether performance on the measures of selective attention used in this experiment was related to individual differences in the self-rated emotionality and anger of the facial stimuli, correlations were carried out between the ratings, and the DPT_{200_3SD} and DPT_{1000_3SD} bias scores. No significant correlations emerged. Pearson r values for these analyses are listed in Table 10.

Table 10

Correlations (r) between anger and emotionality ratings of facial stimuli and measures of selective attention for Experiment 1

	DPT_{200_3SD} bias score	DPT_{1000_3SD} bias score
Neutral face-Anger	-0.01	0.03
Neutral face-Emotionality	-0.10	-0.01
Angry face-Anger	0.06	0.05
Angry face-Emotionality	0.12	0.07

In order to evaluate whether scores on the four personality factors (see section III-2.3.1; Factor Analysis) were related to the perceived emotionality and anger of the facial stimuli, additional correlational analyses were carried out between the four factor scores and mean anger and emotionality rating scores. No significant correlations emerged. Pearson r values for these analyses are listed in Table 11.

Table 11

Correlations (r) between personality factors and anger and emotionality ratings of facial stimuli for Experiment 1

	Non-defensive anxiety factor	Suppression factor	Reappraisal factor	Automatic emotion regulation factor
Neutral face-Anger	-0.13	-0.06	0.18	0.18
Neutral face-Emotionality	-0.17	-0.08	0.16	0.08
Angry face-Anger	-0.09	-0.06	0.12	0.00
Angry face-Emotionality	-0.13	-0.10	0.10	0.03

3. Discussion

The results of experiment 1 suggested that high trait-suppression combined with low emotion expressivity may be associated with a greater avoidance of negative emotional information early, but not late, in the attentional process. Specifically, at 200 ms, individuals high in trait-suppression who are also low in emotion expressivity, were significantly less vigilant for angry faces than individuals low in suppression and high in emotion expressivity. Directly comparing groups of individuals with high and low factor scores showed that the high-suppression/low-emotion expression group showed no significant bias either toward or away from angry faces. In contrast, low-suppression /high-emotion expression group had significant vigilance for angry faces. Although these results were statistically significant only when using a conservative method of data preparation (median method), less conservative methods suggested the same trend: trait suppression combined with low emotion expression may indeed be related to decreased selective attention for emotional information at early, but not late, stages in the attentional process. This finding provides support for hypothesis 1 that trait-emotion regulation would be correlated with better attentional control (i.e., away from negative materials), whereas trait-emotion expression would be correlated with worse attentional control. This finding does not however, support hypothesis 2; that greater trait-suppression will be correlated with worse attentional control away from negative materials. Instead the use of suppression was associated with attenuated attention biases towards negative emotional information. The results of this experiment did not find support for hypothesis 3; that greater trait-reappraisal will be correlated with better attentional control (i.e., avoidance of negative materials). Instead, no relationship was found between reappraisal and attention bias. Findings from the emotional Stroop task indicated that overall, neutral words interfered less with colour-naming relative to both negative and borderline-salient words. Therefore, across all participants, emotional words were better able to capture and hold attentional resources relative to neutral words. However, there was no significant relationship between the scores on the four personality factors and Stroop interference scores.

The results of experiment 1 have provided insight into the relationship between personality and selective attention. Specifically, it appears that while trait-reappraisal is not related to performance on measures of selective attention (i.e., emotional Stoop and dot-probe), trait-suppression along with low emotional expressivity is related to better attentional control away from negative material early in the attentional process (i.e., 200ms). In a second experiment (experiment 2) designed to follow-up on these findings, trait-reappraisal and trait-suppression were compared more directly in their impact on selective attention to negative emotional information.

In order to allow for a more direct comparison and to maximize observable differences between people with trait-suppression and high trait-reappraisal, in experiment 2 extreme scoring subjects were pre-selected based on their trait-emotion regulation strategies. In line with the results of experiment 1 which found a relationship between emotion regulation and selective attention early but not late in the attentional process, experiment 2 used only a single dot-probe task that assessed early (250ms) attention biases towards negative information. Additionally, several important changes were made to the dot-probe task design for experiment 2. First, in the experiment 1 dot-probe tasks, a dot-probe appeared on every trial. A limitation of this design is that participants can attend only one side of the computer screen and respond correctly based on either the presence or absence of the dot-probe. If the dot-probe replaces angry and neutral faces an equal number of times on each side of the screen (as in experiment 1), responses to dot-probes replacing angry faces would not differ significantly from responses to dot-probes replacing neutral faces. Therefore, if participants attend only one side of the screen, the dot-probe task would fail to detect the presence of any attentional biases either towards or away from negative emotional information. It is unclear as to whether this limitation influenced the results in experiment 1. In order to interfere with participants' attempts to attend to only one side of the screen, no-probe trials were incorporated into the task design in experiment 2. More specifically, in experiment 2 a dot-probe stimulus appeared in only two-thirds (67%) of all trials. In the remaining one-third (33%) of trials, no dot-probe appeared. In this way, participants are required to search both sides of the screen in order to respond correctly (Fox et al., 2002).

A second change involved the addition of neutral-neutral trials to the dot-probe task design in experiment 2. Note that in the dot probe task, the attentional bias measure is a compound score made up of orienting toward and disengaging from a stimulus. That is, attentional bias scores are calculated by subtracting the mean reaction times to dot-probes replacing angry stimuli, from the mean reaction times to dot-probes replacing neutral stimuli in the angry–neutral stimulus pairs. Importantly, in the attentional bias score equation ("RT dot at angry face location" – "RT dot at neutral face location"), a positive bias score may result from either a small ''RT dot at angry face location'' component, reflecting fast responses to dot-probes replacing angry facial stimuli (e.g. orienting toward angry faces), and/or a large ''RT dot at neutral face location'' component, reflecting slow responses to dot-probes replacing neutral stimuli, possibly due to slow disengagement from angry faces. In this way, a high attentional bias score could be due to faster orientation toward angry faces or to more difficulty in disengaging attention from angry faces, or both (Salemink, van de Hout, & Kindt, 2007).

To disentangle attentional orienting and attentional disengagement from the overall attentional bias score, experiment 2 incorporated an additional trial block comprising neutral-neutral face pairs in to the dot-probe task design. According to Koster, Crombez, Verschuere, and De Houwer (2004), fast orienting toward angry faces is indicated by faster responses to dots replacing the location of the angry stimuli compared to dot-probes replacing neutral stimuli. In contrast, difficulties in disengaging from angry faces is indicated by slower responses to dot-probes replacing neutral stimuli when an angry stimulus is in the other location as compared to when a neutral stimulus is in the other location. In experiment 2, this method was employed with the aim of further evaluating whether potential attentional biases covarying with emotion regulation may result from either faster orientation toward negative emotional information, difficulty in disengaging attention from angry faces, or both.

IV. Experiment 2

In this study, participants were pre-selected based on their scores on the two sub-scales of the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003). The goal was to obtain: a) a sample of participants who endorse a high dispositional use of reappraisal in combination with a low dispositional use of suppression; and, b) a sample of participants who endorse a high dispositional use of suppression in combination with a low dispositional use of reappraisal. This method of pre-selection was based on Abler, Hofer, and Viviani (2008) and was used to separate the influence of dispositional reappraisal and suppression on attention. Selecting extreme individuals with clear preferences of one strategy over the other should also maximise possible emotion-regulation/attention differences between the two experimental groups. In addition, across mass testing sessions reappraisal was found to be negatively correlated with trait-anxiety scores ($r = -0.331$, $N = 3573$, $p < .001$) while suppression was positively correlated with trait-anxiety ($r = 0.260$, $N = 3573$, $p < .001$). Recently, another research group (Christophe, Antoine, Leroy, & Delelis, 2009) has reported similar findings. Therefore, high- and low-anxious control groups who also reported low levels in both emotion regulation traits were included as well. The pre-selection tools (ERQ; Gross & John, 2003, and STAI-T; Spielberger, 1983) used in this experiment were self-report inventories, and were therefore subject to positive response biases - conscious and unconscious attempts by an individual to endorse positive and deny negative personality traits (Paulhus & Ried, 1991). To limit confounds caused by biases in responding to self-report questionnaires, experimental and control groups were matched on total scores on the BIDR, a measure of social desirability and possible positive bias in responses (Paulhus & Ried, 1991), such that all groups had low mean scores of desirable responding.

Similar to experiment 1, subjects completed an emotional dot-probe task to assess early (250ms) attentional biases towards negative information. Additionally, to disentangle attentional orienting and attentional disengagement from the overall attentional bias score, experiment 2 incorporated an additional trial block comprising neutral-neutral face pairs in to the dot-probe task design. Using this method, researchers have demonstrated that differences in attentional biases in high as compared to low anxious individuals is predominantly a result of a delay in disengaging attention from threat in high anxious relative to low anxious individuals (Fox et al., 2001; Salemink et al., 2007).

In line with findings from experiment 1 that suggested suppression together with low emotional expressivity attenuated attentional biases towards negative emotional information, I predicted that:

1. A group of individuals with high trait-suppression (who are also high anxious), will have less of a selective attention bias towards negative faces than a group of high anxious individuals who do not use suppression to regulate their emotions.

Additionally, experiment 1 found that trait-reappraisal did not predict performance on tasks of selective attention. Following from this finding, I predicted that:

2. A group of inviduals with high trait-reappraisal (who are also low anxious) will have the same selective attention bias towards negative faces as low anxious individuals who do not use reappraisal to regulate their emotions. Both groups are characterised by low emotional experience and expression and therefore neither should show any attentional biases towards or away from negative faces.

Together, experiment 1 suggested that while trait-suppression along with low emotional expressivity was related to better attentional control away from negative material, trait-reappraisal was not related to selective attention. In line with this finding, I predicted that:

3. Compared to people with high trait-reappraisal, individuals with high trait-suppression will have attenuated attentional bias scores toward angry faces.

Finally, as discussed in section II-2.2.3, studies using dot-probe paradigms have shown that high trait anxious individuals are more likely than low trait anxious individuals to show attentional biases toward negative emotional information (for reviews, see Frewen et al., 2008; Mineka et al., 2003; Williams et al., 1996). Additionally, trait anxiety has a greater impact on the ability to disengage attentional resources from a threatening stimulus location, than on the speed of orienting attention toward the stimulus location (Fox et al., 2001). In line with previous findings, I hypothesized that:

4. Individuals with low trait-anxiety will show less of a bias towards negative faces than individuals with high trait-anxiety.
5. Compared to low-anxious individuals, high trait-anxious individuals will not be faster in their orientation towards negative stimuli, but will be particularly impaired in disengaging attention from negative faces.

1. Method

1.1. Participants

A total of 3573 undergraduate students (1451 male and 2122 female) were administered the ERQ (Gross & John, 2003), BIDR (Paulhus, 1991), the Trait version of the STAI (Spielberger, 1983) in three separate mass testing sessions held in the fall semester of 2008, the winter semester of 2009, and the fall semester of 2009 in the Department of Psychology at the University of Alberta. Pre-selection for this study was carried out by first computing the median score of STAI-T and BIDR total based on the fall 2008 sample (N = 1644; STAI-T median = 42; BIDR total median = 157). These scores were used for all subsequent recruitment for this study. Only participants with BIDR total scores less than 157 were invited to participate in this study.

Individuals with relatively high scores for one emotion regulation strategy on the 7-point scaled ERQ, and relatively low scores for the other ('Reappraisers': reappraisal scores greater than 4 and suppression scores at least 2 points lower; 'Suppressors': suppression scores greater than 4 and reappraisal scores at least 2 points lower; similar to the procedure used by Abler, Hofer, & Viviani, 2008) were invited to participate in this study, and comprised the two trait-emotion regulation groups ('Reappraisers': N = 27, 16 female and 11 male; 'Suppressors': N = 23, 11 female and 12 male). Pre-selection for the high- and low- anxiety control groups was carried out by first selecting individuals with relatively low scores on both emotion regulation strategies (reappraisal and suppression scores less than 4 and no greater than 2 point difference between scores on the two emotion regulation strategies). From this group, individuals with either relatively high STAI-T scores (greater than the STAI-T median of 42) or relatively low STAI-T scores (less than 42) were invited to participate in this study, and comprised the high- and low-anxious control groups ('High-anxious': N = 23, 12 female and 11 male; 'Low-anxious': N = 22, 12 female and 10 male), respectively.

In total, ninety-five (51 female and 44 male) undergraduate students participated in this study. Table 12 provides a summary of the experimental and control groups used in this study.

As intended, reappraisers had higher reappraisal scores than any other group, (reappraisers versus low anxious: *t*[47] = 13.82, *p* < .001; reappraisers versus suppressors: *t*[48] = 16.38, *p* < .001; reappraisers versus high anxious *t*[48] = 14.60, *p* < .001). Suppressors had higher suppression scores than any other group (suppressors versus high anxious: *t*[44] = 12.98, *p* < .001; suppressors versus reappraisers: *t*[48] = 15.80, *p* < .001; suppressors versus low anxious: *t*[43] = 13.72, *p* < .001). Reappraisers and low anxious were matched in anxiety (*t*[38.5] = 1.27, *p* = .21) [6]. As well, suppressors and high anxious were matched in anxiety (*t*[44] = 1.31, *p* = .20). Reappraisers and low anxious were lower anxious than suppressors and high anxious (reappraisers versus suppressors: *t*[48] = -8.79, *p* < .001; reappraisers versus high anxious: *t*[48] = -7.22, *p* < .001; low anxious versus suppressors: *t*[38.04] = -13.72, *p* < .001; low anxious versus high anxious: *t*[35] = -10.84, *p* < .001). All groups were matched in BIDR (*F*[3, 91] = 1.21, *p* = .31).

The mean age of participants was 19.03 years (*SD* = 2.24, range = 17–29 years). Each participant received partial course credit toward a research participation requirement of their introductory psychology course.

Table 12

Means and standard deviations of ERQ, STAI-Trait, and BIDR total scores for the experimental and control groups of Experiment 2

	ERQ		STAI	BIDR
Group	Reappraisal	Suppression	Trait	total
Reappraisers	5.99 (0.74)	2.32 (0.75)	40.56 (6.64)	131.59 (11.02)
Low-anxious (control group)	3.39 (0.53)	2.73 (0.68)	39.73 (3.12)	137.59 (13.30)
Suppressors	2.51 (0.76)	5.39 (0.59)	55.17 (4.78)	130.74 (19.09)
High-anxious (control group)	2.93 (0.73)	2.76 (0.77)	53.17 (5.54)	136.52 (16.33)

[6] For all comparisons, in case of unequal group variances as indicated by Levene's test, the unequal variance *t*-test correcting degrees of freedom, was applied (incorporated in SPSS).

1.2. Materials

The apparatus and questionnaires were the same as in experiment 1 with the following exceptions: First, the emotional Stroop task was excluded as it seemed not to covary with the personality variables (experiment 1). Additionally, the ER-IAT, AAQ, and the STAI-S were excluded as they seemed unrelated to selective attention biases (experiment 1). While scores on the BIDR and STAI-T were also not indicated as variables of interest by experiment 1, these questionnaires were included in the current experimental design. The STAI-T was included because trait-anxiety covarird with individual differences in emotion regulation (Christophe et al., 2009). Additionally, scores on the BIDR are highly correlated with anxiety ($r = -0.46$, $p < .01$ in the total mass testing sample; N = 3573) and therefore, were also included in the current experiment. The stimuli and design of the dot-probe task used in the current experiment are described in sections IV-1.2.1 and IV-1.2.2.

1.2.1. Dot-Probe Task Stimuli

Using the same procedure outlined in experiment 1, 18 faces with unambiguously angry emotional expressions and 54 faces with a definite neutral expression were selected from the pooled standardized databases (NimStim Database[1]; Ekman & Friesen, 1975; Lyons et al., 1998). The additional neutral face stimuli were included to accommodate the introduction of neutral-neutral trials in the current experiment design. Because the pooled face database contained a limited number of individual neutral faces, and the task design required a 1:3 ratio of angry to neutral faces, the number of angry faces needed to be reduced in this experiment. The 54 photos with the lowest scores on the anger rating scale and the emotionality rating scale were selected to serve as neutral face stimuli. The 18 photos with the highest scores on both scales were selected to serve as angry face stimuli (see Appendix A). The selected angry faces had a mean anger rating of 5.6 (SD = 0.45; lowest anger rating: 4.89, see Appendix A), and a mean emotion rating of 5.4 (SD = 0.45; lowest emotionality rating: 4.69). Neutral faces had a mean anger rating of 1.7 (SD = 0.35; highest anger rating:

2.51) and emotionality rating of 2.0 (SD = 0.27; highest emotionality rating: 2.41). Again, both face types differed significantly in anger ratings ($t[71] = 37.94$, $p < .001$) and in emotionality ratings ($t[71] = 38.51$, $p < .001$).

As in experiment 1, the photographs were presented side-by-side in pairs of two different individuals. All photographs measured 198 pixels (height) x 140 pixels (width). Each facial expression when displayed on the screen measured 45 x 30 mm (subtending a visual angle of 1.9º horizontally and 2.9º vertically); the distance between the inner edges of a pair of faces was 64 mm (subtending a visual angle of 2.0º). The dot-probe stimulus was a small grey dot with a diameter of 1 mm (subtending a visual angle of 0.1º) displayed on a contrasting black screen. An additional 10 neutral face pairs were prepared as practice items.

1.2.2. Dot-Probe Task Design

The dot-probe task consisted of 20 practice trials and 864 experimental trials[7] (432 angry-neutral face pairs and 432 neutral-neutral face pairs) presented in a new random order for each participant. Like the dot-probe tasks used in experiment 1, on angry-neutral face pair trials half of the angry faces were presented to the right visual field and half to the left. Additionally, there were equal numbers of trials where the dot-probe appeared in the same location as the neutral face and in the same location as the angry face. In this way, there was no predictive relationship between angry face position and dot-probe position. Each trial started with a central fixation cross for 500 ms at which point a pair of faces appeared on the screen, one to the right of the fixation cross and one to the left. The pair of faces subsequently disappeared following a 250 ms interval. Unlike the dot-probe tasks used in Experiment 1, in which a dot-probe appeared on every trial, in Experiment 2, a dot-probe stimulus appeared in only two-thirds (67%) of all trials. The dot-probe remained on the screen until a response was made. Participants pressed either the ‘5’ or ‘2’ key on the number pad of the computer

[7] The number of experimental trials was increased from 288 in experiment 1 to 864 in experiment 2. The added experimental trials in experiment 2 included 432 neutral-neutral trials and 188 angry-neutral no-probe trials. Two-hundred and eighty-eight angry-neutral probed trials were included in experiment 2 design. This did not differ from experiment 1.

keyboard with the index (2 key) and middle finger (5 key) of their dominant hand to indicate the position of the probe (5 = right, 2 = left). In the remaining one-third (33%) of trials, no dot-probe appeared and the trial automatically ended after a 1000 ms interval. Participants made no response on the no-probe trials. The no-probe trials consisted of half angry-neutral and half neutral-neutral face pairings and were included in order to interfere with participants' attempts to attend only one side of the computer screen and respond to either the presence or absence of the dot-probe. Additionally, the addition of neutral-neutral trials facilitates an evaluation of whether attentional biases in emotion regulation result from heightened orientation toward negative emotional information, difficulty in disengaging attention from angry faces, or both (see section III-3). Reaction times to probe trials were electronically recorded. The interval between responses for one trial to presentation of the following trial was 1000 ms. Standard written instructions requested that participants respond as quickly and accurately as possible. The dot-probe task comprised 4 blocks of 216 trials each. Each face stimulus was presented six times per block, for a total of 24 presentations of each face stimulus in the experiment. Trials within the blocks were presented in a random order.

1.3. Procedure

Participants completed the experimental tasks individually in quiet, moderately-lit surroundings. During the dot-probe task participants sat approximately 90 cm from the computer monitor. Face stimuli were presented using the Inquisit software for Windows XP (Inquisit, 2007). Each participant completed one version of a dot-probe task (DPT_{250}). Following the completion of the experimental task, participants were administered the BEQ followed by a brief demographic questionnaire (age, years of education, highest level of education completed, gender, handedness) and stimulus rating task in which participants rated each of the face stimuli from the dot-probe task, individually presented in a randomized order. Ratings were made on 7-point Likert scales for how angry the facial expression was (1 = *neutral*, 7 = *very angry*), and whether the face was expressing any emotion at all (1 = *not at al emotional*, 7 = *very emotional*).

2. Results

2.1. Dot-Probe

The data analysis for the dot-probe task was based on RTs for correct responses. Data from trials with errors were discarded and not analysed further. Reaction times less than 200 ms or more than 2000 ms were excluded, and the means and *SD*s across all trials were calculated for each participant. In keeping with experiment 1, reaction times more than 3 *SD*s above each participant's mean were excluded. For each participant, mean scores for each dot-probe condition ($Angry_{left}Probe_{left}$, $Angry_{right}Probe_{right}$, $Angry_{left}Probe_{right}$, $Angry_{right}Probe_{left}$) were calculated by summing the remaining latency scores within each condition and dividing by the number of trials. The mean percentage of excluded data due to errors was 0.9%. The mean percentage of data excluded due to all exclusion criteria described above was 3.5%.

2.1.1. Analysis of Dot-Probe Detection Latencies

The resulting data was entered into a 2 x 2 repeated measures ANOVA (see Table 13) with within-subjects factors: angry face position (right, left) and probe position (right, left). There was a significant main effect of probe position ($F[1, 94] = 50.91$, $p < .001$), with participants responding faster to probes appearing on the left side of the computer screen ($M = 474.51$; $SD = 80.10$) as compared to probes appearing on the right ($M = 491.68$; $SD = 86.07$). There was no significant main effect of angry face position ($F[1, 94] = 0.05$, $p = .83$). The two-way interaction of face position x probe position, indicating an attentional bias towards faster detection of dots in angry than neutral face positions, was also significant ($F[1, 94] = 4.39$, $p = .04$; see Figure 8).

Table 13

Outcome of the analysis of variance for DPT_{250} in Experiment 2

	F	*p*	Partial Eta Squared
Face	0.05	.83	0.00
Probe	50.91	.00	0.35
face*probe	4.39	.04	0.05

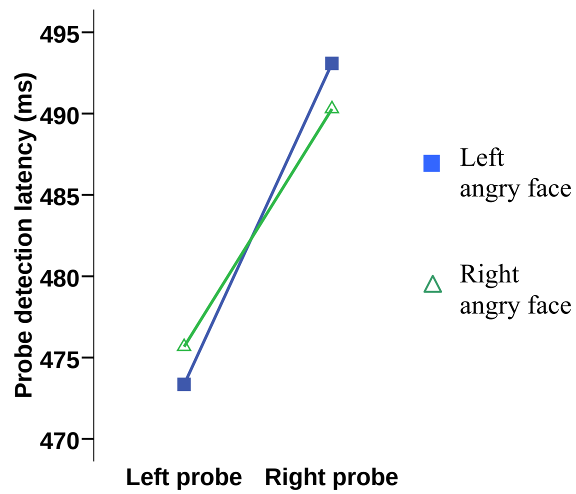

Figure 8. Mean RTs (ms) to probes illustrating the interaction between face position X probe position.

To clarify the two-way interaction, four paired t-tests were carried out. As can be seen in Figure 8, left and right probes were detected faster when they followed an angry face on the same side as compared to a neutral face. However, the two associated paired comparisons were not significant: Left probe-left angry face (473 ms) versus left probe-right angry face [476 ms]; $t[94] = -1.40$, $p = .16$. Right probe-left angry face (493 ms) versus right probe-right angry face (490 ms): $t[94] = 1.77$, $p = .08$). In addition, similar to the main effect, faster responses to left-sided than right-sided probes were detected, now for both face locations: Left probe-left angry face (473 ms) versus right probe-left angry face (493 ms); $t[94] = -7.32$, $p < .001$. Left probe-right angry face (476 ms) versus right probe-right angry face (490 ms); $t[94] = -5.41$, $p < .001$. Thus, although the interaction between face and probe side indicated a slight advantage in detection of probes following angry compared to neutral faces, the differences were minimal (~3 ms) and were not found to be significant in post-hoc testing.

2.2. Emotion Regulation and Dot-Probe

Attentional bias scores were calculated using the same method as outlined in experiment 1 (III-2.2.3). Briefly, positive scores indicate attentional bias towards angry faces and negative scores indicate attentional bias away from angry faces. Attentional bias scores were calculated for each of the four groups and are illustrated in Figure 9.

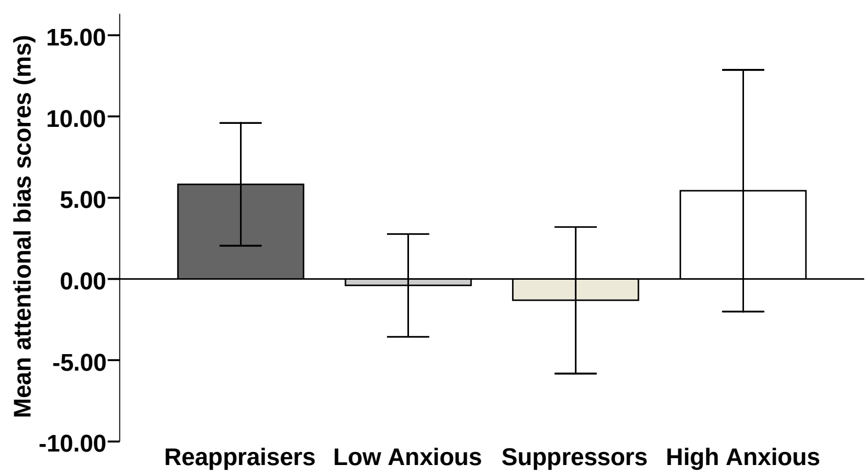

Figure 9. Mean attentional bias scores (in ms) for angry faces presented in the DPT_{250} task, for the four groups: reappraisers, low anxious, suppressors, and high anxious. Error bars are 95% confidence intervals around the mean.

As can be seen in Figure 9, and confirmed by one-sample *t*-tests comparing bias scores against zero, only reappraisers had a positive attentional bias ($t[26] = 3.17$, $p < .005$), while none of the other three groups had a bias that was significantly above or below zero (suppressors: $t[22] = -0.60$, $p = .55$; low-anxious: $t[22] = -0.26$, $p = .80$; high-anxious: $t[22] = 1.51$, $p = .14$).

To then test between-group differences in bias scores, the following planned *t*-tests were conducted:[8]

1. Suppressors compared to their high anxious control group: This comparison tested the first hypothesis that individuals with high trait-suppression (who are also high anxious) will have less of a selective attention bias towards negative faces than high anxious individuals who do not use suppression to regulate their emotions.
2. Reappraisers compared to their low anxious control group: This comparison tested the second hypothesis that individuals with high trait-reappraisal (who are also low anxious) will have the same selective attention bias towards negative faces as low anxious individuals who do not use reappraisal to regulate their emotions.
3. Reappraisers compared to suppressors: This comparison tested the third hypothesis that compared to high trait-suppression, high trait-reappraisal will be associated with better attentional control away from negative emotional information.
4. Low anxious versus high anxious control groups: This comparison was conducted as a manipulation check, and tested the fourth hypothesis that individuals with low trait-anxiety will show less of a bias towards negative faces than individuals with high trait-anxiety.

In case of unequal group variances, as indicated by Levene's test, the unequal variance *t*-test with corrected degrees of freedom, was applied (incorporated in SPSS). Comparing suppressors with high anxious controls revealed no significant difference in mean attentional bias scores ($t[36.2] = -1.61$, $p = .12$). The finding did not support hypothesis 1: trait-suppressors (who are are high anxious) will have less of a selective attention bias towards negative faces than high anxious

[8] A simple ANOVA with group as the between-subjects factor and attentional bias scores as the dependent variable showed no significant between-group differences in attentional bias ($F[3, 91] = 2.49$, $p = .07$). Importantly, the experimental hypotheses in the current study require that only four comparisons be made (instead of six following up on potential interactions in an ANOVA). To eliminate unneeded comparisons, and to more directly test the hypotheses of the current experiment, planned comparisons were carried out in place of an ANOVA.

individuals who do not use suppression to regulate their emotions. Contrary to the second hypothesis, reappraisers were significantly more vigilant for angry faces as compared to their low anxious controls ($t[47] = 2.53$, $p < .05$). This finding suggests that trait-reappraisers (who are low anxious) have a greater selective attention bias towards negative faces than low anxious individuals who do not use reappraisal to regulate their emotions. Also unexpected was that reappraisers were significantly more vigilant for angry faces as compared to suppressors ($t[48] = 2.53$, $p < .05$). Finally, comparing high- and low-anxious control groups indicated no significant difference in mean attentional bias scores ($t[29.6] = -1.50$, $p = .15$). This finding did not support hypothesis 4: individuals with low trait-anxiety will show less of a bias towards negative faces than individuals with high trait-anxiety

2.2.1. Attentional Orienting versus Disengagement

To further examine the relationship between emotion regulation and selective attention, indices for both components of selective attention were calculated, based on Salemink et al. (2007). The orienting index was calculated by subtracting the mean RT for dots replacing angry faces from the mean RT for dots replacing neutral faces:

$$\text{Orienting index} = RT_{N,N} - RT_{A,N};$$

where $RT_{N,N}$ stands for dots replacing neutral faces in the presence of other neutral faces and $RT_{A,N}$ for dots replacing angry faces in the presence of neutral faces. A positive score on the orienting index indicates faster response to dots appearing after angry as compared to neutral faces. To calculate the ease of disengaging attention from negative emotional information, the mean RT for neutral faces in the presence of neutral faces was subtracted from the mean RT for neutral faces in the presence of angry faces. In the equation:

$$\text{Disengaging index} = RT_{N,A} - RT_{N,N};$$

where $RT_{N,A}$ stands for dots replacing neutral faces in the presence of angry faces. A positive score on the disengaging index indicates slower responses to neutral faces in the presence of angry faces compared to neutral faces in the presence of other neutral faces (Salemink et al., 2007). The mean orienting and disengaging index scores are listed in Table 14.

Table 14

Orienting and disengaging index scores of all groups in Experiment 2

	Reappraiser	Low-anxious control	Suppressors	High-anxious control
Orienting	0.80	0.61	-0.71	0.09
SD	12.19	6.33	10.95	17.06
Disengaging	5.02	-1.00	-0.60	5.34
SD	10.24	4.59	9.70	11.76

As illustrated in Figure 10 and confirmed by *t*-tests against zero, none of the four groups had significant attentional orientation towards or away from angry faces (all *p*'s > 0.1). In addition, planned comparisons (see analyses of attentional bias scores, section IV-2.2) indicated no significant between-group differences in orienting (see Figure 10; all *p*'s > 0.1).

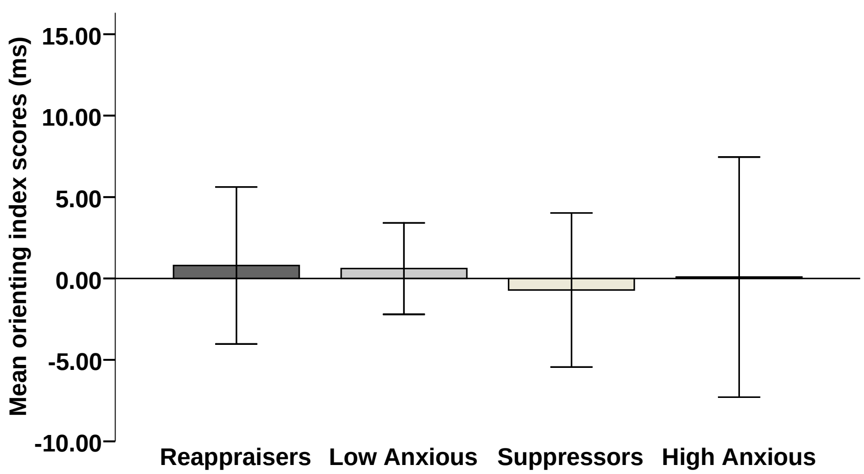

Figure 10. Mean orienting index scores in the DPT_{250} task, for the four groups: reappraisers, low anxious, suppressors, and high anxious. Error bars are 95% confidence intervals around the mean.

As illustrated in Figure 11 and confirmed by *t*-tests against zero, only reappraisers and high anxious individuals had significant delays in disengaging attention away from angry faces (reappraisers: $t[26] = 2.55$, $p < .05$; high anxious:

$t[22] = 2.18$, $p < .05$). An examination of group differences in disengagement from negative emotional information revealed that suppressors were almost, but not significantly, faster to disengage from angry faces as compared to their high-anxious controls ($t[44] = -1.87$, $p = .06$). Reappraisers were however, significantly slower to disengage their attention from negative emotional information as compared to their low-anxious controls ($t[37.6] = 2.74$, $p < .01$). Reappraisers were also significantly slower to disengage their attention from negative emotional information compared to suppressors ($t[48] = 1.98$, $p = .05$). Finally, in line with findings from previous studies (Salemink et al., 2007), planned comparisons indicated that high-anxious controls were significantly slower to disengage from angry faces as compared to low-anxious controls ($t[28.8] = -2.40$, $p < .05$). The disengagement scores are further illustrated in Figure 11.

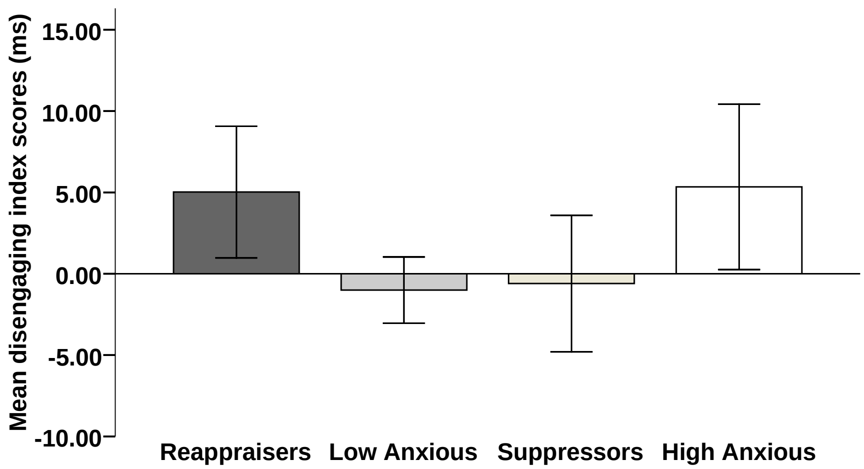

Figure 11. Mean disengagement index scores in the DPT_{250} task, for the four groups: reappraisers, low anxious, suppressors, and high anxious. Error bars are 95% confidence intervals around the mean.

2.3. Emotional Expression and Dot-Probe

In experiment 1, attentional bias scores were correlated with trait-suppression but only if combined with emotional expressivity (factor 2 in the factor analysis, see section III-2.3.1). Therefore, in addition to suppression, emotional expressivity may play a role in determining the strength and direction of attentional biases to negative emotional information. To follow up on the relationship between emotion expressivity and attentional bias in this experiment, correlations between scores on the BEQ subscales and attentional bias scores, orienting index scores, and disengagement scores were calculated (see Table 15). While there were no significant correlations between emotional expressivity and orienting index, both attentional bias and the disengagement index were positively correlated to the overall BEQ, especially with the subscales ‘negative emotional expressivity’ and ‘impulse strength’. These findings suggest that negative emotional expressivity and impulse strength (in addition to, or instead of emotion regulation) may play a role in influencing between-group differences in attentional bias and disengagement.

Table 15

Correlations (r) between emotional expressivity and attentional bias, orienting and disengagement index scores in Experiment 2

	Attention bias	Orienting Index	Disengagement index
Negative expressivity (BEQ-NEX)	0.29**	0.06	0.28**
Positive expressivity (BEQ-PEX)	0.20	0.03	0.21*
Impulse Strength (BEQ-IS)	0.39**	0.14	0.30**
Total BEQ	0.29**	0.10	0.23*

** Correlation is significant at the 0.01 level (two-tailed).
* Correlation is significant at the 0.05 level (two-tailed).

In order to test whether between-group differences in attentional bias and disengagement scores would withstand correction for emotional expressivity, an analysis of covariance (ANCOVA) was conducted.

Analyses revealed however, that the data set violated the assumption of homogeneity of regression coefficients (between groups)[9]. As a result, an ANCOVA could not be carried out. Instead, to evaluate between-group (reappraisers, suppressors, high anxious, low anxious) differences on scores of positive expressivity (BEQ-PEX), negative expressivity (BEQ-NEX), and impulse strength (BEQ-IS), a one-way between-subjects ANOVA was performed, with group as the between-subjects factor, and scores on the three subscales of the BEQ as the dependent factors. Results of these analyses are listed in Table 16. These analyses revealed no significant between-group differences in positive expressivity or impulse strength. There were however, significant between-group differences in negative expressivity ($F[3, 91] = 3.07$, $p < .05$) with suppressors reporting significantly less negative emotional expressivity compared to high anxious controls (suppressors: $M = 3.14$, $SD = 0.93$; high anxious: $M = 4.92$, $SD = 0.91$; $t[44] = -2.97$, $p <.05$).

Table 16

Results of ANOVA with group as the between-subjects factor and the three subscales of the BEQ as dependent variables in Experiment 2

	F	*p*
BEQ-NEX	3.07	.03
BEQ-PEX	2.68	.05$_{4}$
BEQ-IS	0.69	.56

Additionally, to examine whether individual differences in emotional expressivity might be associated with attentional bias scores within each group, linear regressions were carried out separately for reappraisers, suppressors, low anxious and high anxious individuals, using the three subscales of the BEQ (negative expressivity, positive expressivity, impulse strength) as predictors and

[9] An analysis of covariance assess the statistical significance of mean between-group differences on a dependent variable with an adjustment made for initial differences on one or more covariates (in the current experiment, the three subscales of the BEQ). This adjustment is based on an average of the individual regression coefficients associated with the separate treatment groups. Analysis of covariance therefore assumes that group regression coefficients are homogeneous, allowing the adjustment to be made at any value of the covariates. When regression coefficients are non-homogeneous, the effect of the adjustment is different for different values of the covariates to which groups are equated (Keppel & Zedeck, 1989).

attentional bias scores as the dependent variable.[10] Results of these analyses are listed in Table 17. Using the enter method, no significant models emerged for reappraisers, low anxious, or high anxious groups, however, in the suppressor group the BEQ scales significantly predicted bias (F[3, 19] = 4.07, p = .02), explaining 29.5% of the variance (Adjusted R^2 = 0.295). Table 18 shows, however, that none of the single predictors were found to be significant. These findings suggest that emotional expressivity does not mediate the attentional bias scores in the reappraiser, low anxious, and high anxious groups. In suppressors only, overall emotional expressivity is related to attentional bias scores, although none of the expressivity subscales alone were found to be significant predictors of attentional biases in this group.

Table 17

Results of the regression analyses for emotional expressivity and attentional bias by group in Experiment 2

	Complete model	
Group	F	*p*
Reappraisers	1.67	.20
Low anxious	0.09	.96
Suppressors	4.07	.02
High anxious	3.04	.05$_3$

[10] Linear Regression assumes that the predictors are independent of each other. In this set of analysis however, the BEQ subscales are not independent. To determine whether linear regression was justified, an analysis of collinearity was used for each regression analysis. This analysis provides tolerance values which are measures of the correlation between the predictor variables. This value can vary between 0 and 1 with values closer to zero indicating a stronger relationship between predictor variables. Tolerance values greater than .01 are commonly accepted for linear regression (Brace, Kemp, & Snelgar, 2006). For this set of regression analyses, all tolerance values were greater than 0.60.

Table 18

The unstandardised and standardized regression coefficients for the variables entered into the complete model for the suppressor group in Experiment 2

Variable	Unstandardised coefficients		Standardised coefficient	t	*p*
	B	SE B	(β)		
BEQ-NEX	3.91	2.35	0.35	1.66	.11
BEQ-PEX	-1.03	2.03	-0.11	-0.51	.62
BEQ-IS	4.33	2.17	0.45	2.00	.06

The same regression analyses were carried out on the disengagement index scores within each group. Results of these analyses are listed in Table 19. Using the enter method, no significant models emerged. Emotional expressivity therefore seems not to mediate the attentional disengagement from negative emotional information in any of the four groups.

Table 19

Results of the regression analyses for emotional expressivity and disengagement index scores by group in Experiment 2

Model	*F*	*p*
Reappraisal	1.29	.30
Low-anxiety	0.42	.74
Suppression	1.09	.38
High-anxiety	1.93	.16

2.4. Stimulus Ratings

To assess whether angry facial stimuli from the dot-probe task were in fact perceived as angry and neutral facial stimuli were perceived as neutral, participants were asked to rate each of the facial stimuli following the completion of the dot-probe task. Mean ratings on the ‘anger’ and ‘emotionality’ scales, administered to rate each face used in the dot-probe task, were calculated by averaging the scores within each emotional face condition (angry or neutral). In total, four mean rating scores (angry face-anger, angry face-emotionality, neutral face-anger, and neutral face-emotionality) were calculated for each participant. As intended, the angry face set was rated as angrier (M = 5.60, SD = 0.90), and more emotional (M = 5.92, SD = 0.83) than the neutral face set (anger rating: M = 1.78, SD = 0.76; emotionality rating: M = 2.49, SD = 0.83). Emotional face conditions were significantly different from each other in both anger ($t[108] = 36.09$, $p < .001$), and emotionality ratings ($t[108] = 32.01$, $p < .001$).

To evaluate whether performance on the measures of selective attention used in this experiment was related to individual differences in the perceived emotionality and anger of the facial stimuli, correlational analyses were carried-out between mean anger and emotionality ratings, and the attentional bias, orienting index, and disengagement index scores. No significant correlations emerged. Pearson r values for these analyses are listed in Table 20.

Table 20

Correlations (r) between anger and emotionality ratings of facial stimuli and measures of selective attention in Experiment 2.

	Attentional bias	Orienting index	Disengagement index
Neutral face-Anger	-0.06	-0.12	0.07
Neutral face-Emotionality	0.05	-0.04	0.10
Angry face-Anger	-0.05	-0.06	0.02
Angry face-Emotionality	0.00	0.02	-0.02

To evaluate whether the four groups differed in their ratings of the angry and neutral faces, ‘anger’ and ‘emotionality’ ratings for both face types were compared across groups using ANOVAs (see Table 21). No significant between-group differences in anger and emotionality ratings of angry facial stimuli emerged. Additionally, groups did not differ significantly in their ‘anger’ rating of the neutral facial stimuli. There were however, significant between-group differences in ‘emotionality’ ratings of neutral facial stimuli ($F[3, 88] = 3.23$, $p < .05$) with suppressors rating neutral faces as significantly less emotional as compared to high anxious controls (suppressors: M = 2.10, SD = 0.84; high anxious: M = 2.82, SD = 0.82; $t[44] = -2.97$, $p < .05$).

Table 21

Results of one-way between-groups ANOVA for ratings of dot-probe facial stimuli in Experiment 2

	F	*p*
Neutral face-Anger	1.91	.13
Neutral face-Emotionality	3.23	.03
Angry face-Anger	1.16	.33
Angry face-Emotionality	0.52	.67

3. Discussion

The results of experiment 2 did not support hypothesis 1: that trait-suppressors (who are also high anxious) will have less of a selective attention bias towards negative faces than high anxious individuals who do not use suppression to regulate their emotions. Rather, high anxious individuals were neither significantly vigilant for nor avoidant of angry faces, and furthermore they were not more vigilant for angry faces compared to suppressors. Note that a high degree of variance in attentional bias scores was observed in the high anxious group that may have contributed to this finding by limiting possible between-group differences in high anxious individuals and suppressors.

In line with findings from experiment 1, experiment 2 found that emotional expressivity was related to attentional bias scores in suppressors. Specifically, in suppressors, decreases in overall emotional expressivity were related to an attenuation in attentional bias scores. These findings suggest that in suppressors, attentional biases to negative emotional information may, in part, be accounted for by changes in emotional expressivity. In contrast to findings from experiment 1, the results of experiment 2 further revealed a significant vigilance for angry faces in reappraisers. Additionally, reappraisers were significantly more vigilant for angry faces as compared to both low anxious controls as well as suppressors. Separating attentional bias scores into attentional orienting and disengagement components revealed that reappraisers are not faster to orient, but rather are slower to disengage their attention from negative emotional information as compared to low anxious individuals and suppressors. These findings suggest that while low anxiety and suppression are not associated with significant attentional biases either toward or away from negative emotional information, reappraisal is associated with a difficulty in disengaging attention from negative emotional information.

Additionally, although high- and low-anxious individuals did not differ in their attentional biases to negative emotional information (contrary to hypothesis 4), high anxious individuals were significantly slower to disengage from angry faces (confirming hypothesis 5). Like reappraisers, high anxious individuals were not faster to orient towards negative stimuli, but instead were impaired in disengaging attention from negative emotional stimuli.

Importantly, there was a significant main effect of probe position in this experiment, with left probes being detected faster than right probes across all probed trial types. The more dominant index finger was used to indicate left probes while the less dominant middle finger was used to indicate right probes. Possibly, the prove position main effect reflects faster response times associated with the use of the index as compared to middle finger. However, since congruent and incongruent trials occurred an equal number of times on each side of the screen, both types of trials should have been affected equally (i.e., faster responding to left anger congruent and incongruent probes, and slower responding to right anger congruent and incongruent probes). Additionally, since attention bias is calculated by subtracting the mean congruent response latencies from the mean incongruent response latencies, and since both congruent and incongruent trials were impacted in the same way, faster responses to left probes is not likely to have significantly influenced the overall attention bias scores.

V. General Discussion

The main findings from the present set of experiments are as follows: (1) High trait suppression along with low emotional expressivity was negatively correlated with attention biases to angry faces in an emotional dot-probe task in experiment 1. However, across both experiments, groups of high trait-suppressors did not show any substantial bias towards or away from angry faces. In experiment 2, a selected group of high anxious trait suppressors showed statistically similar attention biases to non-suppressing high anxious controls. (2) While there was no relationship between reappraisal and attention bias in experiment 1, a selected group of low anxious reappraisers showed significant vigilance for angry faces in experiment 2. (3) These low anxious trait reappraisers were also significantly more vigilant for angry faces compared to both low anxious non-reappraisers and suppressors. Reappraisers' vigilance was not due to faster orienting towards angry faces but due to a greater difficulty in disengaging attention from angry faces. (4) High anxious individuals (who were also low in emotion regulation) did not differ in attentional bias scores relative to low anxious individuals (who were also low in emotion regulation). However, they did demonstrate a significant impairment in disengaging attention from angry faces as compared to low anxious individuals. (5) An emotional Stroop task in experiment 1 showed that emotional words were better able to capture and hold attentional resources relative to neutral words. However, there was no significant relationship between the personality factors and Stroop interference scores. These results are discussed in turn.

1. Trait Suppression and Attention Biases

The finding that groups of high trait-suppressors (experiment 1: subjects who scored high on the suppression factor comprised of high trait suppression along with low emotional expressivity; experiment 2: a preselected group of high trait suppressors) did not have significant attentional biases towards negative emotional information, was unexpected in the context of the emotion regulation literature. Gross (1998a) argues that suppression requires a constant outlay of cognitive resources (i.e., self-monitoring and self-corrective action) throughout an emotional event, thus reducing the resources available for other cognitive processes (e.g., attention, memory; Gross, 1998b; Richards & Gross, 2000). Following from this argument, if cognitive and self-regulatory resources are depleted by momentary suppression, dispositional suppressors may also be impaired in directing attention away from negative emotional information. However, this was not observed. Instead, results of experiment 1 showed a negative correlation between suppression (together with low emotional expressivity) and attention bias to negative faces. Here, high trait suppressors/low emotion expressors were better able to direct attentional resources away from negative emotional information. Although running counter to my initial assumption (i.e., suppression being positively related to attention biases), based on the results in experiment 1, I then expected an extreme group of selected individuals with high trait-suppression in experiment 2 to have a similarly reduced attention bias. Selected suppressors (who were also high anxious) in experiment 2 however, were not different in their attention bias compared to non-suppressing high anxious individuals. The main reason for this discrepancy (i.e., a reduction of attention bias by trait suppression in experiment 1, no difference in attention bias between suppressors and their controls in experiment 2) may be related to the statistical power of experiment 2 with regard to the high anxious group to which suppressors were compared. Although not significant, the high anxious group did show a trend toward preferentially attending angry faces. The high degree of variance in attentional bias scores in the high anxious group (see also Figure 9) may have limited the detection of potential between-group differences. A larger sample size in the high anxious control group would likely help reduce this variability and strengthen the observed trend of an attention bias to angry faces in the high anxious control group. Thus, even though (high anxious) trait-suppressors in experiment 2 were not significantly different in their attention biases relative to their high anxious control group, it is likely that by increasing the sample size of the high anxious group, suppressors' reduced attention bias to angry faces may become more apparent.

My findings of a reduced attention bias related to suppression were unexpected in the context of the literature examining individual differences in emotion-cognition interactions. Studies examining the emotional consequences of emotion regulation have shown that suppression results in decreases in the expression of negative emotion without actually down-regulating the subjective negative emotional experience (e.g., Gross & Levenson, 1997). As was shown in the literature review (section II-2.2.3), individual differences in state or trait-emotion (i.e., anxiety) influence ongoing cognitive processes (e.g., selective attention). Findings from studies examining individual differences in anxiety suggest that higher negative emotion (i.e., high trait anxiety) may be related to *worse* attentional control away from negative emotional information as compared to low levels of negative emotion (i.e., low trait anxiety; for reviews, see Frewen et al., 2008; Mineka et al., 2003; Williams et al., 1996). Since suppression does not result in decreases to the subjective experience of negative emotion (Gross & Levenson, 1997), suppression should either increase or maintain, but not attenuate, attentional biases to negative emotional information. Thus, in contrast to the existing emotion regulation literature, as well as findings on interactions between emotion and cognition, the current research suggests that high trait-suppression is not associated with attentional biases towards, but rather away from, negative emotional information. This unpredicted result is highly suggestive of the fact that suppression involves or even requires diverting attention away from the emotional event. Importantly, studies suggesting that memory of emotional events is negatively impacted by suppression (e.g., Richards and Gross, 2000) are complemented by my findings: If high suppression decreases attention toward negative emotional materials, subsequent memory for emotional events would necessarily have to be impaired. Thus, while not predicted, avoidant emotion processing in high trait-suppression supports and extends findings from studies examining the memory consequences of instructed suppression (e.g., Richards and Gross, 2000).

Suppression was related to attentional avoidance early, but not late in the attentional process (experiment 1). According to Gross' (1998b) process model of emotion regulation, suppression occurs late in the emotion process, once an emotion is already underway and experiential, behavioural, and physiological responses have been elicited. Evidence for this claim comes primarily from behavioural and neuroimaging studies examining the emotional and cognitive consequences of the instructed use of suppression (e.g., Richards & Gross 2000, Ohira et al., 2006; i.e., short-term consequences of the instructed use of suppression). Importantly, the current study examined trait- rather than instructed emotion regulation. Individuals who use suppression as their primary means of regulating emotions should be well practiced in suppression. As a result, for these individuals suppression might be elicited more automatically, with less cognitive effort, and earlier in the emotion process as compared to individuals who do not use suppression in their day-to-day life. Although only speculative, these findings suggest that there may be important differences in the consequences of instructed versus dispositional emotion regulation. For example, while the instructed use of suppression may result in late regulation of emotion and reduced cognitive resources for concomitant cognitive processes, dispositional suppression is likely initiated automatically, earlier in the emotion process, and may require less cognitive resources.

Across two studies, trait suppression was negatively related to emotional expressivity. This is in line with findings from Gross and John (2003) who found that in both self-report and peer-report measures, suppression decreased observable emotion expression. Gross (1998a) defines suppression as the inhibition of emotionally expressive behaviour to alter an ongoing emotional response. Thus, suppression is defined by emotion regulatory efforts targeted at decreasing emotion expression. Accordingly, the ERQ-Suppression subscale is comprised of questions targeting emotion expression such as “I control my emotions by *not expressing* them” and “when I am feeling negative emotions, I make sure not to *express* them”. Notably, the BEQ also targets the expression and suppression of positive and negative emotions. For example, “I am sometimes unable to hide my feelings, even though I would like to", "I am an emotionally expressive person", and "I've learned it is better to *suppress* my anger than to show it". Notably, the ERQ-Suppression subscale refers to the term *emotion expression* to indicate less suppression. In parallel, the BEQ refers to the term *suppression* to indicate less emotion expression. To my knowledge, no study has directly addressed whether the ERQ-Suppression subscale and the BEQ measure distinct constructs. However, the terminology used across both questionnaires suggests that suppression and emotion expression are related constructs, with suppression and expression likely representing opposite ends of emotional expressivity. Accordingly, it is not entirely surprising that trait suppression (as measured by the ERQ) and emotional expressivity (as measured by the BEQ) were negatively related to each other in both my experiments. The relationship and seemingly high conceptual overlap between suppression and emotion expression as measured by the ERQ and BEQ should be carefully examined in future research to delineate more precisely their differences and to avoid redundancies across measures.

2. Trait Reappraisal and Attention Biases

Reappraisers showed a significant attentional bias towards negative emotional information compared to neutral information. This finding was not predicted in the context of the previous emotion regulation literature. In contrast to suppression, Gross (1998b) suggests that reappraisal is an emotion regulation strategy that is evoked early on in the emotion process, before the emotion is able to fully impact physiological and behavioural responding. As a result, reappraisal should not require continuous self-regulatory effort, and therefore should not impact concomitant cognitive processes. Following from this argument, if cognitive and self-regulatory resources are not depleted by reappraisal, reappraising individuals should be well able to disengage and divert their attention away from negative emotional information. However, the opposite was observed (in experiment 2): Reappraisers looked preferentially at angry faces.

This finding runs counter to studies examining the emotional consequences of emotion regulation as well as studies on emotion-cognition interactions. First, reappraisal should result in decreases in both the expression and experience of negative emotion (e.g., Gross & Levenson, 1997). If momentary or stable individual differences in emotionality influence selective attention such that lower negative emotion (i.e., low trait anxiety) results in directing attention away from negative information (e.g., Frewen et al., 2008) and since reappraising individuals experience less negative emotion (Gross & Levenson, 1997), they should also show no vigilance towards, or possibly even avoidance of emotional information. However, trait-reappraisers were impaired in directing attention away from angry faces. This suggests that trait-reappraisal may require continuous attention to negative emotional information and possibly even an increased vigilance for detecting negative emotional materials. Also, these findings add to a growing body of evidence that suggests that the use of reappraisal may not be entirely without cognitive cost (e.g., Drabant et al., 2009; Ohira et al., 2006; Phan et al, 2005; Sheppes and Meiran, 2008). Additionally, studies suggesting that memory for emotional events is unaffected by the use of reappraisal (e.g., Richards and Gross, 2000) are complemented by my findings: If high trait reappraisal promotes attentional vigilance for negative emotional materials, all negative information should be properly and entirely encoded in memory and therefore later retrieval of emotional events should not be impaired. In addition, reappraisers were significantly more vigilant for angry faces compared not only with low anxious individuals, but also with suppressors. This vigilance was not related to faster orienting toward angry faces. Rather, reappraisers had greater difficulty in disengaging attention from angry faces as compared to low anxious individuals and suppressors. Possibly, reappraisal requires attentional resources to be directed *toward* the emotional event, e.g., for the actual reappraisal process. For example, continuous and increased attention to emotional events may help reappraisers to accomplish a cognitive reinterpretation of the meaning of an emotional event so that it becomes less emotional.

Importantly, in contrast to the findings in experiment 2, experiment 1 showed no relationship between reappraisal and attention biases to angry faces. These discrepant findings may be related to methodological differences between experiments. Specifically, in experiment 1 participants had a broad range of scores in both emotion regulation subscales, while in experiment 2 only extreme individuals with clear preferences of one strategy over the other were included. In this way, the design of experiment 2 maximized the probability of observing and separating possible attentional biases associated with the two different emotion regulation traits. Notably, high trait reappraisal in combination with low trait suppression is rare, comprising only 3.7% of the total 3573 participant mass testing sample. In experiment 1, only 3 out of the total 121 participants would have qualified as high-trait reappraisers (using the pre-selection standards outlined in experiment 2). It is possible that the small number of relatively ‘pure’ forms of high trait reappraisal in experiment 1 limited findings related to trait reappraisal.

A recent fMRI study (Drabant et al., 2009) showed that trait-reappraisal was associated with decreased amygdala activity and increased activation of the dorsolateral PFC (implicated in working memory and selective attention) in response to negative emotional stimuli. Thus, while results from the current study suggest vigilance for negative emotional materials in trait reappraisers, Drabant’s (2009) findings suggests increased regulatory effort (possibly attempts to disengage attention away from negative emotional information) in combination with down-regulation of brain activity in emotion processing areas of the brain. Importantly, Drabant and colleagues’ study examined brain activation in response to angry faces over a 4 second interval. As a result, the implications of this research pertain primarily to late emotion regulation. In contrast, the current study examined attentional biases at 250ms, and thus measured early attention and emotion regulation processes. Although only speculative, Drabant et al’s findings along with my own could suggest early vigilance followed by late avoidance of negative emotional materials in reappraisers. Further research on attentional biases in trait-reappraisal across the timeline of attention is needed to clarify whether and how attention may shift from a vigilance and failure to disengage from negative stimuli early on, to a possible subsequent avoidance.

An additional point of consideration is the finding that attention biases in selected low anxious trait reappraisers in experiment 2 did not differ significantly from those of high anxious individuals. Thus, although these two groups showed similar attentional biases indicating vigilance for anger faces, by definition, they differed significantly in their levels of anxiety. In other words, while attentional biases in trait reappraisers and high anxious individuals did not differ quantitatively, there might be substantial differences in the causation and/or consequences of these attentional biases in each group. Possibly, reappraisers direct their attention *toward* the emotional event to accomplish the reappraisal process and decrease their emotion experience (e.g., Gross & Levenson, 1997). In contrast, sensitivity (i.e., vigilance) for detecting negative emotional information in the absence of emotion regulation may encourage high levels of anxiety. Alternatively, an early attentional vigilance in reappraisers might suggest high levels of emotion (similar to high anxiety) that is later down-regulated through a reinterpretation of the emotional event and will overall result in low self-reported emotionality (as evidenced in studies examining trait-reappraisal and self-reported emotions; Gross & John, 2003).

3. Anxiety and Attention Biases

Finally, high- and low-anxious individuals did not differ in their attentional biases to negative emotional information in either experiment 1 or experiment 2. This finding runs counter to many studies examining attention biases in anxiety finding high trait anxious individuals are more vigilant to threat than low trait anxious individuals (for reviews, see Frewen et al., 2008; Mineka et al., 2003; Williams et al., 1996). In experiment 1, anxiety scores loaded together negatively with scores on the BIDR self-deceptive enhancement subscale, a measure of the tendency toward a positively biased understanding of the self. In other words, experiment 1 participants who reported high levels of anxiety (a negative trait) were also low in self-deceptive enhancement; however, participants who reported low levels of anxiety (a positive trait), were also high in self-deceptive enhancement and had a positively biased understanding of the self. Possibly, experiment 1 participants who reported low levels of anxiety were not truly as low anxious as they perceived themselves to be. If this was the case, some individuals scoring low in anxiety (along with high self-deceptive enhancement) might actually be high anxious and show attention biases similar to high anxious individuals. This would result in attenuated difference in attention biases between low- and high-anxiety subjects in experiment 1. Additionally, the finding that high- and low-trait anxious individuals did not differ in attention biases to negative emotional information in experiment 2 may be related to the high degree of variance in attentional bias scores in the high anxious group (see also Figure 9). A larger sample size in the high anxious control group would likely help reduce this variability and strengthen any between-group differences in attention biases to angry faces.

Although high- and low-anxious individuals did not differ in their attentional biases to negative emotional information, high anxious individuals were indeed significantly slower to disengage from angry faces compared to low-anxious individuals in experiment 2. These findings are in line with previous research suggesting that individual differences in trait anxiety exert a greater impact on the ability to disengage from negative information, than on the speed of orienting attention toward negative information (Fox et al., 2001). Thus, high anxious individuals are not faster to orient toward angry faces, but rather have a greater difficulty disengaging attention away from negative emotional information relative to low anxious individuals.

4. Emotional Stroop

In experiment 1, the emotional Stroop task was included as a non-spatial measure of selective attention toward negative emotional information. In contrast to results of the dot-probe task in experiment 1, there was no significant relationship between trait emotion regulation and emotional Stroop interference scores. This finding may reflect differences in task difficulty between spatial (i.e., dot-probe task) and non-spatial (i.e., emotional Stroop task) measures of selective attention. For example, in the dot-probe task, trait suppression was related to shifting attention away from negative emotional information across the screen towards emotionally neutral materials. In this way, negative emotional materials could be ignored. However, in the emotional Stroop task negative (i.e., words) and neutral (i.e., colour) information are presented in the same spatial location, making it much more difficult to shift attention away from negative emotional information, by focusing solely on neutral information. Therefore, to the extent that individuals struggle in ignoring negative emotional information without shifting attention to another spatial location, the relationship between trait suppression and attention biases toward negative emotional information will disappear. This interpretation would provide further support for my previous interpretation that trait suppression may require diverting attention away from negative information, specifically *away from the spatial location* of negative information.

5. Limitations and Future Directions

There are several limitations to the experiments in the present thesis. First, I assessed quantitative differences in attention biases towards negative emotional information in trait-suppressors, trait-reappraisers, and individuals low in emotion regulation. However, it remains unclear how differences and similarities in attention biases are related to qualitative differences in the actual emotion experience. For example, I suggest that attentional vigilance in reappraisers may be associated with decreased emotion experience, while a similar vigilance in high anxious individuals may be associated with high levels of emotion experience. Alternatively, early attentional vigilance in reappraisers might suggest high levels of emotion (similar to high anxiety) that is later down-regulated through a reinterpretation of the emotional event. To determine whether attention biases in reappraisal and high anxiety reflect the same or different underlying cause, further research assessing emotional experience along with attention biases is needed.

A second limitation is that, in my emotional dot-probe paradigms, angry-neutral face pairs were presented for either a short (i.e., 200ms, 250ms) or a long duration (i.e., 1000ms). It is conceivable that at stimulus durations less than 200ms, greater than 250ms, or greater than 1000ms, a different pattern of attention biases would become evident. For example, studies have shown that high anxious individuals may have an early vigilance for threat, followed by an avoidance of threat information late in the attentional process (e.g., Mogg, Bradley, Miles, & Dixon, 2004). To determine whether similar attention shifts occur in trait emotion regulation along the timeline of attention, further research assessing multiple stimulus durations would be helpful. This is particularly true for experiment 2, in which only one exposure duration was assessed. In this experiment reappraisers showed vigilance to the angry faces early at 250 ms, but without testing attention biases at longer SOAs, it remains unexplored whether their vigilance may change later on or whether reappraisers continue to prefer emotional over neutral information.

A third possible limitation is that the experiments likely did not induce emotion to the extent that spontaneous emotion regulation was evoked. The focus of this study was on trait rather than momentary emotion regulation. Unlike momentary instructed emotion regulation, trait emotion regulation should impact behaviour at all times, even in the absence of an emotion to regulate. However, it might still be more direct to induce an emotion in trait emotion regulators and have them perform momentary emotion regulation while assessing their attention performance. An experimental design that combines trait and momentary emotion regulation should therefore further maximise observable difference in attention biases associated with trait emotion regulation.

Finally, I examined attention biases toward negatively valenced highly arousing emotional stimuli (i.e., angry faces). In this way, it was unclear whether attention biases observed in this study reflected a vigilance or avoidance of negatively valenced materials, highly arousing materials, or both. Future research incorporating both positively and negatively valenced stimuli (e.g., happy versus sad faces), along with varying levels of emotional arousal (e.g., happy versus excited faces) may help determine whether it is the valence or arousal value (or both) of a stimulus that is responsible for attention biases in emotion regulation.

6. Conclusions

The results of the present study provide preliminary evidence for selective processing of negative emotional information in trait-emotion regulation. Specifically, while trait-suppression is associated with decreases in attentional biases towards negative emotional information, trait-reappraisal is associated with greater vigilance for negative emotional materials. Thus, while trait-suppression seems to involve less attention toward negative emotional information, trait-reappraisal may require sustained attention toward present threat, possibly in order to accomplish a cognitive reinterpretation of the meaning of an emotional event so that it becomes less emotional. To my knowledge this study is the first to investigate selective attention processes in trait emotion regulation.

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Appendix A

Due to copyright issues, the individual angry and neutral facial stimuli used in this set of Experiments could not be displayed. Instead, example items of angry and neutral facial stimuli taken from the pooled database of 137 photographs are provided.

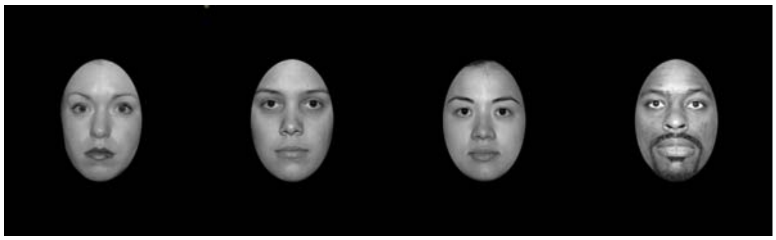

Figure A-1. Examples of neutral facial stimuli used in the dot-probe tasks of Experiment 1 and Experiment 2.

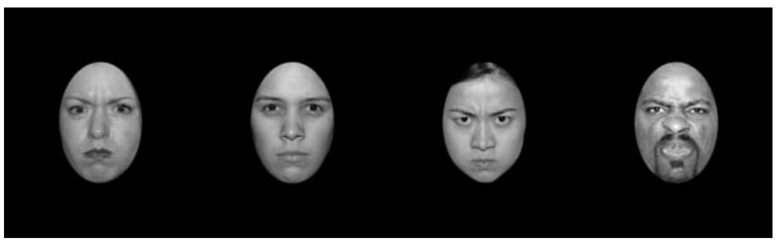

Figure A-2. Examples of angry facial stimuli used in the dot-probe tasks of Experiment 1 and Experiment 2.

Table A-1

Mean anger and emotion scores across ten student judges for each facial stimulus of a pooled database of 137 photographs (*NimStim Database; Ekman & Friesen, 1975; Lyons, Akamatsu, Kamachi, & Gyoba, 1998).*

	Stimulus	Anger rating		Emotionality rating		Experiment 1 (yes/no)	Experiment2 (yes/no)
		Mean	SD	Mean	SD		
			Neutral face stimuli				
1	NE66	1.2	(0.6)	1.3	(0.5)	yes	yes
2	NE26	1.5	(0.5)	1.5	(0.8)	yes	yes
3	NE72	1.5	(0.7)	1.5	(0.7)	yes	yes
4	NE54	1.6	(0.7)	1.5	(0.8)	yes	yes
5	NE68	1.7	(1.1)	1.5	(1.3)	yes	yes
6	NE85	1.9	(1.1)	1.5	(0.7)	yes	yes
7	NE3	1.1	(0.3)	1.6	(0.5)	yes	yes

(Table A-1 continued)

	Stimulus	Anger rating		Emotionality rating		Experiment 1 (yes/no)	Experiment2 (yes/no)
		Mean	SD	Mean	SD		
8	NE80	1.6	(0.8)	1.6	(0.8)	yes	yes
9	NE47	1.7	(0.9)	1.6	(1.1)	yes	yes
10	NE25	1.6	(0.7)	1.7	(0.8)	yes	yes
11	NE63	1.2	(0.4)	1.8	(0.8)	yes	yes
12	NE61	1.6	(0.8)	1.8	(0.8)	yes	yes
13	NE89	1.7	(1.1)	1.8	(1.0)	yes	yes
14	NE90	1.7	(1.3)	1.8	(1.2)	yes	yes
15	NE42	1.8	(0.9)	1.8	(0.8)	yes	yes
16	NE91	1.9	(1.3)	1.8	(1.2)	yes	yes
17	NE62	2.4	(1.3)	1.8	(1.0)	yes	yes
18	NE84	2.5	(1.6)	1.8	(1.0)	yes	yes
19	NE33	1.2	(0.4)	1.9	(1.0)	yes	yes
20	NE44	1.3	(0.7)	1.9	(1.0)	yes	yes
21	NE41	1.4	(0.7)	1.9	(1.0)	yes	yes
22	NE13	1.5	(0.8)	1.9	(1.1)	yes	yes
23	NE73	1.6	(1.1)	1.9	(1.0)	yes	yes
24	NE34	1.8	(0.9)	1.9	(1.3)	yes	yes
25	NE50	1.3	(0.5)	2.0	(1.1)	yes	yes
26	NE87	1.4	(0.7)	2.0	(1.2)	yes	yes
27	NE36	1.7	(1.2)	2.0	(1.4)	yes	yes
28	NE56	1.8	(1.0)	2.0	(0.8)	yes	yes
29	NE8	2.3	(0.9)	2.0	(0.9)	yes	yes
30	NE67	1.2	(0.4)	2.1	(0.9)	yes	yes
31	NE69	1.2	(0.4)	2.1	(1.5)	yes	yes
32	NE70	1.4	(0.7)	2.1	(0.9)	no	yes
33	NE20	1.7	(1.3)	2.1	(1.3)	yes	yes
34	NE38	1.7	(0.9)	2.1	(1.2)	yes	yes
35	NE88	1.7	(0.9)	2.1	(1.1)	no	yes
36	NE6	1.9	(1.0)	2.1	(1.1)	yes	yes
37	NE76	2.0	(1.4)	2.1	(1.4)	no	yes
38	NE19	2.2	(1.5)	2.1	(0.9)	yes	yes
39	NE64	2.2	(0.9)	2.1	(1.1)	yes	yes
40	NE9	2.2	(1.0)	2.1	(1.2)	no	yes
41	NE55	1.3	(0.5)	2.2	(1.7)	no	yes
42	NE79	1.3	(0.7)	2.2	(1.1)	no	yes
43	NE57	1.6	(0.5)	2.2	(1.0)	no	yes
44	NE75	2.0	(0.9)	2.2	(1.3)	no	yes
45	NE81	2.0	(1.5)	2.2	(1.4)	no	yes
46	NE82	2.2	(1.8)	2.2	(1.6)	no	yes
47	NE12	1.5	(0.7)	2.3	(0.8)	no	yes
48	NE16	1.7	(0.8)	2.3	(0.8)	no	yes
49	NE2	1.9	(0.9)	2.3	(1.6)	no	yes

(Table A-1 continued)

	Stimulus	Anger rating		Emotionality rating		Experiment 1 (yes/no)	Experiment2 (yes/no)
		Mean	SD	Mean	SD		
50	NE39	1.9	(1.2)	2.3	(1.2)	no	yes
51	NE23	1.1	(0.3)	2.4	(1.1)	no	no
52	NE37	1.2	(0.4)	2.4	(1.3)	no	no
53	NE31	1.4	(0.8)	2.4	(1.5)	no	no
54	NE14	1.5	(0.7)	2.4	(1.1)	no	yes
55	NE17	1.6	(0.8)	2.4	(1.3)	no	no
56	NE45	1.9	(1.0)	2.4	(1.3)	no	no
57	NE83	1.9	(0.9)	2.4	(1.1)	no	yes
58	NE28	2.0	(1.1)	2.4	(1.3)	no	yes
59	NE40	2.3	(1.1)	2.4	(1.2)	no	no
60	NE10	2.4	(1.0)	2.4	(1.1)	no	yes
61	NE74	1.5	(0.5)	2.5	(0.8)	no	no
62	NE21	1.7	(0.9)	2.5	(1.6)	no	no
63	NE24	1.9	(0.9)	2.5	(1.2)	no	no
64	NE43	1.9	(1.3)	2.5	(1.6)	no	no
65	NE77	2.1	(1.4)	2.5	(1.2)	no	no
66	NE27	2.2	(0.9)	2.5	(1.4)	no	no
67	NE71	2.2	(0.9)	2.5	(1.5)	no	no
68	NE15	1.7	(1.1)	2.6	(1.2)	no	no
69	NE29	2.5	(1.5)	2.6	(1.1)	no	no
70	NE30	1.4	(0.5)	2.7	(1.5)	no	no
71	NE86	3.0	(1.2)	2.7	(1.8)	no	no
72	NE22	1.2	(0.4)	2.8	(1.9)	no	no
73	NE18	1.3	(0.5)	2.8	(0.9)	no	no
74	NE46	1.8	(0.6)	2.8	(1.1)	no	no
75	NE35	2.0	(0.9)	2.8	(1.1)	no	no
76	NE1	2.3	(0.8)	2.8	(1.5)	no	no
77	NE49	2.5	(1.1)	2.8	(0.8)	no	no
78	NE5	1.2	(0.4)	2.9	(1.4)	no	no
79	NE4	2.3	(1.6)	2.9	(1.2)	no	no
80	NE32	1.3	(0.5)	3.0	(0.8)	no	no
81	NE51	2.6	(1.4)	3.0	(1.5)	no	no
82	NE59	1.3	(0.7)	3.2	(1.5)	no	no
83	NE7	1.9	(1.2)	3.2	(1.2)	no	no
84	NE48	2.8	(1.4)	3.2	(1.1)	no	no
85	NE60	1.2	(0.4)	3.3	(1.2)	no	no
86	NE52	3.1	(1.4)	3.3	(1.9)	no	no
87	NE53	3.5	(1.3)	3.3	(1.6)	no	no
88	NE58	2.0	(1.3)	3.4	(1.2)	no	no
89	NE78	2.3	(1.3)	3.7	(1.6)	no	no
90	NE65	2.5	(1.3)	3.7	(1.5)	no	no
91	NE11	2.2	(1.5)	3.8	(1.8)	no	no

(Table A-1 continued)

	Stimulus	Anger rating		Emotionality rating		Experiment 1 (yes/no)	Experiment2 (yes/no)
		Mean	SD	Mean	SD		
		Angry face stimuli					
92	AN45	2.5	(1.8)	5.2	(1.5)	no	no
93	AN17	2.7	(1.4)	4.0	(1.5)	no	no
94	AN43	2.8	(1.4)	4.2	(1.3)	no	no
95	AN46	3.1	(0.6)	3.6	(1.3)	no	no
96	AN22	3.3	(1.3)	4.9	(1.6)	no	no
97	AN44	3.8	(1.4)	3.5	(1.4)	no	no
98	AN8	3.8	(1.5)	3.7	(1.3)	no	no
99	AN30	3.8	(0.8)	4.4	(1.6)	no	no
100	AN18	3.9	(1.5)	4.5	(1.4)	no	no
101	AN24	4.1	(1.1)	3.6	(1.7)	yes	no
102	AN15	4.1	(1.6)	4.2	(1.5)	yes	no
103	AN33	4.1	(1.4)	4.2	(1.9)	no	no
104	AN16	4.1	(1.3)	4.8	(1.7)	yes	no
105	AN27	4.3	(0.9)	3.8	(1.5)	yes	no
106	AN3	4.3	(1.1)	3.8	(1.5)	yes	no
107	AN12	4.3	(1.1)	3.9	(1.2)	yes	no
108	AN13	4.3	(1.3)	4.2	(1.4)	yes	no
109	AN37	4.3	(1.4)	4.3	(1.9)	yes	no
110	AN1	4.3	(1.2)	4.6	(1.0)	yes	no
111	AN19	4.3	(1.5)	4.6	(1.3)	yes	no
112	AN26	4.5	(1.3)	4.2	(1.7)	yes	no
113	AN6	4.5	(1.6)	5.2	(1.0)	yes	no
114	AN25	4.5	(1.4)	5.3	(1.6)	yes	no
115	AN4	4.6	(1.6)	4.0	(1.6)	yes	no
116	AN34	4.6	(1.2)	4.2	(1.2)	yes	no
117	AN36	4.7	(1.1)	4.7	(1.3)	yes	no
118	AN35	4.8	(1.3)	4.8	(1.4)	yes	no
119	AN11	4.9	(1.0)	4.8	(1.4)	yes	no
120	AN2	4.9	(1.0)	4.8	(1.3)	yes	yes
121	AN31	4.9	(1.4)	5.0	(1.3)	yes	yes
122	AN7	5.2	(1.1)	4.7	(1.5)	yes	yes
123	AN28	5.2	(1.5)	5.5	(1.4)	yes	yes
124	AN41	5.3	(0.8)	4.9	(0.9)	yes	yes
125	AN20	5.4	(1.6)	5.0	(1.4)	yes	yes
126	AN10	5.4	(1.1)	5.3	(1.3)	yes	yes
127	AN23	5.5	(1.4)	5.3	(1.6)	yes	yes
128	AN29	5.5	(1.2)	5.4	(1.5)	yes	yes
129	AN9	5.5	(1.3)	5.4	(1.5)	yes	yes
130	AN39	5.6	(1.2)	5.0	(1.4)	yes	yes
131	AN21	5.6	(1.3)	5.4	(1.4)	yes	yes

(Table A-1 continued)

	Stimulus	Anger rating		Emotionality rating		Experiment 1 (yes/no)	Experiment2 (yes/no)
		Mean	SD	Mean	SD		
132	AN38	5.7	(0.7)	4.9	(1.7)	yes	yes
133	AN42	5.7	(1.3)	5.6	(1.6)	yes	yes
134	AN40	6.0	(0.9)	6.0	(1.2)	yes	yes
135	AN14	6.3	(0.9)	6.0	(1.2)	yes	yes
136	AN5	6.3	(0.8)	6.0	(1.6)	yes	yes
137	AN32	6.5	(1.0)	6.1	(1.7)	yes	yes

	Experiment 1		Experiment 2	
Mean neutral face anger rating*	1.6	(0.8)	1.7	(0.35)
Mean neutral face emotionality rating*	1.8	(1.0)	2.0	(0.27)
Mean angry face anger rating*	5.0	(1.2)	5.6	(0.45)
Mean angry face emotionality rating*	4.5	(1.4)	5.4	(0.45)

* Calculated means and SDs are based on selected (i.e., "yes") facial stimuli for each experiment.
NE = neutral faces (as designated by database of origin).
AN = angry faces (as designated by database of origin).

Appendix B

Table B-1

Sample means, SDs for the ERQ,BEQ, STAI-State, STAI-Trait, BIDR, and AAQ.

	Mean	SD
ERQ		
(N = 104)		
Reappraisal:	4.81	(1.04)
Suppression:	3.59	(1.18)
BEQ		
(N = 104)		
Negative expressivity:	3.81	(1.16)
Positive expressivity:	5.38	(1.12)
Impulse strength:	4.71	(1.33)
Total:	4.63	(1.01)
STAI-State	35.37	(8.47)
(N = 104)		
STAI-Trait	47.10	(8.42)
(N = 104)		
BIDR		
(N = 104)		
Impression management:	71.41	(16.05)
Self-enhancement:	80.06	(11.93)
Total:	151.47	(22.21)
AAQ		
(N = 104)		
Action	4.59	(0.73)
Willingness	3.91	(0.71)

Appendix C
Emotion Regulation Questionnaire

In this section, we would like to ask you some questions about your emotional life, in particular, how you control (that is, regulate and manage) your emotions. We are interested in two aspects of your emotional life. One is your emotional experience, or what you feel like inside. The other is your emotional expression, or how you show your emotions in the way you talk, gesture, or behave. Although some of the following questions may seem similar to one another, they differ in important ways. For each of the statements located on the next two pages, please indicate your level of agreement or disagreement by circling one of the scale categories to the right of each statement. Use the scale as shown below:

1	2	3	4	5	6	7
Strongly disagree			**Neutral**			**Strongly agree**

1.	When I want to feel more *positive* emotion (such as joy or amusement), I change *what I'm thinking about.*	1	2	3	4	5	6	7
2.	I keep my emotions to myself.	1	2	3	4	5	6	7
3.	When I want to feel less *negative* emotion (such as sadness or anger), I change *what I'm thinking about.*	1	2	3	4	5	6	7
4.	When I am feeling *positive* emotions, I am careful not to express them.	1	2	3	4	5	6	7
5.	When I'm faced with a stressful situation, I make myself *think about it* in a way that helps me stay calm.	1	2	3	4	5	6	7
6.	I control my emotions by *not expressing them.*	1	2	3	4	5	6	7
7.	When I want to feel more *positive* emotion, I *change the way I'm thinking* about the situation.	1	2	3	4	5	6	7
8.	I control my emotions by *changing the way I think* about the situation I'm in.	1	2	3	4	5	6	7
9.	When I am feeling *negative* emotions, I make sure not to express them.	1	2	3	4	5	6	7
10.	When I want to feel less *negative* emotion, I *change the way I'm thinking* about the situation.	1	2	3	4	5	6	7

Appendix D

Berkley Expressivity Questionnaire

For each statement below, please indicate your agreement or disagreement. Do so by filling in the blank in front of each item with the appropriate number from the following rating scale:

1	2	3	4	5	6	7
Strongly disagree			**Neutral**			**Strongly agree**

____	1.	Whenever I feel positive emotions, people can easily see exactly what I am feeling.
____	2.	I sometimes cry during sad movies.
____	3.	People often do not know what I am feeling.
____	4.	I laugh out loud when someone tells me a joke that I think is funny.
____	5.	It is difficult for me to hide my fear.
____	6.	When I'm happy, my feelings show.
____	7.	My body reacts very strongly to emotional situations.
____	8.	I've learned it is better to suppress my anger than to show it.
____	9.	No matter how nervous or upset I am, I tend to keep a calm exterior.
____	10.	I am an emotionally expressive person.
____	11.	I have strong emotions.
____	12.	I am sometimes unable to hide my feelings, even though I would like to.
____	13.	Whenever I feel negative emotions, people can easily see exactly
____	14.	There have been times when I have not been able to stop crying even though I tried to stop.
____	15.	I experience my emotions very strongly.
____	16.	What I'm feeling is written all over my face.

Appendix E

STAI – State

Due to copyright issues, only five sample items from the STAI-State instrument can be displayed here.

A number of statements which people have used to describe themselves are given below. Read each statement and then blacken the appropriate circle to the right of the statement to indicate how you feel right now, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best. Please use the following scale:

0	1	2	3
Not at all	**Somewhat**	**Moderately so**	**Very much so**

1. I feel calm.	0	1	2	3
2. I feel secure.	0	1	2	3
3. I feel tense.	0	1	2	3
4. I feel strained.	0	1	2	3
5. I feel at ease.	0	1	2	3

Appendix F

STAI – Trait

Due to copyright issues, only five sample items from the STAI-Trait instrument can be displayed here.

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate you generally feel. Please use the following scale:

0	**1**	**2**	**3**
Almost never	**Rarely**	**Sometimes**	**Almost always**

1.	I feel pleasant.	0	1	2	3
2.	I feel nervous and restless.	0	1	2	3
3.	I feel satisfied with myself.	0	1	2	3
4.	I wish I could be as happy as others seem to be.	0	1	2	3
5.	I feel like a failure.	0	1	2	3

Appendix G

Balanced Inventory of Desirable Responding

Items 1-20 make up the Self-Deceptive Enhancement subscale, while items 21-40 make up the Impression Management subscale.

Using the scale below as a guide, write a number beside each statement to indicate how much you agree with it. Please use the following scale:

1 **Not true**	2	3	4 **Somewhat true**	5	6	7 **Very true**

____	1.	My first impression of people usually turns out to be right.
____	2.	It would be hard for me to break any of my bad habits.
____	3.	I don't care to know what other people really think of me.
____	4.	I have not always been honest with myself.
____	5.	I always know why I like things.
____	6.	When my emotions are aroused it biases my thinking.
____	7.	Once I've made up my mind, other people can seldom change my opinion.
____	8.	I am not a safe driver when I exceed the speed limit.
____	9.	I am fully in control of my own fate.
____	10.	It's hard for me to shut off a disturbing thought.
____	11.	I never regret my decisions.
____	12.	I sometimes lose out on things because I can't make up my mind soon enough.
____	13.	The reason I vote is because my vote can make a difference.
____	14.	My parents were not always fair when they punished me.
____	15.	I am a completely rational person
____	16.	I rarely appreciate criticism.
____	17.	I am very confident of my judgements.
____	18.	I have sometimes doubted my abilities as a lover
____	19.	It's all right with me if some people happen to dislike me.
____	20.	I don't always know the reasons why I do the things I do.
____	21.	I sometimes tell lies if I have to.

____	22.	I never cover up my mistakes.
____	23.	There have been occasions when I have taken advantage of someone.
____	24.	I never swear.
____	25.	I sometimes try to get even rather than forgive and forget.
____	26.	I always obey laws, even if I'm unlikely to get caught.
____	27.	I have said something bad about a friend behind his or her back.
____	28.	When I hear people talking privately, I avoid listening.
____	29.	I have received too much change from a salesperson without telling him or her.
____	30.	I always declare everything at customs.
____	31.	When I was young I sometimes stole things.
____	32.	I have never dropped litter on the street.
____	33.	I sometimes drive faster than the speed limit.
____	34.	I never read sexy books or magazines.
____	35.	I have done things that I don't tell other people about.
____	36.	I never take things that don't belong to me.
____	37.	I have taken sick-leave from work or school even though I was not really sick.
____	38.	I have never damaged a library book or store merchandise without reporting it.
____	39.	I have some pretty awful habits.
____	40.	I don't gossip about other people's business.

Appendix H

Action and Acceptance Questionnaire

Below you will find a list of statements. Please rate the truth of each statement as it applies to you. Please use the following scale:

1 **Never true**	2 **Very rarely true**	3 **Seldom true**	4 **Sometimes true**	5 **Frequently true**	6 **Almost always true**	7 **Always true**

1.	I am able to take action on a problem even if I am uncertain what is the right thing to do.	1	2	3	4	5	6	7
2.	When I feel depressed or anxious, I am unable to take care of my responsibilities.	1	2	3	4	5	6	7
3.	I try to suppress thoughts and feelings that I don't like by just not thinking about them.	1	2	3	4	5	6	7
4.	It's OK to feel depressed or anxious.	1	2	3	4	5	6	7
5.	I rarely worry about getting my anxieties, worries, and feelings under control.	1	2	3	4	5	6	7
6.	In order for me to do something important, I have to have all my doubts worked out.	1	2	3	4	5	6	7
7.	I'm not afraid of my feelings.	1	2	3	4	5	6	7
8.	I try hard to avoid feeling depressed or anxious.	1	2	3	4	5	6	7
9.	Anxiety is bad.	1	2	3	4	5	6	7
10.	Despite doubts, I feel as though I can set a course in my life and then stick to it.	1	2	3	4	5	6	7
11.	If I could magically remove all the painful experiences I've had in my life, I would do so.	1	2	3	4	5	6	7
12.	I am in control of my life.	1	2	3	4	5	6	7
13.	If I get bored of a task, I can still complete it.	1	2	3	4	5	6	7
14.	Worries can get in the way of my success.	1	2	3	4	5	6	7
15.	I should act according to my feelings at the time.	1	2	3	4	5	6	7
16.	If I promised to do something, I'll do it, even if I later don't feel like it.	1	2	3	4	5	6	7
17.	I often catch myself daydreaming about things I've done and what I would do differently next time.	1	2	3	4	5	6	7
18.	When I evaluate something negatively, I usually recognize that this is just a reaction, not an objective fact.	1	2	3	4	5	6	7
19.	When I compare myself to other people, it seems that most of them are handling their lives better than I do.	1	2	3	4	5	6	7

Appendix I

Table I-1

Correlation matrix among personality measures for experiment 1 participants (N = 104)

	Variable	1	2	3	4	5	6	7	8	9	10	11	12
1.	ERQ-Reappraisal	-											
2.	ERQ-Suppression	-.10	-										
3.	BEQ-NEX	-.02	-.66**	-									
4.	BEQ-PEX	.13	-.56**	.64**	-								
5.	BEQ-IS	.02	-.36**	.57**	.48**	-							
6.	STAI-State	-.21*	.14	.11	-.09	.22*	-						
7.	STAI-Trait	-.25**	.29**	.01	-.12	.34**	.61**	-					
8.	BIDR-IM	.02	-.14	-	.09	-.03	-.29**	-.26**	-				
9.	BIDR-SDE	.18	-.05	-.17	.05	-.29**	-.48**	-.58**	.24*	-			
10.	AAQ-Action	.10	-.08	-.15	-	-.25**	-.30**	-.46**	.11	.41**	-		
11.	AAQ-Willingness	-.20*	-.14	-	-	-.16	-.28**	-.39**	.08	.26**	.27**	-	
12.	ER-IAT	.10	.12	-.12	-.15	-.05	-.10	-.09	.14	-.01	-.06	-.30	-

* Correlation is significant at 0.01 level (two-tailed).
** Correlation is significant at 0.05 level (two-tailed).