AN EXAMINATION OF ATTENTIONAL BIAS FOR THREAT IN MOTOR VEHICLE ACCIDENT SURVIVORS WITH POSTTRAUMATIC STRESS DISORDER

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Sophie Duranceau, candidate for the degree of Master of Arts in Clinical Psychology, has presented a thesis titled, *An Examination of Attentional Bias for Threat in a Motor Vehicle Accident Survivors with Posttraumatic Stress Disorder*, in an oral examination held on Friday, July 11, 2014. The following committee members have found the thesis acceptable in form and content, and that the candidate demonstrated satisfactory knowledge of the subject material.

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Abstract

Theoretical models of anxiety suggest that cognitive vulnerabilities are involved in the development and maintenance of posttraumatic stress disorder (PTSD; Elwood, Hahn, Olatunji, & Williams, 2009). Attentional bias for threat has been identified as a cognitive vulnerability which may facilitate the development and maintenance of PTSD (Bomyea, Risbrough, & Lang, 2012). Several cognitive tasks have previously been used to assess attentional bias for threat in anxiety pathologies (i.e., emotional Stroop task, visual search task, dot probe task). The proposed investigation was designed to assess the directionality (i.e., facilitated attention, difficulty in disengagement, avoidance) and time-course of attentional bias for threat in motor vehicle accident (MVA) survivors using a contemporary dot probe task. Participants included MVA survivors with high PTSD symptoms (n = 18), MVA survivors with low PTSD symptoms (n = 46), and a control group with no history of MVA or PTSD (n = 64) recruited across North America. Results suggest that MVA survivors reporting high PTSD symptoms display a different attentional pattern than individuals without such symptoms during the early stages of cognitive processing. Specifically, MVA survivors with high PTSD symptoms 1) easily disengage their attention from MVA-related threat and, contrary to individuals without PTSD symptoms, 2) fail to engage with generally threatening stimuli. A lack of engagement with threatening stimuli could interfere with the processing and re-appraisal of threat, in turn contributing to the exacerbation of PTSD symptoms. Attention bias modification programs could be useful for the treatment of PTSD. Comprehensive results, methodological considerations, implications, and future research are discussed.
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1.0 Literature Review

The present investigation was designed to assess the directionality and time course of cognitive attentional bias for threat in motor vehicle accident (MVA) survivors with Posttraumatic Stress Disorder (PTSD) symptoms using a contemporary dot probe paradigm. First, the development of PTSD as a recognized psychological disorder will be discussed. Second, an overview of the theoretical framework underlying attentional bias for threat in anxiety disorders will be presented, including Cisler and Koster’s recent integrative framework. Third, the discussion will focus on a review of the literature on attentional bias for threat in PTSD and in MVA survivors more specifically. Findings pertaining to attentional bias for threat in PTSD will be discussed in relation to the model proposed by Cisler and Koster. Theoretical models of attentional bias for threat and past empirical findings support the current investigation, including the methods and analyses. Fourth, findings from the current investigation and their implications for future research will be discussed in the context of research and clinical practice.

Wars begin when you will but they do not end when you please.  
Niccolò Machiavelli, 1532

1.1. Posttraumatic Stress Disorder

1.1.1 General History

Written five centuries ago, Machiavelli's work offers observations of the political and social landscape during Renaissance Italy. Unbeknownst to the author, his words also underscore the lasting impact a traumatic event such as war may have on an individual. The word “trauma” finds its origin in the ancient Greek word “wound” (Liddell & Scott, 1999) and initial accounts of traumatic stress symptoms can be found as early as in the Antiquity literature. For five millennia, testimonies of wars and great civilian
catastrophes have come with descriptions of traumatic stress symptoms such as intrusive recollections of the event and the inability to find sleep (Birmes, Hatton, Brunet, & Schmitt, 2003; Homère, 1975; Pepys, 1994; Trimble, 1981). Despite repeated reports of traumatic stress symptoms in the literature, a nosology of trauma-related psychological disorders only emerged in the 19th century.

In 1892, Oppenheim coined the term “Traumatischen Neurosen” to describe the irritable mood and nightmares produced by a shaken nervous system following a railway accident (Kraepelin, 1896). In 1896, Kraepelin renamed such a condition “Schreckneurose” or “fright neurosis” and was the first to recognize that serious accidents or injuries can lead to an independent clinical condition with an emotional rather than a physical etiology (Kraepelin, 1896). Grinker and Spiegel (1945) later wrote about the many problems that awaited a returnee from World War II with “combat neuroses,” namely depression, agitation, sympathetic overactivity, difficulty concentrating, and suspicion. In the same book, the authors noted that the symptoms experienced by soldiers with combat neuroses mirrored the symptoms presented by any man who failed to adapt to a stressful environment. A year later, Hans Selye introduced the notion of the pituitary-adrenocortical response to stress and exposed that chronic activation of the physical stress response could produce a “disease of adaptation” (Selye, 1950). For the first time, it was recognized that psychological symptoms which present following a stressful event may be associated with the physiological response to stress.

1.1.2 Diagnostic History

The end of World War II fueled the dissemination of knowledge between the American and the European scientific communities. A consensus quickly emerged
regarding the need for a standardization of mental health disorders and the first Diagnostic and Statistical Manual of Mental Disorders was published in 1952 (DSM-I; American Psychological Association [APA], 1952). “Gross Stress Reaction” was incorporated within the “Transient Situational Personality Disorders” category of DSM-I and identified as an acute distress response (e.g., nightmares, increased arousal, irritability) to extreme physical demand or emotional stress, such as in war combat or in a civilian catastrophe (e.g., fire, earthquake, explosion; Wilson, 1994). Given the transient nature of Gross Stress Reaction, persistence of symptoms was taken as a sign of a more severe predispositional disturbance (i.e., neurosis and psychosis; Wilson, 1994).

The second installment of the DSM (DSM-II; APA, 1968) sustained a similar view and “Adjustment Reaction of Adult Life” as a Transient Situational Personality Disorder replaced Gross Stress Reaction in DSM-II. The provisional nature of Adjustment Reaction of Adult Life was reiterated and a list of life stressors was provided in appendices (e.g., motor vehicle accidents, railway accidents, water transport accidents, air transport accidents; Wilson, 1994). The early classifications of DSM-I and DSM-II rendered normal the short-term psychological symptoms experienced following an extreme life stressor; however, due to the longer lasting nature of their symptoms, veterans of the Vietnam War were still being diagnosed with schizophrenia and other psychotic disorders (Ozer, Best, Lipsey, & Weiss, 2003). Accordingly, a new classification was required to account for the continuing psychological distress experienced by some individuals following trauma exposure.

By the early 1970s, Vietnam’s battlefields had become increasingly violent and unpredictable (Honzell, 2008). Many veterans returned to the United States and reported
experiencing recurrent nightmares, flashbacks, numbing of emotions, social withdrawal, and hyperarousal to stimuli in the environment (Ozer et al., 2003). Around the same time, a nurse at Boston City Hospital witnessed signs of re-experiencing, avoidance, and hyperarousal in women who were sexually assaulted. Such a collection of symptoms was recognized as “rape trauma syndrome” (Burgess & Holmstrom, 1974). The three distinct clusters of symptoms (i.e., re-experiencing, avoidance/numbing, and hyperarousal) experienced in “rape trauma syndrome” became Criterion B, C, and D respectively for the DSM-III (APA, 1980) diagnosis of PTSD. Contrary to Gross Stress Reaction and Adjustment Disorder of Adult Life, PTSD was recognized as a persistent psychological condition caused by a traumatic event and was classified as an Anxiety Disorder.

DSM-III divided PTSD into five different criteria, all of which were necessary to meet PTSD diagnosis. Notably, Criterion A stipulated that the traumatic event had to be one that would cause distress in almost everyone. By recognizing that certain extraordinary stressors could produce traumatic reactions in almost everyone, DSM-III recognized certain traumatic reactions as appropriate, contrary to DSM-I and DSM-II (Lifton, 1988). Rather than being caused by an individual predisposition, PTSD was perceived as the consequence of normal feelings and behaviors that persisted long after a traumatic event and lead to maladaptive functioning (Wilson, 1994). Such a view was maintained in the revised version of the DSM-III installment (DSM-III-R; APA, 1987) and the diagnostic criteria for PTSD were further clarified. Criterion A made an explicit reference to the experiencing of traumatic events outside the range of normal human experience (e.g., physical life threat, threat to psychological well-being, and disaster of natural or human origin) and was extended to individuals hearing about such threats to
significant others, or witnessing such traumatic events. The notion of delayed onset of the disorder—when symptoms begin more than six months after the experience of a traumatic event—also emerged for the first time.

Research and clinical knowledge about PTSD rapidly highlighted the fact that many potentially traumatic stressors did not meet the DSM-III-R prerequisite of falling outside the range of normal human experience (Spitzer, First, & Wakefield, 2007). As a result, further changes to the PTSD diagnosis were made in the DSM-IV (APA, 1994). Criterion A was divided into two components. Criterion A1 required the individual to have experienced, witnessed, or been confronted with actual or threatened death or serious injury, or threat to the physical integrity of oneself or others and resembled the original concept of gross stress found in DSM-I (Spitzer et al., 2007). Criterion A2 specified that horror, fear, and helplessness must be experienced in response to the traumatic event. Criteria B (re-experiencing symptoms), C (avoidance/numbing symptoms), D (hyperarousal symptoms), and E (timeframe requirements) remained relatively unchanged but a sixth criterion was added to the disorder. Criterion F required that symptoms presented in criteria B, C, and D cause significant distress and impairment in occupational, social or other aspects of functioning. The changes to DSM-IV were accompanied by a distinction between acute and chronic PTSD. Acute PTSD referred to the presence of symptoms for less than 3 months, after which point chronic PTSD could be diagnosed.

The diagnosis of PTSD did not undergo any significant changes in the revised version of DSM-IV (DSM-IV-TR; APA, 2000); however, PTSD as defined by DSM-IV-TR was debated within the scientific community. The existence of the disorder itself has
been called into question (Scott, 1990; Summerfield, 2001; Young, 1995). The question was supported by evidence that patients can display several symptoms consistent with PTSD without experiencing a traumatic event (Bodkin, Pope, Detke, & Hudson, 2007; Gold, Marx, Soler-Baillo, & Sloan, 2005; Mol et al., 2005), underscoring the non-specificity of PTSD symptoms (McHugh & Treisman, 2007).

The recent publication of DSM-5 led to further changes to the diagnosis (APA, 2013). Criterion A had been qualified as vague, unreliable (Spitzer et al., 2007), and as facilitating "conceptual bracket creep" (McNally, 2003); accordingly, it became more explicit in DSM-5 and Criterion A2 was dropped (APA, 2013). Avoidance and numbing symptoms have been consistently shown to represent two distinct symptom clusters (e.g., Asmundson, Stapleton, & Taylor, 2004; Asmundson et al., 2000) and are considered as such in the DSM-5, with numbing symptoms being identified as “negative alterations in cognitions and mood” (APA, 2013). The distinction between Acute and Chronic PTSD was removed and a specifier was added for individuals presenting with high levels of dissociative symptoms (i.e., depersonalization, derealization). Finally, PTSD was re-categorized as a Trauma- and Stressor-related Disorder rather than as an Anxiety Disorder (APA, 2013), even though PTSD remains highly correlated with anxiety disorders (e.g., Ginzburg, Ein-Dor, & Solomon, 2010) and shares common vulnerability factors with such disorders (e.g., Bomyea, Risbrough, & Lang, 2012).

1.1.3 Vulnerabilities to Posttraumatic Stress Disorder

Approximately 90% of individuals in the general population will experience a traumatic event during their lifetime and men are 1.2 times more likely than women to be exposed to such an event (Breslau et al., 1998). In the general population, the most
prevalent traumatic events encountered include death of a close friend or a loved one (60%), violent assault (38%), MVAs (28%), and natural disasters (13%; Breslau et al., 1998). Estimates suggest that 9.2% of individuals who experience such events will meet full criteria for PTSD (Breslau et al., 1998). The discrepancy between the prevalence of traumatic event exposure and the prevalence of PTSD suggests that individual differences prior to, during, and following trauma exposure may play an important role in the development of the disorder. Women appear to be twice as likely as men to develop PTSD following trauma exposure (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995) and the difference remains even after controlling for the type of traumatic event experienced (Breslau, Chilcoat, Kessler, Peterson, & Lucia, 1999). Being from an ethnic minority group has also been identified as a vulnerability for the development of PTSD (Kessler et al., 1995), although ethnic differences may result from a larger proportion of ethnic minorities being from lower socioeconomic status and less educated, two vulnerabilities for PTSD (Brewin, Andrews, & Valentine, 2000). In line with twin studies suggesting that genetic factors account for approximately 30% of the risk of developing PTSD (Koenen, Nugent, & Amstadter, 2008; Koenen, Fu, et al., 2008), the personality trait of neuroticism (Paris, 2000) and family history of psychopathology (Keane, Marx, & Sloan, 2009) have been identified as vulnerability factors present prior to the occurrence of a traumatic event. During trauma, peritraumatic emotional response (e.g., fear, helplessness, horror, guilt, and shame) and peritraumatic dissociation (e.g., altered sense of time, “blanking out”, and feeling disconnected from one’s body) both confer an added risk of developing PTSD (Keane et al., 2009). Following trauma, lack of social support
further increases the likelihood of developing PTSD (e.g., Brewin et al., 2000; Keane et al., 2009).

Some predispositional variables (e.g., sex, ethnicity, family history of psychopathology) cannot readily be modified; however, cognitive risk factors may be altered (e.g., Barlow, 2008). Cognitive models of PTSD suggest that individuals developing PTSD present cognitive vulnerabilities defined as biases regarding the probability of threat in the outside world (Elwood, Hahn, Olatunji, & Williams, 2009). Cognitive vulnerabilities which have been implicated in the development and maintenance of PTSD include, but are not limited to, a negative attributional style, rumination, anxiety sensitivity, and a looming cognitive style (Elwood et al., 2009) which can manifest itself through an attention bias for threat (Bomyea et al., 2012). Attentional bias for threat—an asymmetrical distribution of attentional resources towards threatening stimuli in the environment—has been implicated as a general vulnerability factor for anxiety disorders (e.g., Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van IJzendoorn, 2007) and specifically for PTSD (Beevers, Lee, Wells, Ellis, & Telch, 2011; Bomyea et al., 2012). The anxiety disorders literature consistently supports the existence of a moderate attentional bias for threat in anxiety pathologies; however, the theoretical framework underlying this bias is subject to ongoing research and debate (Bar-Haim et al., 2007). In an attempt to clarify the nature of attentional bias for threat in anxiety disorders, cognitive models of attentional bias for threat have been developed over the past 25 years (e.g., Beck, Emery, & Greenberg, 1985; Eysenck, 1992; Wells & Matthews, 1994; Williams, Watts, MacLeod, & Mathews, 1988). Such models can be used as a
foundation to better understand the relationship that exists between attentional bias for threat and PTSD.

1.2. Theoretical Framework of Attentional Bias for Threat in Anxiety Disorders

1.2.1. Beck and Clark’s Cognitive Model

The earliest theoretical model of attentional bias for threat in anxiety disorders was developed almost 25 years ago (Beck et al., 1985) and later refined (Beck & Clark, 1997). In this three-stage information processing model, pathological anxiety is the product of overestimating the threatening nature of stimuli in the environment and underestimating one’s own coping abilities (Beck et al., 1985), leading to inaccurate interpretations of external stimuli during the different stages of the information processing sequence. The first stage, the orienting mode, is primarily one of automatic processing (Beck, 1996). Automaticity is characterized by rapid, effortless, and primarily unconscious processing requiring minimal higher-order capacity (Logan, 1988; McNally, 1995). During this stage, stimulus features are rapidly processed in order to identify potentially threatening situations (Beck et al., 1985). In the context of threat, such early and pre-attentive analysis solely seeks to classify stimuli in terms of emotionality (i.e., negative, positive, neutral) and relevance (i.e., personally relevant vs. irrelevant; Beck & Clark, 1997). Demonstrations from investigations using subliminal presentations of stimuli show that, in anxious individuals, the orienting mode has a propensity to detect and allocate attentional resources to negative and personally relevant stimuli (Bradley, Mogg, Millar, & White, 1995; Mogg, Bradley, Williams, & Mathews, 1993).

The identification of personally relevant negative stimuli activates the second stage of information processing, also referred to as the primal threat mode (Beck, 1996). The primal threat mode encompasses an array of rigid and reflective schemas ensuring
evolutionary survival; however, controlled processing begins to emerge during this stage and allows for the interpretation of novel or complex situations (Beck & Clark, 1997).

The primal threat mode leads to primary cognitive appraisal of threat information and coordinated cognitive, affective, behavioral, and physiological responses seeking to minimize danger and maximize safety (Beck et al., 1985). As part of this goal-directed strategy, cognitive processing is narrowed and focuses on potentially threatening components of a situation, while positive features are selectively dismissed (Beck & Clark, 1997). An overestimation of the threat probability and threat severity arises from the above biased processing of information in the environment and leads to further catastrophic thinking—a core component of anxiety disorders (Beck et al., 1985; Beck & Clark, 1997; Clark, 1986). According to Beck and Clark’s model, in order to maintain focus on the strategic goal of minimizing danger and maximizing safety the primal threat mode activates negative automatic thoughts of threat and danger concurrently with the semantic analysis of threat stimuli (Beck & Clark, 1997). Taken together, the previous two stages of the information-processing sequence ensure that once the primal threat mode is activated, it governs information processing and minimizes the use of more constructive and reflexive modes of processing. The first two stages of the information processing sequence may offer a strategic advantage in the presence of a significant threat; however, repeated activation of the primal threat mode by minimally threatening stimuli may lead to pathological anxiety, especially if secondary appraisal processes do not occur.

The final stage of Beck and Clark’s schema-based information processing model is secondary elaboration. Contrary to the more automatic orienting mode and primal
threat mode, secondary elaboration mainly involves schema-driven controlled processing. During secondary elaboration, threat stimuli are appraised in the context of the self-in-relation-to-the-world and coping resources are evaluated (Beck et al., 1985). The reappraisal of threatening situations through strategic processing allows for a decrease in anxiety by reducing the probability or severity of the threat and increasing awareness of one’s coping resources (Beck & Clark, 1997). A failure to appropriately complete such a process results in one of two outcomes. First, the automatic primal threat mode may continue to dominate information processing resources; second, escape and avoidance behaviors may be adopted. The former results in an escalation of anxious thoughts, feelings, and cognitions, whereas the latter offers temporary relief contrasted with a resurgence of anxiety once safety signals are gone or escape is no longer possible (Beck & Clark, 1997). Therefore, according to Beck and Clark’s schema-based information processing model, initial automatic allocation of attentional resources to potentially threatening stimuli is responsible for the initial anxious cognitions and emotions, whereas inappropriate strategic appraisal of threatening stimuli is responsible for the maintenance of clinical anxiety (Mathews, 1990; Zinbarg, Barlow, Brown, & Hertz, 1992).

Beck’s early cognitive model pioneered the field of attentional bias for threat research and highlighted fundamental processes in the development and maintenance of anxiety disorders. Beck’s postulation that a threat detection mechanism operates during the early automatic stages of processing and leads to vigilance towards threat (Beck et al., 1985) was integrated into most subsequent models of attentional bias for threat (Bar-Haim et al., 2007; Eysenck, Derakshan, Santos, & Calvo, 2007; Mathews & Mackintosh, 1998; Mogg & Bradley, 1998; Ohman, 1996; Williams, Watts, MacLeod, & Mathews,
1997) and later empirically supported (Carlson & Reinke, 2008; Koster, Crombez, Verschuere, Van Damme, & Wiersema, 2006). The notion that anxious individuals may not only be hypervigilant to threat, but may also have a difficulty disengaging their attention from threat during later strategic stages of processing, is also an idea originally presented by Beck and Clark (1997) that was later supported by research on anxiety disorders (Amir, Elias, Klumpp, & Przeworski, 2003; Cisler & Olatunji, 2010; Fox, Russo, & Dutton, 2002; Koster, Crombez, Verschuere, & De Houwer, 2004; Yiend & Mathews, 2001). By contrasting facilitated attention towards threat with difficulty disengaging from threat, and automatic processing with strategic or controlled processing, Beck and Clark’s model highlights the possibility that different components of the attention bias for threat may occur at different stages of processing (Cisler & Koster, 2010).

Despite support for assumptions underlying Beck and Clark’s model (e.g., Amir et al., 2003; Carlson & Reinke, 2008; Cisler & Olatunji, 2010), some research has drawn attention to the associated limitations (Cisler, Bacon, & Williams, 2009; Cisler & Koster, 2010; Fox et al., 2002; Koster et al., 2004). Beck and Clark’s model does not overtly explain the mechanisms underlying attentional avoidance of threat stimuli in anxious individuals (Koster, Verschuere, Crombez, & Van Damme, 2005). In addition, Beck and Clark’s model does not directly integrate contemporary research into mediating mechanisms of attentional bias for threat, such as attentional control (Derryberry & Reed, 2002; Eysenck et al., 2007) and emotion regulation (Gross, 1998; Koole, 2009). The need for a revised theoretical framework of attentional bias for threat has led to the development of several models (Bar-Haim et al., 2007; Eysenck et al., 2007; Mathews &
Mackintosh, 1998; Mogg & Bradley, 1998; Ohman, 1996; Wells & Matthews, 1994; Williams et al., 1997) following Beck’s early model and Beck and Clark’s schema-based information processing model (Beck et al., 1985; Beck & Clark, 1997). There is also a lack of agreement amongst the many contemporary models of attentional bias for threat, which have also not integrated all of the available evidence on attentional bias for threat in anxious pathologies (Cisler & Koster, 2010). In an attempt to integrate contemporary findings on attentional bias for threat and to reconcile already existing models of attentional bias for threat, Cisler and Koster (2010) developed an integrative theoretical framework.

1.2.2. Cisler and Koster’s Integrative Framework of Attentional Bias for Threat

The primary assumption underlying Cisler and Koster’s (2010) framework is that attentional bias for threat can be divided into three distinct components: facilitated attention, difficulty in disengagement, and attentional avoidance (Koster et al., 2004). Each component would be subject to different mediating mechanisms and would occur at a different stage of the processing sequence. Attentional bias for threat would be the product of the interaction between the different attentional components and their mediating mechanisms (see Figure 1).

Facilitated attention is defined as the speed at which attention is oriented towards threat stimuli (Cisler & Koster, 2010). The amygdala is thought to be the neural structure critically involved in this process (Ohman, 2005) and enhanced amygdala activity would be at least partially responsible for the heightened activation of a threat detection mechanism (Carlson, Reinke, & Habib, 2009). The threat detection mechanism is predicted to operate during automatic processing and to primarily respond to threat of
Figure 1: Integrative Framework of Attentional Bias for Threat

high intensity presented for a short duration (i.e., 100 ms or less; Carlson & Reinke, 2008; Carlson et al., 2009; Koster et al., 2004; Koster et al., 2006). Accordingly, facilitated attention would operate outside of awareness.

Difficulty in disengagement from threat is defined as the degree to which one’s ability to transfer attention from one threat stimulus to another stimulus—threatening or otherwise—is impaired (Cisler & Koster, 2010). The prefrontal cortex is thought to be the neural structure responsible for this difficulty in disengagement (Derryberry & Reed, 2002; Miller & Cohen, 2001) through its influence on attentional control. Attentional control can be construed as an individual’s top-down ability to regulate allocation of attentional resources and to inhibit the bottom-up influence of emotional distracters (Eysenck et al., 2007; Posner & Rothbart, 2000). Anxious individuals devoid of such a regulatory ability are thought to show a difficulty disengaging their attention from threat stimuli (Derryberry & Reed, 2002). Accordingly, attentional control would be an effortful cognitive mechanism used during higher-order strategic processing and would mediate an individual’s ability to disengage attention from threat.

Attentional avoidance is a more recently identified component of attentional bias for threat and defined as the preferential allocation of attentional resources at locations opposite to the threat stimuli location (Cisler & Koster, 2010). Attentional avoidance is primarily witnessed when threat stimuli are presented to high trait anxious individuals for long periods of time (i.e., 1250 ms; Koster et al., 2006; Koster, Verschuere, et al., 2005; Mogg, Bradley, Miles, & Dixon, 2004) and is thought to be mediated by the prefrontal cortex (Kim & Hamann, 2007; Ochsner et al., 2004). Prefrontal cortical structures would exert their influence on attentional avoidance by activating emotion regulation.
mechanisms, allowing individuals to control which emotions they have as well as when and how they express them (Gross, 1998). Attentional avoidance, or re-allocation of attentional resources to distracting stimuli, would serve as a controlled strategy used to regulate the negative affect brought on by threat stimuli (Cisler & Koster, 2010; Koster et al., 2006; Mogg et al., 2004). Given that effortful avoidance strategies require higher-order strategic processing, anxious individuals would only display patterns of attentional avoidance after being exposed to threatening stimuli for a long enough period of time (Cisler & Koster, 2010).

Based on empirical data, Cisler and Koster’s (2010) integrative framework of attentional bias for threat hypothesizes a temporal interaction between the three different components of attentional bias. Delayed disengagement can be observed in the absence of facilitated attention (Rinck, Becker, Kellermann, & Roth, 2003; Yiend & Mathews, 2001) but the reverse usually does not hold (Koster et al., 2004; Koster, Crombez, Van Damme, Verschuere, & De Houwer, 2005), suggesting that facilitated attention likely precedes delayed disengagement. Accordingly, Cisler and Koster’s (2010) framework proposes that facilitated attention makes it easier for a stimulus in the environment to reach a "threat threshold" and, once that threshold is reached, a threat detection mechanism and the amygdala become activated and come to dominate information processing. As a result, higher-order cortical structures such as the prefrontal cortex are no longer able to regulate allocation of attentional resources, leading to difficulty disengaging attention from threat stimuli. Alternatively, delayed disengagement occurs in the absence of facilitated attention if someone already has poor higher-order regulatory abilities. Indeed, simply telling an individual with poor higher-order regulatory abilities
to briefly attend to a threat stimulus (e.g., “look out for the snake!”) could be enough to activate a threat detection mechanism and the amygdala, even though a threat threshold may not have been reached through facilitated attention (Cisler & Koster, 2010).

Cisler and Koster’s (2010) framework attempts to reconcile the somewhat contradictory finding that delayed disengagement and attentional avoidance both occur during later stages of processing. Attentional avoidance of a stimulus appears to exclude the possibility of simultaneously demonstrating a difficulty disengaging attention from that stimulus. Accordingly, in the original vigilance-avoidance hypothesis of attentional bias for threat (Mogg et al., 2004), anxious individuals were thought to initially show facilitated attention towards threat stimuli followed by avoidance of threat stimuli, but difficulty in disengagement was not discussed. Reconciling the latter two components of attentional bias for threat, Cisler and Koster’s contemporary theory suggests that overt avoidance of a stimulus does not preclude covert attention towards that stimulus (Weierich, Treat, & Hollingworth, 2008). For instance, an individual with a snake phobia who encounters a snake may employ overt avoidance strategies such as looking away from the snake; however, cognitive resources may still be covertly directed towards the snake (e.g., rumination). Further, increased difficulty disengaging attention from a threatening stimulus likely increases the need for avoidance of that stimulus, possibly explaining why attentional avoidance would occur subsequent to difficulty in disengagement.

According to Cisler and Koster’s (2010) framework of attentional bias for threat, an overactive threat detection mechanism and an underactive attentional control mechanism would underlie attentional bias for threat in individuals with anxiety.
pathologies. The threat detection mechanism would be responsible for facilitated attention to threat during automatic processing, whereas the attentional control mechanism would be implicated in delayed disengagement from threat and attentional avoidance of threat during higher-order processing. An attentional bias for threat could occur in the absence of one component or another; however, the attentional bias for threat is likely the end product of the interaction between the three different components.

1.3. Attentional Bias for Threat in Posttraumatic Stress Disorder

Several cognitive paradigms have been used in the anxiety disorders literature to assess attentional bias for threat. In the following sections, research making use of the emotional Stroop task, the visual search task, and the dot probe task to assess attentional bias for threat is presented. For each paradigm, findings pertaining to anxious populations in general, and to PTSD and MVA survivors specifically are discussed, as well as methodological issues associated with the use of each paradigm.

1.3.1 Emotional Stroop Task

The emotional Stroop task involves naming the colours of a list of emotional (i.e., positive and negative) and neutral words. Longer latency to naming emotional word colours has been argued to represent increased cognitive interference from emotional words (i.e., interference effect; McNally, 1998). Past research has repeatedly shown that individuals with anxiety pathologies are slower at naming colours of threatening words associated with their clinical condition (e.g., “snake” for spider phobia, “heart attack” for panic disorder, “germs” for obsessive-compulsive disorder; see Williams, Mathews, & MacLeod, 1996 for review). There is evidence to suggest that the emotional Stroop interference effect (i.e., slower colour naming) also exists in individuals with PTSD. Research with individuals having experienced sexual assault (Cassiday, McNally, &
Zeitlin, 1992; Foa, Feske, Murdock, Kozak, & McCarthy, 1991), ferry disaster survivors
(Thrasher, Dalgleish, & Yule, 1994), and war veterans (Kaspi, McNally, & Amir, 1995;
McNally, Kaspi, Riemann, & Zeitlin, 1990; McNally, Amir, & Lipke, 1996; McNally,
English, & Lipke, 1993; Vrana, Roodman, & Beckham, 1995) has provided evidence that
individuals with PTSD experience interference from specific trauma-related words (e.g.,
“boat” for ferry disaster survivors), an effect not found in trauma survivors without PTSD
or in control groups.

The emotional Stroop task has been used to identify attentional biases for threat in
MVA survivors with PTSD in at least four investigations. In the first investigation, the
response latencies of MVA survivors with PTSD, MVA survivors without PTSD but with
a simple driving phobia, and MVA survivors with low anxiety were compared for strong
(e.g., smash, death, blood) and mild (e.g., traffic, bridge, intersection) MVA-related
threat words, positive words, and neutral words (Bryant & Harvey, 1995). The authors
found that MVA survivors with PTSD experienced interference from strong threat words,
an effect not found in MVA survivors with a driving phobia or with low anxiety (Bryant
& Harvey, 1995), despite research having previously shown that an emotional Stroop
interference effect can occur in individuals with simple phobias (e.g., Watts, McKenna,
Sharrock, & Trezise, 1986). The finding that MVA survivors with PTSD experience
interference from strong threat words was corroborated by a second investigation
comparing the response latencies for threat words and neutral words presented to MVA
survivors with PTSD, MVA survivors without PTSD, and control subjects having never
been exposed to a MVA or having met criteria for PTSD. Again, the MVA survivors
with PTSD experienced interference from threat words whereas the other two groups did
not (Harvey, Bryant, & Rapee, 1996). A third investigation compared the response latencies of MVA survivors with PTSD and pain, MVA survivors with pain but no PTSD, and MVA survivors with no pain and no PTSD for accident-related (e.g., wrecked), pain-related (e.g., ache), positive, and neutral words. Highlighting the specificity of the attentional bias for threat, both MVA survivor with pain groups showed response delays to pain-related words, whereas only MVA survivors with pain and PTSD were slower to respond to accident-related words, and no interference effect was found for MVA survivors with no pain and no PTSD (Beck, Freeman, Shipherd, Hamblen, & Lackner, 2001). In a fourth investigation, successful psychological treatment did not appear to reduce interference from trauma-related threat words in MVA survivors with PTSD (Devineni, Blanchard, Hickling, & Buckley, 2004). The lack of effect of psychological treatment on interference to trauma-related threat suggests possible methodological issues with the emotional Stroop task, limited clinical utility for this task, or that the presence of attention biases for threat may not be the only factor associated with psychopathology.

The emotional Stroop interference effect repeatedly found in the PTSD literature has generally been viewed as an indication of a robust attentional bias for trauma-related threat words (e.g., Buckley, Galovski, Blanchard, & Hickling, 2003; Emilien et al., 2000; McNally, 1998); however, recent work has called into question whether the biases actually are robust. A review of peer-reviewed studies and dissertation abstracts investigating the Stroop interference effect in PTSD suggests that the robustness of the emotional Stroop interference effect may be overestimated. Only 44% of published studies and 8% of dissertation abstracts supported the emotional Stroop interference
effect (Kimble, Frueh, & Marks, 2009). A meta-analysis of 26 studies on the emotional Stroop task in PTSD suggested that the emotional Stroop interference effect for trauma-relevant threat words exists in individuals exposed to trauma, regardless of PTSD status (Cisler et al., 2011). The Stroop interference effect could, therefore, be due to the personal relevance of trauma-related words rather than their threatening nature. Findings from the broader Stroop task literature suggest that stimuli with strong personal relevance can produce a Stroop interference effect regardless of stimuli emotionality (i.e., positive vs. negative) and psychopathology (i.e., anxious vs. normal subjects; e.g., Dalgleish, 1995; Riemann & McNally, 1995). Accordingly, the specific cognitive mechanisms underlying this interference effect warrant clarification.

An emotional Stroop interference effect for threatening words was traditionally interpreted as facilitated attention towards threatening stimuli (MacLeod, 1991); however, delayed responses to threat related words may result from mechanisms other than facilitated attention (De Ruiter & Brosschot, 1994; MacLeod et al., 1986). Individuals with PTSD may process threatening words and neutral words in a similar fashion, but threatening words may result in negative affective states interfering with and generally slowing down task performance (Algom, Chajut, & Lev, 2004; MacLeod et al., 1986). The interference effect has been shown to diminish when the task requires a manual rather than a vocal response (see MacLeod, 1991 for review), suggesting that the emotionally-laden words may interfere with general motor response performance rather than cognitive processing (Algom et al., 2004). In such a case, attentional control mechanisms (Derryberry & Reed, 2002), rather than heightened threat detection mechanisms (Williams et al., 1996), would modulate task performance.
Consistent with the idea that attentional control may modulate task performance, contemporary research has found delayed reaction times to neutral words that follow threat words but not to the threat words themselves (McKenna & Sharma, 2004). The emotional Stroop interference effect may therefore result from disrupted slow and effortful processing (i.e., attentional control) rather than disrupted fast and automatic processing (i.e., facilitated threat detection). A recent meta-analysis supported the emotional Stroop interference effect as only occurring in PTSD samples when word stimuli are presented supraliminally and some degree of elaborate or effortful processing can occur (Cisler et al., 2011). An earlier meta-analysis of studies using anxious samples also found that the emotional Stroop interference effect likely reflects late controlled processing (e.g., response selection; Schmidt & Besner, 2008) rather than early stages of attentional processing (Bar-Haim et al., 2007). The interpretation difficulties surrounding the emotional Stroop task has propagated the use of other paradigms, such as the visual search task (Neisser, 1963) and the dot probe task (MacLeod et al., 1986), to investigate attentional bias for threat in anxious samples and in PTSD more specifically.

1.3.2 Visual Search Task

The original visual search task requires participants to identify a target in a matrix of identical stimuli (Treisman & Gormican, 1988). Variations of the task used in research investigating attentional bias for threat require participants to identify a threatening target in an array of neutral stimuli or to identify a neutral target in an array of threatening stimuli. Faster reaction times for the identification of a threatening target within neutral stimuli is believed to indicate facilitated attention to threat. Conversely, slower reaction times for the identification of a neutral target within threatening stimuli is taken to reflect
attentional interference from threat (e.g., Byrne & Eysenck, 1995; Ohman, Lundqvist, & Esteves, 2001). Using the visual search task, interference arising from difficulty in disengaging attention from threatening stimuli has been demonstrated in individuals with high trait anxiety (Byrne & Eysenck, 1995), social phobia (Gilboa-Schechtman, Foa, & Amir, 1999), and generalized anxiety disorder (Rinck et al., 2003); however, results pertaining to facilitated attention towards threatening stimuli are mixed. Some investigations have shown facilitated detection of threat stimuli in anxious populations (Byrne & Eysenck, 1995; Gilboa-Schechtman et al., 1999; Ohman, Flykt, & Esteves, 2001) and others have found no such effect (Fox et al., 2000; Rinck et al., 2003; Rinck & Becker, 2005).

The visual search task has been used at least twice to assess attentional bias for threat in PTSD. The first investigation was completed with 57 male Vietnam veterans (Pineles, Shipherd, Welch, & Yovel, 2007). The results indicated that veterans reporting PTSD were slower to identify a target within trauma-relevant threat words suggesting difficulty disengaging attention from threat stimuli; however, there was no evidence for facilitated attention towards threat stimuli. The results were replicated in a second investigation assessing attentional bias for threat in women exposed to sexual assault (Pineles, Shipherd, Mostoufi, Abramovitz, & Yovel, 2009). Women reporting PTSD displayed difficulty disengaging their attention from threat stimuli but not facilitated attention towards threat stimuli. In addition, difficulty disengaging attention was found for trauma-specific threat stimuli but not generally threatening stimuli, suggesting specificity of the attentional bias for threat in PTSD and supporting previous findings from the Stroop task (Beck et al., 2001; Foa et al., 1991; McNally et al., 1990). Like the
emotional Stroop task (McKenna & Sharma, 1995), the visual search task appears to produce an order effect such that participants habituate to threat words (Pineles et al., 2009; Pineles et al., 2007). The dot probe task is less likely to produce habituation (Staugaard, 2009) but can still distinguish facilitated attention and difficulty in disengagement; as such, the dot probe task may be more appropriate for investigations of attention biases for threat in PTSD.

1.3.3 Dot Probe Task

The dot probe task was designed to overcome some of the interpretation difficulties associated with the emotional Stroop task (e.g., impaired cognitive processing vs. impaired motor responding) and requires participants to engage in a neutral response (i.e., press a key) when a neutral probe (e.g., “•”) appears on a computer screen (MacLeod et al., 1986). In the original version of the task, participants were simultaneously presented with one threatening word and one neutral word prior to the appearance of the probe. An attentional bias for threat was inferred when a participant was faster at identifying the probe on trials where it replaced a threatening word (MacLeod et al., 1986). The assumption behind the task is that, if the participant’s visual attention was directed towards the threatening word, a shift in attention allocation was not required to identify the probe, resulting in shorter reaction times. Using the dot probe task, research has shown that individuals with generalized anxiety disorder (Bradley, Mogg, White, Groom, & Bono, 1999), social phobia (Asmundson & Stein, 1994), and panic disorder (Asmundson, Sandler, Wilson, & Walker, 1992) display an attentional bias for disorder-specific threat information. In a general review of the literature on anxiety and attentional bias for threat, the dot probe task effectively identified an attentional bias
for threat in anxious populations relative to non-anxious populations (Bar-Haim et al.,
2007). Despite empirical support for the use of the dot probe task to investigate
attentional bias for threat, only two published investigations have used this paradigm with
PTSD samples.

Attentional bias for threat was investigated in PTSD with a dot probe task
completed by a sample of MVA survivors (Bryant & Harvey, 1997). The reaction time of
MVA survivors with PTSD, MVA survivors with subclinical PTSD, and MVA survivors
with low trait anxiety (i.e., < 30 on the Trait scale of the State-Trait Anxiety Inventory
[STAI]) and no history of PTSD were compared for strong MVA-related threat words
(e.g., mortality), mild MVA-related threat words (e.g., highway), positive words (e.g.,
friendly), and neutral words (e.g., blanket). A modified version of the dot probe task was
used wherein the probe was presented on the screen simultaneously with the threatening
word and the neutral word. MVA survivors with PTSD displayed an attentional bias for
mildly threatening words, a bias not found in MVA survivors with subclinical PTSD or
MVA survivors with no history of PTSD. An attentional bias for strong threat words was
not found, possibly due to the use of a modified version of the dot probe task (Bardeen &
Orcutt, 2011) or due to the cognitive avoidance of strong threat words (De Ruiter &
Brosschot, 1994). The results were originally interpreted has an indication of facilitated
attention towards trauma-relevant threatening words in MVA survivors with PTSD;
however, contemporary research has suggested that the dot probe task may better reflect a
difficulty in disengaging attention from threat (Koster et al., 2004; Koster et al., 2006;
Salemink, van den Hout, & Kindt, 2007).
The dot probe task has recently been modified to distinguish between facilitated attention, difficulty in disengagement, and avoidance (Koster et al., 2004; Salemink et al., 2007) of threatening stimuli. Using this new method, researchers have found evidence that individuals with high anxiety display facilitated attention to threatening stimuli presented for 100 ms (Carlson & Reinke, 2008), difficulty in disengaging attention from threatening stimuli presented for 500 ms (Koster et al., 2004; Koster et al., 2006; Koster, Vershuere, et al., 2005; Salemink et al., 2007), and avoidance of threatening stimuli presented for 1250 ms (Garner, Mogg, & Bradley, 2006; Koster, Vershuere, et al., 2005; Mogg et al., 2004). Accordingly, using a contemporary method for the dot probe task with the presentation of stimuli at different exposure times should allow for time-course analyses of attentional bias threat dimensions as defined by Cisler and Koster (2010).

The contemporary dot probe task has already been used to investigate attentional bias for threat in undergraduate students with posttraumatic stress symptoms (Bardeen & Orcutt, 2011). The investigation made use of a 100 ms and 500 ms stimulus onset asynchrony (SOA; i.e., the duration of time between initial presentation of the stimulus and presentation of the probe) to assess for facilitated attention to threatening images and difficulty in disengagement from threatening images. Individuals reporting higher levels of PTSD symptoms did not display facilitated attention to threatening stimuli at 150 ms; however, consistent with previous research using the visual search task (Pineles et al., 2009; Pineles et al., 2009), individuals reporting higher levels of PTSD symptoms did display difficulty disengaging attention from threatening stimuli at 500 ms. Results from the Bardeen and Orcutt (2011) investigation highlighted the importance of difficulty in disengagement from threat in individuals with PTSD symptoms; nevertheless, the role of
facilitated attention remains unclear. An absence of facilitated attention to threatening stimuli may have resulted from the use of a non-clinical sample or non-trauma specific threatening stimuli. Alternatively, a SOA of 150 ms may have been long enough for attentional shifts to occur, making such an exposure time inappropriate for the assessment of facilitated attention (Bardeen & Orcutt, 2011). Furthermore, the investigation did not assess cognitive avoidance, which is likely to occur at longer SOA (e.g., 1250 ms; Cisler & Koster, 2010). Cognitive avoidance can be posited as one mechanism through which PTSD is maintained (e.g., Salters-Pedneault, Tull, & Roemer, 2004); as such, an integrative investigation assessing the avoidance component of attentional bias for threat, in addition to the facilitated attention and difficulty in disengagement components of attentional bias for threat, may provide useful insights for PTSD researchers and clinicians.

1.4 Current Investigation, Purposes, and Hypotheses

The previous literature review of attentional bias for threat in anxiety pathologies—including PTSD—highlights several discrepancies among past research findings. In addition, based on a review of the current literature, clarifying the directionality and time course of attentional bias for threat using a contemporary dot probe method appears warranted. Cisler and Koster’s (2010) integrative framework suggests that attentional bias for threat in PTSD (and anxiety pathologies as a whole) may result from an interaction between stimulus threat level and stimulus exposure time; however, such an interaction was never explored in research investigating attentional bias for threat in MVA survivors. Furthermore, the limited available research on MVA survivors (Bryant & Harvey, 1995, 1997; Harvey et al., 1996) makes it unclear whether
MVA survivors without PTSD also demonstrate an attentional bias for trauma-relevant threat stimuli (Cisler et al., 2011). Given that attentional biases for threat are thought to be involved in the development and maintenance of PTSD (Elwood et al., 2009), that MVAs are one of the primary cause of PTSD in the general population (Blanchard & Hickling, 2003), and that research on MVA survivors and attentional bias for threat is sparse, a contemporary investigation of attentional bias for threat in MVA survivors is warranted.

The current investigation was designed to assess the directionality and time course of attentional bias for threat in MVA survivors reporting high PTSD symptoms (MVA-High PTSD), MVA survivors reporting low PTSD symptoms (MVA-Low PTSD), and a control group of people who have not experienced an MVA and do not report PTSD symptoms (Control) using a contemporary detection dot probe task (Salemink et al., 2007). Words of different threat level (i.e., neutral, mild threat, and strong threat; Bryant & Harvey, 1995, 1997) were followed by a probe presented at different levels of SOA (i.e., 100 ms, 500 ms, 1250 ms; Koster, Verschuere, et al., 2005). The different presentation threat levels and SOA were included in an attempt to disentangle the relationship between the cognitive mechanisms of facilitated attention to threat, difficulty in disengagement from threat, and avoidance of threat.

1.4.1 Purposes

The current research had two main purposes. First, the current investigation extended previous research by integrating stimulus threat level and SOA to simultaneously assess all three components of attentional bias for threat (i.e., facilitated attention, difficulty in disengagement, and avoidance) in individuals with PTSD
symptoms. To date, two similar investigations have been conducted; however, only one of the two investigations employed exposure durations identical to the ones used in the proposed investigation (Koster, Verschuere, et al., 2005) and the manipulation of exposure duration rather than SOA may have induced a measurement confound. Further, neither of the two investigations used a sample with PTSD symptoms (Koster et al., 2006; Koster, Verschuere, et al., 2005), and both used picture rather than word stimuli. The inherently abstract threat themes associated with anxiety in PTSD are more reasonably represented by written words than by focused and refined pictures (Bar-Haim, 2010). Second, the proposed investigation used a contemporary dot probe task to assess the directionality and time course of attentional bias for threat in a sample of MVA survivors. The only investigation to have used a dot probe task to assess attentional bias for threat in MVA survivors did not differentiate between mechanisms of facilitated attention to threat, difficulty in disengagement from threat, and avoidance of threat (Bryant & Harvey, 1997). Through the use of a contemporary method, the proposed investigation evaluated the three different components of attentional bias for threat in MVA survivors. A comparison between the MVA-High PTSD, MVA-Low PTSD, and Control groups was used to help clarify the relationship that exists between exposure to an MVA, PTSD symptoms, and attentional bias for threat.

1.4.2 Hypotheses

Details pertaining to the computation of attentional bias indices are presented in a later section; however, based on Cisler and Koster’s (2010) framework of attentional bias for threat, groups demonstrating an attentional bias for threat were expected to display the following pattern of results.
1. Threat words presented at 100 ms SOA were expected to produce facilitated attention (i.e., positive orienting index).
2. Threat words presented at 500 ms SOA were expected to produce difficulty in disengagement (i.e., positive disengaging index).
3. Threat words presented at 1250 ms SOA were expected to produce avoidance (i.e., negative orienting index).

In addition, the following hypotheses were made based on group assignment and stimulus threat level.

4. The groups were expected to differ such that the orienting and disengaging indices would be larger for the MVA-High PTSD group compared to the MVA-Low PTSD group, and for the MVA-Low PTSD group compared to the Control group.
5. The threat level of the words presented was expected to influence the size of the effect such that the orienting and disengaging indices would be larger for strong threat words compared to mild threat words.

2.0 Method

2.1 Environment

The proposed investigation was conducted at the University of Regina in the Anxiety and Illness Behaviours Laboratory (AIBL). The investigation was completed online using two tools. The SurveyMonkey online survey tool (www.surveymonkey.com; SurveyMonkey, 2012) was used to assess self-report information and the Inquisit software tool (www.millisecond.com; Millisecond Software Inc., Seattle, WA) was used to assess attentional biases.

2.2 Recruitment
Participants were recruited across North America through online social media advertising (www.facebook.com), community advertising (e.g., www.kijiji.ca, newspaper advertising, posters), and the University of Regina psychology participant pool. Participants recruited through the psychology participant pool received 1 credit for participation. Participants were asked to voluntarily and anonymously complete an Internet-based survey as well as an attention task as part of an experiment investigating attentional processes following MVAs.

2.3. Participants

Participants included in the proposed investigation had to be between the ages of 18 and 65 years, report English as their first language, have no vision problems not corrected by glasses or contact lenses, no history of traumatic brain injury, and no pattern of problematic alcohol use. To be included in one of the MVA groups, participants needed to report the experience of a MVA severe enough to warrant the filing of a police report. To ensure that the DSM duration criterion for PTSD (APA 2000; 2013) could be met, the MVA also had to have occurred more than a month prior to the completion of the investigation. Subsyndromal PTSD symptoms have been associated with increased impairment, comorbidities, and suicidality in community, veteran, and rescue worker samples (Cukor, Wyka, Jayasinghe, & Difede, 2010; Marshall et al., 2001; Yarvis & Schiess, 2008) and participants with probable subsyndromal PTSD have previously been included in PTSD treatment experiments of MVA survivors (Maercker, Zöllner, Menning, Rabe, and Karl, 2006). Accordingly, in the current investigation the MVA-High PTSD group was comprised of participants self-reporting both full PTSD and subsyndromal PTSD symptoms (see below; Weathers et al., 1991) in reference to a MVA
specifically. To be included in the Control group or the MVA-Low PTSD group, participants needed to self-report the absence of full PTSD or subsyndromal PTSD symptoms in reference to a MVA or any other traumatic event.

A total of 306 participants started the experiment; however, only 127 participants (100 women, 27 men, $M_{\text{age}} = 23.76$, $SD = 7.98$, age range: 18-56 years) met basic eligibility criteria, completed all measures, and were included in the current investigation. Excluded from the investigation were 9 participants who did not report English as their first language, 4 participants with vision problems not corrected by glasses or contact lenses, 11 participants with a history of traumatic brain injury, 61 participants with a probable alcohol use problem, 28 participants who did not meet group inclusion criteria (i.e., high PTSD symptoms from an event other than a MVA), and 55 participants who had not completed all measures. An additional 8 participants were excluded based on their request to exclude their data from the experiment, as well as 3 outliers with mean dot probe reactions times more than 3 $SD$ above or below the mean.

2.4 Measures

2.4.1 Demographic Measures

The Demographic Measures questionnaire presented in Appendix A was used to assess eligibility to participate in the investigation, in addition to providing demographic data relevant to the investigation. The Demographic Measures included demographic questions (e.g., age, sex), questions relevant to inclusion in the investigation (e.g., first language, vision problems), and questions relevant to MVA history (e.g., “Were you in a motor vehicle accident […]?”).

2.4.2 Standardized Measures
Attentional Control Scale (ACS; Derryberry & Reed, 2002; Appendix B). The ACS is a 20-item measure requiring respondents to report on their perceived ability to flexibly control attention. Items pertaining to attention shifting (e.g., “I can quickly switch from one task to another”), focusing of attention (e.g., “When concentrating, I can focus my attention so that I become unaware of what’s going on in the room around me”), and the ability to flexibly control thought (e.g., “It is hard for me to break from one way of thinking about something and look at it from another point of view”) are reported on a 4-point Likert-type scale (1 = almost never to 4 = always). The initial psychometric evaluation of the ACS has shown good internal consistency for this measure (Derryberry & Reed, 2002) and internal reliability was good in the current sample (α = .85; Cohen, 1988). Higher scores on the ACS have previously been associated with the activation of brain areas involved in top-down emotion regulation (Mathews, Yiend, & Lawrence, 2004); as such, the ACS was included in the current investigation to better characterize the sample.

Alcohol Use Disorders Identification Test (AUDIT; Barbor, de la Fuente, Saunders, & Grant, 1989; Appendix C). The AUDIT is a 10-item self-report questionnaire comprised of items assessing alcohol consumption (e.g., “How often do you have a drink containing alcohol?”) and adverse consequences of alcohol use (e.g., “Have you or someone else been injured as a result of your drinking?”) over the past 12 months. Items are reported on a 5-point Likert-type scale (for most items, 0 = never to 4 = daily or almost daily). The AUDIT has demonstrated internal reliability above .80 in a number of studies (see Reinert & Allen, 2002 for review) and a total score of eight or above has been shown to be a sensitive indicator of problematic drinking (Saunders,
Aasland, Babor, de la Fuente, & Grant, 1993). The AUDIT demonstrated adequate internal reliability ($\alpha = 57$; Cohen, 1988) in the current sample. The AUDIT was included in the current investigation as a screening measure and to better characterize the sample.

Emotion Regulation Questionnaire (ERQ; Gross & John, 2003; Appendix D). The ERQ is a 10-item measure requiring respondents to self-report on their use of two different emotion regulation strategies—cognitive reappraisal (“I control my emotions by changing the way I think about the situation I’m in”) and expressive suppression (“I control my emotions by not expressing them”). Items are reported on a 7-point Likert-type scale (1 = strongly disagree to 7 = strongly agree). Expressive suppression has previously been associated with increased PTSD symptomatology (Moore, Zoellner, & Mollenholt, 2008) and, during later stages of processing, may be involved in the avoidance component of attentional bias for threat. Both the ERQ reappraisal scale (ERQ-R; $\alpha = .86$) and the ERQ suppression scale (ERQ-S; $\alpha = .82$) showed good internal reliability in the current sample (Cohen, 1988). The ERQ was included in the current investigation to better characterize the sample.

PTSD Checklist–Stressor Specific Version (PCL-S; Weathers et al., 1991; Appendix E). The PCL-S is a 17-item self-report measure of PTSD assessing symptoms in relation to a specific stressful experience (e.g., MVA). For each item, respondents are required to indicate how much a particular symptom (e.g., “Feeling jumpy or easily startled”) has bothered them over the past 30 days using a 5-point Likert-type scale (1 = not at all to 5 = extremely). A total score can be obtained by summing all PCL-S items. Alternatively, PCL-S items can be divided into four different subscales (APA, 2013;
Asmundson et al., 2000; Asmundson et al., 2004) assessing DSM-IV re-experiencing, avoidance, numbing, and arousal PTSD symptoms. A total of 19 studies reported values above .75 for the PCL-S internal consistency (see Wilkins, Lang, & Norman, 2011 for review) and previous research demonstrated high convergent validity with the Clinician Administered PTSD Scale in samples of MVA survivors (Blanchard et al., 1996). In the current investigation, all MVA survivors completed the PCL-S in reference to their MVA. Further, participants who indicated having experienced another event that was more traumatic than a MVA also completed the PCL-S in reference to that event. Internal reliability was good (Cohen, 1988) in the current sample for both the PCL-S completed in reference to the MVA (PCL-S MVA; \( \alpha = .86 \)) and the PCL-S completed in reference to any other traumatic event (PCL-S Other; \( \alpha = .90 \)). The PCL-S was included in the current investigation as a grouping measure and to better characterize the sample.

**STAI** (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The STAI is a measure comprised of 40 items (e.g., “I feel nervous and restless”) requiring respondents to self-report on their general level of anxiety (i.e., STAI-State) and their current level of anxiety (i.e., STAI-Trait). Items are reported on a 4-point Likert-type scale (1 = *almost never/not at all* to 4 = *almost always/very much so*). The STAI has demonstrated good psychometric properties (Barnes, Harp, & Jung, 2002; Spielberger et al., 1983) and both the STAI-State (\( \alpha = .94 \)) and the STAI-Trait (\( \alpha = .93 \)) showed good reliability in the current sample. Individuals with higher anxiety scores are thought to perceive situations as more dangerous and threatening (Spielberger, 1972 as cited in Barnes et al., 2002). The STAI was included in the current investigation to better characterize the sample.

**2.4.3 Dot Probe Task**
The dot probe task software used to assess participant allocation of attentional resources was previously shown to provide sensitive reaction time measures (De Clercq, Crombez, Buysse, & Roeyers, 2003). The dot probe task was made accessible online, allowing participants to be assessed from many locations. The dot probe task requires the identification of a probe on a computer screen following the presentation of stimuli. An attentional bias for threat is inferred based on the speed with which the probe is identified (MacLeod et al., 1986). Accordingly, dot probe task reaction times were used to derive a measure of attentional bias for threat in the current investigation.

The current investigation used 50 words as stimuli (i.e., 30 neutral words, 10 mildly threatening words, and 10 strongly threatening words: see Appendix F). The valence associated with the threat and neutral words used in the current investigation has been established in prior research with MVA survivors and healthy controls (Arnell, Killman, & Fijavz, 2007; Bryant & Harvey, 1995, 1997). Positive words were not used in the current investigation because attentional bias for threat (as opposed to positive stimuli) is thought to underlie anxiety pathologies (e.g., Bar-Haim, 2007; Beck & Clark, 1997; Cisler & Koster, 2010). Furthermore, an attentional bias for positive stimuli has not been reliably demonstrated in anxiety disorders (see Ruiz-Caballero & Bermudez, 1997); as such, positive words appeared an unnecessary addition to participant burden in the current research context. During the dot probe task, the words were presented in pairs matched for character length. The word pairs consisted of two neutral words (N-N), one neutral word and one mildly threatening word (N-MT), or one neutral word and one strongly threatening word (N-ST). Word pairs appeared in a random sequence and each word pair was presented for 100ms. A probe appeared 100 ms, 500 ms, or 1250 ms
following the onset of the word pair (i.e., SOA) and half of the N-N trials were not followed by a probe (i.e., “filler” trials).

2.5 Procedure

Participants in the current investigation were presented with an online consent form briefly describing the purpose of the investigation. Participants were asked to provide consent by checking a “Yes” or “No” box. Participants were asked to fill out an initial battery of online questionnaires. Upon completion of all the questionnaires, participants were asked to follow a weblink to the dot probe task.

Instructions for the dot probe task were presented on the screen. Participants were instructed to observe the black fixation cross in the middle of the screen and informed that the black cross would be followed by the appearance of two words, one above the other. Participants were told that for the majority of trials a probe (i.e., “•”) would appear on the screen following the offset of the words. Participants were instructed to press the space bar when the probe appears on the screen. Upon responding, the next trial would start. Participants were also instructed that on some trials a probe would not appear following the offset of the words. Participants were instructed not to press the space bar and to wait for the next trial to start. Participants completed 10 practice trials prior to the 240 trial test phase. During the test phase, participants completed 80 trials (i.e., 20 filler trials, 20 “N-N” words, 20 “N-MT” words, and 20 “N-ST” words) for each SOA condition (i.e., 100 ms, 500 ms, and 1250 ms). The probe appeared in the location previously occupied by a threatening word for half of the N-MT and half of the N-ST trials. The probe appeared in the location previously occupied by a neutral word for the other half of the N-MT and the N-ST trials, as well as for all the N-N trials. Each trial
started with a black fixation cross presented for 1500 ms. The order of the trials was randomized for each participant. Following the dot probe task, participants were asked a screening question (i.e., “Based on how distracted you were while completing the computer task, should we include your data as part of our study?”) to control for careless responding.

2.6 Analyses

2.6.1 PTSD status

Participant PTSD status was made based on PCL-S scores. In MVA survivors, a total score of 44 and above indicates a probable diagnosis of PTSD (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996); however, a high total score can be obtained without endorsing symptoms in a pattern coherent with a PTSD diagnosis (Ruggiero, Del Ben, Scotti, & Rabalais, 2003). Accordingly, probable PTSD classification was limited to respondents scoring on symptom clusters as per the delineations in DSM-IV. PTSD classification required reporting above 3 on at least one re-experiencing symptom, three avoidance and numbing symptoms, and two arousal symptoms, in addition to scoring above 44 on all scales combined (Pineles et al., 2009; Pineles et al., 2007). Probable subsyndromal PTSD classification was assigned for participants endorsing at least two PTSD symptom clusters, including the re-experiencing cluster but not meeting probable PTSD criteria (Blanchard, Hickling et al., 1996).

2.6.2 Preparation of Reaction Time Data

Reaction times of less than 100 ms or more than 2000 ms were excluded to account for anticipatory responding and distraction (Salemink et al., 2007). Dot probe task reaction times have traditionally been analyzed using a bias index (e.g., Bryant &
Harvey, 1997; Koster, Verschuere et al., 2005) computed by subtracting mean reaction times to congruent trials from mean reaction times to incongruent trials (see below for detailed description of congruent and incongruent trials). However, in line with contemporary investigations assessing the different components attentional bias for threat (Koster et al., 2004) and already established congruency and incongruency indices (Asmundson, Carleton, & Ekong, 2005; Asmundson & Hadjistavropoulos, 2007), orienting and disengaging indices (Salemink et al., 2007) were the primary measures of interest in the current investigation. There were six orienting indices (i.e., mild threat words vs. strong threat words, at each SOA condition, 100 ms vs. 500 ms vs. 1250 ms) and six disengaging indices (i.e., mild threat words vs. strong threat words, at each SOA condition, 100 ms vs. 500 ms vs. 1250 ms) that were computed.

The orienting index was computed by subtracting a participant’s mean reaction time on trials on which the probe replaces a threat word in the presence of a neutral word (N, dT; i.e., congruent trials) from trials when the probe replaces a neutral word in the presence of another neutral word (N, dN).

Orienting Index = N, dN – N, dT

A positive orienting index indicates faster identification of the probe when it follows threat words in the presence of neutral words and a negative orienting index indicates slower identification of the probe when it follows threat words in the presence of neutral words.

The disengaging index was computed by subtracting a participant’s mean reaction time on trials on which the probe replaces a neutral word in the presence of another
neutral word (N, dN) from trials on which the probe replaces a neutral word in the presence of a threat word (dN, T; i.e., incongruent trials).

Disengaging Index = dN, T – N, dN

A positive disengaging index indicates slower identification of probes that follow a neutral word in the presence of a threat word, compared to probes that follow a neutral word in the presence of another neutral word.

2.6.3 Analyses

All analyses were performed using SPSS Version 21.0 (SPSS, Chicago, IL). Frequencies and descriptive statistics based on demographic measures and trauma history were computed for the purpose of group assignment and to better characterize the sample. Descriptive statistics for all variables included in the primary analyses were also used to evaluate suitability of the data. Subsequently, Pearson correlations were used to analyze relationships between psychological measures (i.e., STAI, ACS, ERQ, PCL-S) and each of the orienting and the disengaging indices to assess for the presence of potential covariates. Thereafter, one sample \( t \)-tests using one-tailed significance were used to compare the strength of the orienting and disengaging indices to chance for each group. The effect of group, SOA, and stimulus threat level on mean orienting and disengaging indices was tested using two group (i.e., Control, MVA-Low PTSD, MVA-High PTSD) \( \times \) SOA (i.e., 100 ms, 500 ms, 1250 ms) \( \times \) threat level (i.e., mild threat, strong threat) mixed-model Analysis of Variance (ANOVA). Statistically significant main effects and interaction effects were analyzed using pairwise contrasts. Exploratory analyses were subsequently conducted and included a group (i.e., Control, MVA-Low PTSD, MVA-High PTSD) \( \times \) SOA (i.e., 100 ms, 500 ms, 1250 ms) \( \times \) threat level (i.e., mild threat,
strong threat) mixed-model Analysis of Variance (ANOVA) exploring the effect of group, SOA, and stimulus threat level on the traditional dot probe bias index (Koster, Verschuere, et al., 2005). Exploratory analyses also included one sample $t$-tests using two-tailed significance to compare the strength of the orienting and disengaging indices to chance for each group. The exploratory analyses were not part of the original data analytic plan and were used to clarify the results of the main analyses and inform future research.

3.0 Results

A total of 63 participants (50 women, 13 men, $M_{\text{age}} = 23.02$, $SD = 7.73$, age range: 18-56 years) did not report the experience of a MVA or high PTSD symptoms in reference to any traumatic event and were included in the Control group. In total, 64 participants reported having experienced a MVA and were further divided into two groups. The MVA-Low PTSD group included 46 participants (35 women, 11 men, $M_{\text{age}} = 24.69$, $SD = 7.39$, age range: 18-53 years) and the MVA-High PTSD group included 18 participants (15 women, 3 men, $M_{\text{age}} = 24.00$, $SD = 10.25$, age range: 18-56 years). There was a statistically significant difference, $F(2, 124) = 3.25$, $p = .04$, $\eta^2 = .05$, between the three groups on the total number of traumatic events experienced (Control, $M = .79$, $SD = 1.12$; MVA-Low PTSD, $M = 1.13$, $SD = 1.17$; MVA-High PTSD, $M = 1.15$, $SD = .99$); however, Tukey’s HSD post hoc analyses indicated that the difference between the MVA-High PTSD group and the Control group was only approaching statistical significance ($p = .05$). There was no statistically significant difference ($p > .05$) between the two MVA groups for the number of months elapsed since the MVA (MVA-Low, $M = 49.24$, $SD = 42.88$; MVA-High PTSD, $M = 32.39$, $SD = 29.11$). There was a statistically
significant difference, $F(2, 65) = 29.57, p < .001, \eta^2 = .48$, between the groups on the PCL-S total score in reference to a traumatic event other than an MVA (i.e., PCL-S Other). Tukey’s HSD post hoc comparisons revealed that, for participants in the MVA-High PTSD group having reported another event as more distressing than the MVA, the mean PCL-S Other score was statistically significantly ($ps < .001$) higher than the mean PCL-S Other score for participants in the Control group and the MVA-Low PTSD group. As expected, the PCL-S total score in reference to the MVA (i.e., PCL-S MVA) was also statistically significantly higher, $t(20.40) = -6.58, p < .001, r = .82$, in the MVA-High PTSD group compared to the MVA-Low PTSD group. The groups were not statistically significantly different ($ps > .05$) on the other self-reported variables (i.e., STAI-State, STAI-Trait, ACS, ERQ-R, ERQ-S, AUDIT) with the exception of the ERQ-S, $F(2, 124) = 3.68, p = .03, \eta^2 = .06$. Tukey’s HSD post-hoc comparisons revealed that the mean ERQ-S score was statistically significantly higher for the Control group compared to the MVA-Low PTSD group ($p = .02$). Participant demographic information (i.e., ethnicity, relationship status, education, employment status), trauma history, and mean scores on self-report measures are presented as a function of group in Tables 1, 2, and 3.

3.1. Main Hypotheses

Indices of univariate Skew and Kurtosis for several variables included in the current investigation indicated potentially problematic non-normality for the primary analyses (i.e., Skew $> 2.00$, Kurtosis $> 7.00$; Tabachnick & Fidell, 2013); as such, adherence to normality was maximized with bootstrapping per current best practices (Preacher, Rucker, & Hayes, 2007). The intercorrelations between scores on the self-report measures and orienting and disengaging indices on the dot probe task are presented
Table 1. Participant Demographic Information as a Function of Group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>MVA-Low PTSD</th>
<th>MVA-High PTSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>(%)</td>
<td>n</td>
</tr>
<tr>
<td>Ethnicity</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>48</td>
<td>(76.2)</td>
<td>39</td>
</tr>
<tr>
<td>First Nations</td>
<td>3</td>
<td>(4.8)</td>
<td>1</td>
</tr>
<tr>
<td>African</td>
<td>2</td>
<td>(3.2)</td>
<td>1</td>
</tr>
<tr>
<td>Asian</td>
<td>2</td>
<td>(3.2)</td>
<td>2</td>
</tr>
<tr>
<td>South Asian</td>
<td>1</td>
<td>(1.6)</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>(6.3)</td>
<td>2</td>
</tr>
<tr>
<td>Rather Not Say</td>
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<td>(4.8)</td>
<td>-</td>
</tr>
<tr>
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</tr>
<tr>
<td>Single</td>
<td>53</td>
<td>(84.1)</td>
<td>35</td>
</tr>
<tr>
<td>Married/Common Law</td>
<td>8</td>
<td>(12.7)</td>
<td>9</td>
</tr>
<tr>
<td>Divorced/Separated</td>
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<td>(3.2)</td>
<td>1</td>
</tr>
<tr>
<td>Rather Not Say</td>
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<td>-</td>
<td>1</td>
</tr>
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<td>Education</td>
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<td>High School</td>
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</tr>
<tr>
<td>Partial College Education</td>
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<td>(54.0)</td>
<td>26</td>
</tr>
<tr>
<td>2-yr College Diploma</td>
<td>3</td>
<td>(4.8)</td>
<td>5</td>
</tr>
<tr>
<td>4-yr College/University</td>
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<td>(12.7)</td>
<td>10</td>
</tr>
<tr>
<td>Partial Graduate Education</td>
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<td>(1.6)</td>
<td>1</td>
</tr>
<tr>
<td>Completed Graduate Education</td>
<td>1</td>
<td>(1.6)</td>
<td>1</td>
</tr>
<tr>
<td>Rather Not Say</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Employment</td>
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<td></td>
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<tr>
<td>Student</td>
<td>51</td>
<td>(81.0)</td>
<td>35</td>
</tr>
<tr>
<td>Part-time</td>
<td>32</td>
<td>(50.8)</td>
<td>19</td>
</tr>
<tr>
<td>Full time</td>
<td>10</td>
<td>(15.9)</td>
<td>10</td>
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<tr>
<td>Unemployed</td>
<td>2</td>
<td>(3.2)</td>
<td>-</td>
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<tr>
<td>Disabled</td>
<td>1</td>
<td>(1.6)</td>
<td>-</td>
</tr>
<tr>
<td>Retired</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes: Table lists frequencies and percentages as a function of group assignment.
Table 2. *Traumatic Events Endorsed and Event Referenced as the Most Traumatic as a Function of Group*

<table>
<thead>
<tr>
<th>Trauma Type</th>
<th>Control</th>
<th>MVA-Low PTSD</th>
<th>MVA-High PTSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>(%)</td>
<td>n</td>
</tr>
<tr>
<td>Endorsed Traumatic Event</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Disaster</td>
<td>5</td>
<td>(7.9)</td>
<td>4</td>
</tr>
<tr>
<td>Accident Other than MVA</td>
<td>1</td>
<td>(1.6)</td>
<td>7</td>
</tr>
<tr>
<td>War-related</td>
<td>1</td>
<td>(1.6)</td>
<td>2</td>
</tr>
<tr>
<td>Unexpected Death</td>
<td>19</td>
<td>(30.2)</td>
<td>17</td>
</tr>
<tr>
<td>Robbery</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Physical Assault</td>
<td>6</td>
<td>(9.5)</td>
<td>6</td>
</tr>
<tr>
<td>Sexual Assault</td>
<td>2</td>
<td>(3.2)</td>
<td>3</td>
</tr>
<tr>
<td>Witnessing Assault</td>
<td>3</td>
<td>(4.8)</td>
<td>4</td>
</tr>
<tr>
<td>Illness</td>
<td>5</td>
<td>(7.9)</td>
<td>3</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>(12.7)</td>
<td>5</td>
</tr>
<tr>
<td>No Trauma</td>
<td>33</td>
<td>(52.4)</td>
<td>-</td>
</tr>
<tr>
<td>Most Traumatic Event</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>MVA</td>
<td>-</td>
<td>-</td>
<td>20</td>
</tr>
<tr>
<td>Natural Disaster</td>
<td>2</td>
<td>(3.2)</td>
<td>-</td>
</tr>
<tr>
<td>Accident Other than MVA</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>War-related</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Unexpected Death</td>
<td>16</td>
<td>(25.4)</td>
<td>10</td>
</tr>
<tr>
<td>Robbery</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Physical Assault</td>
<td>4</td>
<td>(6.3)</td>
<td>1</td>
</tr>
<tr>
<td>Sexual Assault</td>
<td>1</td>
<td>(1.6)</td>
<td>2</td>
</tr>
<tr>
<td>Witnessing Assault</td>
<td>1</td>
<td>(1.6)</td>
<td>1</td>
</tr>
<tr>
<td>Illness</td>
<td>1</td>
<td>(1.6)</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>(9.5)</td>
<td>7</td>
</tr>
<tr>
<td>No Referenced Trauma</td>
<td>32</td>
<td>(50.8)</td>
<td>-</td>
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</table>

*Note. Table lists frequencies and percentages as a function of group assignment. MVA = Motor Vehicle Accident.*
Table 3. *Self-report Measures Mean Score as Function of Group*

<table>
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<tr>
<th>Questionnaire</th>
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<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td><em>M</em></td>
<td><em>SD</em></td>
<td><em>S</em> (<em>SE=.30</em>)</td>
<td><em>K</em> (<em>SE=.60</em>)</td>
<td><em>M</em></td>
<td><em>SD</em></td>
<td><em>S</em> (<em>SE=.35</em>)</td>
<td><em>K</em> (<em>SE=.69</em>)</td>
<td><em>M</em></td>
<td><em>SD</em></td>
<td><em>S</em> (<em>SE=.54</em>)</td>
<td><em>K</em> (<em>SE=1.04</em>)</td>
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<tr>
<td>STAI-State</td>
<td>40.03</td>
<td>11.37</td>
<td>.04</td>
<td>-.59</td>
<td>39.41</td>
<td>10.34</td>
<td>.60</td>
<td>-.01</td>
<td>43.00</td>
<td>12.52</td>
<td>-.30</td>
<td>-.83</td>
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<td>STAI-Trait</td>
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<td>10.37</td>
<td>.16</td>
<td>-.63</td>
<td>40.33</td>
<td>10.23</td>
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<td>-.53</td>
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<td>13.96</td>
<td>.05</td>
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<td>ACS</td>
<td>51.17</td>
<td>7.90</td>
<td>.54</td>
<td>.32</td>
<td>51.59</td>
<td>9.26</td>
<td>.19</td>
<td>-.83</td>
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<td>11.58</td>
<td>.53</td>
<td>.76</td>
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<td>ERQ-R</td>
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<td>7.37</td>
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<td>-.30</td>
<td>26.85</td>
<td>7.53</td>
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<td>-.48</td>
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<td>-.94</td>
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<td>2.36</td>
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<td>Numbing MVA</td>
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<tr>
<td>PCL-S Other</td>
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Note. *M* = Mean; *SD* = Standard Deviation; *S* = Skew; *K* = Kurtosis; *SE* = Standard Error; STAI-State = State-Trait Anxiety Inventory-State Score; STAI-Trait = State-Trait Anxiety Inventory-Trait Score; ACS = Attentional Control Scale Score; ERQ-R = Emotion Regulation Questionnaire-Reappraisal Score; ERQ-S = Emotion Regulation Questionnaire-Suppression Score; AUDIT = Alcohol Use Disorder Identification Test Score; PCL-S = Posttraumatic Stress Disorder Checklist-Stressor Specific; MVA = Motor Vehicle Accident.

*aAll participants with a motor vehicle accident history completed the PCL-S in reference to that event.*

*bMean scores are presented separately for the Avoidance and Numbing subscales as DSM-V makes a distinction between these two symptom clusters. However, the combined score was used for PTSD classification to remain consistent with previous literature making use of the PCL-S for DSM-IV.*

*cA subset of the control group (*n* = 34), MVA-Low PTSD symptoms group (*n* = 26), and MVA-High PTSD symptoms group (*n* = 11) indicated having experienced a traumatic event other than a motor vehicle accident and completed the PCL-S in reference to another event.*
as a function of group in Table 4, 5, and 6. Few statistically significant correlations were found between the scores on the self-report measures and the attention bias indices and none of the correlations supported a specific pattern replicated across the groups. Accordingly, the self-report measures were not included in further analyses.

The mean orienting and disengaging indices are presented as a function of group and trial type in Table 7. The statistical significance of the orienting and disengaging indices was assessed using a series of one sample t-test with one-tailed significance. Contrary to Hypothesis 1, the MVA-Low PTSD group and the MVA-High PTSD group did not display a statistically significant facilitated attention bias at 100 ms SOA (all ps > .05). The Control group (p = .09) and the MVA-High PTSD group (p = .06) demonstrated an avoidance bias for mild threat words that was approaching statistical significance. Contrary to Hypothesis 2, the MVA-Low PTSD group and the MVA-High PTSD group also did not demonstrate a difficulty in disengagement bias at 500 ms SOA (all ps > .05) and the Control group demonstrated a difficulty in disengagement bias towards mild threat words that was trending towards statistical significance (p = .05). Contrary to Hypothesis 3, the MVA-Low PTSD group and the MVA-High PTSD group did not display an avoidance bias at 1250 ms SOA (all ps > .05).

The MVA-High PTSD group and the MVA-Low PTSD group did not display the expected directionality for the orienting and disengaging indices; however, the indices were still analyzed to assess for differences within groups (i.e., SOA, threat level) and between groups using two separate mixed-model ANOVAs. Contrary to Hypothesis 4 and 5, the ANOVA for the orienting indices failed to demonstrate a statistically significant main effect of group, SOA, or strength (all ps > .05) using Greenhouse-
Table 4. Summary of Intercorrelations for Scores on the STAI, ACS, ERQ, and the Orienting and Disengaging Indices for the Control Group

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Note. The Posttraumatic Stress Disorder Checklist-Specific total score was not included in the correlations table for the control group providing that it was not completed in reference to a motor vehicle accident. STAI-State = State-Trait Anxiety Inventory-State Score; STAI-Trait = State-Trait Anxiety Inventory-Trait Score; ACS = Attentional Control Scale Score; ERQ-R = Emotion Regulation Questionnaire-Reappraisal Score; ERQ-S = Emotion Regulation Questionnaire-Suppression Score; AUDIT = Alcohol Use Disorder Identification Test Score; 100OM = Orienting Index 100 ms SOA Mild Threat; 100OS = Orienting Index 100 ms SOA Strong Threat; 100DM = Disengaging Index 100 ms SOA Mild Threat; 100DS = Disengaging Index 100 ms SOA Strong Threat; 500OM = Orienting Index 500 ms SOA Mild Threat; 500OS = Orienting Index 500 ms SOA Strong Threat; 500DM = Disengaging Index 500 ms SOA Mild Threat; 500DS = Disengaging Index 500 ms SOA Strong Threat; 1250OM = Orienting Index 1250 ms SOA Mild Threat; 1250OS = Orienting Index 1250 ms SOA Strong Threat; 1250DM = Disengaging Index 1250 ms SOA Mild Threat; 1250DS = Disengaging Index 1250 ms SOA Strong Threat; SOA = Stimulus Onset Asynchrony.

* p < .05. ** p < .01.
Table 5. Intercorrelations for Scores on the STAI, ACS, ERQ, PCL-S, and the Orienting and Disengaging Indices for the MVA-Low PTSD Symptoms Group

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Note. STAI-State = State-Trait Anxiety Inventory-State Score; STAI-Trait = State-Trait Anxiety Inventory-Trait Score; ACS = Attentional Control Scale Score; ERQ-R = Emotion Regulation Questionnaire-Reappraisal Score; ERQ-S = Emotion Regulation Questionnaire-Suppression Score; AUDIT = Alcohol Use Disorder Identification Test Score; PCL-S MVA = Posttraumatic Stress Disorder Checklist-Stressor Specific Total Score in reference to a motor vehicle accident; 100OM = Orienting Index 100 ms SOA Mild Threat; 100OS = Orienting Index 100 ms SOA Strong Threat; 100DM = Disengaging Index 100 ms SOA Mild Threat; 100DS = Disengaging Index 100 ms SOA Strong Threat; 500OM = Orienting Index 500 ms SOA Mild Threat; 500OS = Orienting Index 500 ms SOA Strong Threat; 500DM = Disengaging Index 500 ms SOA Mild Threat; 500DS = Disengaging Index 500 ms SOA Strong Threat; 1250OM = Orienting Index 1250 ms SOA Mild Threat; 1250OS = Orienting Index 1250 ms SOA Strong Threat; 1250DM = Disengaging Index 1250 ms SOA Mild Threat; 1250DS = Disengaging Index 1250 ms SOA Strong Threat; SOA = Stimulus Onset Asynchrony.

* p < .05. ** p < .01.
Table 6. Intercorrelations for Scores on the STAI, ACS, ERQ, PCL-S, and the Orienting and Disengaging Indices for the MVA-High PTSD Symptoms Group

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<td>.48*</td>
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<td>-.37</td>
<td>-.59*</td>
<td>.53*</td>
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</table>

Note. STAI-State = State-Trait Anxiety Inventory-State Score; STAI-Trait = State-Trait Anxiety Inventory-Trait Score; ACS = Attentional Control Scale Score; ERQ-R = Emotion Regulation Questionnaire-Reappraisal Score; ERQ-S = Emotion Regulation Questionnaire-Suppression Score; AUDIT = Alcohol Use Disorder Identification Test Score; PCL-S MVA = Posttraumatic Stress Disorder Checklist-Stressor Specific Total Score in reference to a motor vehicle accident; 100OM = Orienting Index 100 ms SOA Mild Threat; 100OS = Orienting Index 100 ms SOA Strong Threat; 100DM = Disengaging Index 100 ms SOA Mild Threat; 100DS = Disengaging Index 100 ms SOA Strong Threat; 500OM = Orienting Index 500 ms SOA Mild Threat; 500OS = Orienting Index 500 ms SOA Strong Threat; 500DM = Disengaging Index 500 ms SOA Mild Threat; 500DS = Disengaging Index 500 ms SOA Strong Threat; 1250OM = Orienting Index 1250 ms SOA Mild Threat; 1250OS = Orienting Index 1250 ms SOA Strong Threat; 1250DM = Disengaging Index 1250 ms SOA Mild Threat; 1250DS = Disengaging Index 1250 ms SOA Strong Threat; SOA = Stimulus Onset Asynchrony.

* p < .05. ** p < .01.
Table 7. Mean Orienting and Disengaging Indices as a Function of Group and Trial Type

<table>
<thead>
<tr>
<th>Attention Bias Index</th>
<th>100 MS</th>
<th>500 MS</th>
<th>1250 MS</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>S (SE=.30)</td>
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<tr>
<td><strong>Orienting</strong></td>
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<tr>
<td>M</td>
<td>-12.03</td>
<td>55.44</td>
<td>.35</td>
</tr>
<tr>
<td>S</td>
<td>2.52</td>
<td>63.07</td>
<td>-.33</td>
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<tr>
<td><strong>Disengaging</strong></td>
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<td></td>
<td></td>
</tr>
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<td>M</td>
<td>8.49</td>
<td>64.52</td>
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<tr>
<td>S</td>
<td>29.04</td>
<td>84.76</td>
<td>2.15</td>
</tr>
</tbody>
</table>

**Note.** A positive orienting index indicates facilitated attention to threat and a negative orienting index suggests avoidance of threat. A positive disengagement index indicates difficulty in disengagement from threat and a negative disengagement index suggests facilitated disengagement from threat. M = Mean; SD = Standard Deviation; S = Skew; K = Kurtosis, SE = Standard Error; 100 MS = 100 ms SOA; 500 MS = 500 ms SOA; 1250 MS = 1250 ms SOA; Orienting-M = Orienting Index Mild Threat; Orienting-S = Orienting Index Strong Threat; Disengaging-M = Disengaging Index Mild Threat; Disengaging-S = Disengaging Index Strong Threat; SOA = Stimulus Onset Asynchrony.
Geisser correction. For the disengaging indices, the ANOVA using a Greenhouse-Geisser correction demonstrated a statistically significant interaction effect between SOA and threat level, $F(1.90, 235.73) = 5.68, p = .005, \eta^2_p = .04$. Pairwise contrasts indicated that the disengaging indices for mild and strong threat differed between the 100 ms and the 1250 ms SOA conditions, $F(1, 124) = 5.27, p = .02, \eta^2_p = .04$. At the 100 ms SOA, the disengaging index was negative for the mild threat level and positive for the strong threat level whereas at the 1250 ms SOA the disengaging index was nearing baseline (i.e., zero) for both levels of threat. Accordingly, the disengaging index for mild threat increased as SOA increased and the disengaging index for strong threat decreased as SOA increased. Although the main effect of threat level was approaching statistical significance ($p = .06$), contrary to Hypothesis 4 and 5, the ANOVA for disengaging indices did not demonstrate a statistically significant main effect of group, SOA, or threat level and no further interaction effects were identified (all $ps < .05$).

3.2. Exploratory post hoc Analyses

The null hypothesis could not be rejected for all hypotheses; nevertheless, unplanned exploratory post hoc analyses were conducted with the sample data to provide additional support for the current results, as well as directions for future research. Dot probe mean reaction times as a function of group, SOA, congruency, and threat level are presented in Table 8. Dot probe mean reaction times were analyzed by computing the traditional bias index (e.g., Asmundson & Hadjistavropoulos, 2007; MacLeod & Mathews, 1988), which is more commonly used in the literature than the orienting and disengaging indices, and which has been used in a previous investigation of attentional bias in MVA survivors (Bryant & Harvey, 1997). The bias index was calculated by
Table 8. Mean Non-Indexed Dot Probe Reaction Times as a Function of Group and Trial Type

<table>
<thead>
<tr>
<th>Trial Type</th>
<th>Control</th>
<th>MVA-Low PTSD</th>
<th>MVA-High PTSD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>S (SE=.30)</td>
</tr>
<tr>
<td>100 MS</td>
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<tr>
<td>Incongruent-M</td>
<td>533.02</td>
<td>171.22</td>
<td>2.64</td>
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<tr>
<td>Incongruent-S</td>
<td>553.56</td>
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<td>2.64</td>
</tr>
<tr>
<td>Congruent-M</td>
<td>536.55</td>
<td>144.59</td>
<td>2.50</td>
</tr>
<tr>
<td>Congruent-S</td>
<td>522.00</td>
<td>172.43</td>
<td>3.35</td>
</tr>
<tr>
<td>500 MS</td>
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<tr>
<td>Incongruent-M</td>
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<td>2.06</td>
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<td>Congruent-M</td>
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<td>2.06</td>
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<td>Congruent-S</td>
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<td>1.80</td>
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<td>Congruent-S</td>
<td>451.55</td>
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<td>2.76</td>
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Note. The probe appears behind the neutral word for incongruent trials and behind the threatening word for congruent trials. M = Mean; SD = Standard Deviation; S = Skew; K = Kurtosis; SE = Standard Error; 100 MS = 100 ms SOA; 500 MS = 500 ms SOA; 1250 MS = 1250 ms SOA; Incongruent-M = Incongruent Trial Mild Threat; Incongruent-S = Incongruent Trial Strong Threat; Congruent-M = Congruent Trial Mild Threat; Congruent-S = Congruent Trial Strong Threat; SOA = Stimulus Onset Asynchrony.
subtracting mean reaction times to congruent trials from mean reaction times to incongruent trials (Koster, Verschuere, et al., 2005). Mean bias index scores as a function of group, SOA, and threat level are presented in Table 9. Congruent with the attention bias literature, the bias index was analyzed to assess for differences within groups (i.e., SOA, congruency, threat level) and between groups using a mixed-model ANOVA. Using Greenhouse-Geisser correction, results demonstrated that there was a statistically significant interaction effect between SOA and threat level, $F(1.77, 219.77) = 6.68, p = .002, \eta^2_p = .05$. Pairwise contrasts suggested that the mean bias index for mild and strong threat differed between the 100 ms and the 1250 ms SOA conditions, $F(1, 124) = 7.38, p = .008, \eta^2_p = .06$. At the 100 ms SOA, the bias index was negative for the mild threat level and positive for the strong threat level whereas at the 1250 ms SOA the bias index was nearing baseline (i.e., zero) for both levels of threat. Accordingly, the bias index for mild threat increased as SOA increased and the bias index for strong threat decreased as SOA increased. The ANOVA did not indicate a statistically significant main effect of group, SOA, or threat level and no further interaction effects were identified (all $ps < .05$); however, the main effect of group was approaching statistical significance ($p = .08$).

Mean scores for the orienting and disengaging indices used in the main analyses were widely dispersed in the current sample and did not reflect the directionality of attention bias expected as per Hypotheses 1, 2, and 3. The scores were found on both sides of zero based on group and trial type. Between group comparisons of the orienting and disengaging indices using an ANOVA may have been impacted by a regression towards the mean cancelling out possible differences between the groups. Accordingly, the mean orienting and disengaging indices were further analyzed using an exploratory
Table 9. Mean Traditional Bias Index as a Function of Group and Trial Type

<table>
<thead>
<tr>
<th>Trial Type</th>
<th>Control</th>
<th>MVA-Low PTSD</th>
<th>MVA-High PTSD</th>
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<td>M</td>
<td>SD</td>
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<tr>
<td>100 MS</td>
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<tr>
<td>Bias-M</td>
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<tr>
<td>Bias-S</td>
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<td>Bias-S</td>
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<td>.56</td>
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Note. A positive bias index indicates faster reaction times when the probe appears behind the neutral word. A negative bias index indicates faster reaction times when the probe appears behind the threat word. M = Mean; SD = Standard Deviation; S = Skew; K = Kurtosis; SE = Standard Error; 100 MS = 100 ms SOA; 500 MS = 500 ms SOA; 1250 MS = 1250 ms SOA; Bias-M = Traditional Bias Index Incongruent Mild Threat; Bias-S = Traditional Bias Index Strong Threat; SOA = Stimulus Onset Asynchrony.
series of one sample $t$-tests with no *a priori* hypotheses and two-tailed significance. The orienting and disengaging indices were not statistically significantly different ($p$s > .05) from chance in any of the groups except for three indices. At 100 ms SOA, the Control group, $t(62) = 2.72$, $p = .03$, $r = .33$, and the MVA-Low PTSD group, $t(45) = 2.58$, $p = .02$, $r = .36$, displayed difficulty in disengagement from strong threat words; however, the MVA-High PTSD group displayed “facilitated disengagement” for mild threat words, $t(17) = -2.99$, $p = .008$, $r = .59$. The disengaging indices for the 100 ms SOA have been presented as a function of group and threat level in Figure 2.

### 4.0 Discussion

The current investigation had two purposes. First, the investigation was designed to clarify the directionality and time course of attentional bias for threat using a PTSD sample and a contemporary detection dot probe task. The presentation of a probe at different levels of SOA was used in an attempt to disentangle the relationship between the cognitive mechanisms of facilitated attention to threat, difficulty in disengagement from threat, and avoidance of threat. Second, the investigation was designed to evaluate the three different components of attentional bias for threat in MVA survivors with high PTSD symptoms, MVA survivors with low PTSD symptoms, and a control group with no history of MVA or PTSD symptoms. The role of stimulus threat level in attentional bias was also clarified through the use of mild and strong threat words.

#### 4.1 Time Course of Attentional Bias for Threat

The first objective of the current investigation was to assess Cisler and Koster’s (2010) framework of attentional bias for threat using a sample of individuals with PTSD symptoms. Specifically, an attentional bias was expected for facilitated attention to threat
Figure 2. Mean Disengagement Bias Index at 100 ms SOA as a function of group assignment and threat level. A positive disengagement index indicates difficulty in disengagement from threat and a negative disengagement index suggests facilitated disengagement from threat. SOA = Stimulus Onset Asynchrony. * $p < .05$. 
at 100 ms SOA, difficulty in disengagement from threat at 500 ms SOA, and avoidance of threat at 1250 ms SOA. The current results did not support Cisler and Koster’s (2010) framework regarding the time course and directionality of attentional bias for threat.

Contrary to the first hypothesis, the groups did not display facilitated attention to threat at 100 ms SOA. Findings from the current investigation are inconsistent with past investigations using the dot probe task (Carlson & Reinke, 2008; Mogg & Bradley, 2002; Koster, Crombez, Verschuere, Vanvolsem, & De Houwer, 2007; Koster, Verschuere, et al., 2005), yet consistent with one investigation making use of the spatial cueing task (Fox, Russo, Bowles, & Dutton, 2001). The discrepancy may be due, in part, to dot probe methodological considerations. All investigations finding a facilitated attention bias made use of pictorial threat stimuli (i.e., images) whereas the spatial cueing task investigation made use of semantic threat stimuli (i.e., words). Perhaps threatening words are not salient enough to capture attention as defined by the facilitated attention construct. Alternatively, two of the dot probe task investigations demonstrating a facilitated attention bias made use of masked stimuli (Carlson & Reinke, 2008; Mogg & Bradley, 2002). Unmasked threat stimuli have longer stimulus exposure duration than masked stimuli. Facilitated attention to unmasked threat stimuli may therefore occur at a time point earlier than 100 ms (Carlson & Reinke, 2008). Furthermore, investigations of masked threat stimuli may better allow for the detection of a facilitated attention response generated by unconscious processes; however, the use of unmasked threat stimuli may facilitate the use of conscious processes overshadowing the unconscious facilitated attention response (Jolij & Lamme, 2005).
Contrary to the second hypothesis, the groups did not display difficulty in disengagement from threat at 500 ms SOA, although the control group did display a trend towards difficulty in disengagement from mild threatening words. The trend may have resulted from the recognition of familiar words from a similar semantic category (i.e., MVA-related words) rather than from an attention bias. In the current investigation, the difficulty in disengagement bias mainly appears to have occurred at 100 ms SOA. Specifically, the MVA-High PTSD group displayed facilitated disengagement from mild threat words and both the MVA-Low PTSD group and the Control group displayed difficulty in disengagement from strong threat words. The current finding is incongruent with several dot probe task investigations (Bardeen & Orcutt, 2011; Koster et al., 2004; Koster, Verschuere, et al., 2005; Salemink et al., 2007) which have found a disengagement effect at 500 ms and with a spatial cueing task investigation suggesting that high trait anxious individuals display difficulty disengaging attention from threat at 100 ms (Koster et al., 2006). Nonetheless, the latter investigation does suggest that a disengagement bias can occur at 100 ms.

Discrepancies in disengagement results between the current investigation and previous research may be explained, in part, by method differences in the nature of the threat stimuli used. Most investigations having found a difficulty in disengagement bias at 500 ms made use of pictorial threat stimuli, as opposed to the semantic threat stimuli used in the current investigation. Pictorial stimuli are processed in approximately 100-150 ms (Thorpe, Fize, & Marlot, 1996), whereas semantic stimuli are processed in less than 50 ms (Rayner, Inhoff, Morrison, Slowiaczek, & Bertera, 1981). In the current investigation, the use of threatening words rather than threatening images may have
accelerated the attentional bias sequence such that by 100 ms participants were already involved in more effortful cognitive processes (e.g., disengagement). Although unexpected, the MVA-High PTSD group displaying facilitated disengagement from threat at 100 ms is partly in line with previous investigations that found rapid disengagement from threatening stimuli in anxiety samples (Koster et al., 2006; Garner et al., 2006). The results also suggest that avoidance mechanisms may occur prior to 500 ms and involve more rapid and automatic processes than previously suggested (Cisler & Koster, 2010). Assuming that cognitive processing of stimuli mainly occurred at 100 ms SOA, increased attentional resources may have been required earlier on. Consistent with the current findings, increased need for attentional resources may have translated into generally slower response times in the earlier SOA condition, which progressively became faster as SOA increased.

Contrary to the third hypothesis, the groups did not display avoidance of threat at 1250 ms SOA; however, the High-PTSD group and the Control group both displayed a trend towards avoidance of mild threatening words at 100 ms SOA. The current finding is inconsistent with investigations that have demonstrated an avoidance bias during the late, but not the early stages of processing (Garner et al., 2006; Koster, Verschuere, et al., 2005; Mogg et al., 2004). Nonetheless, the use of word stimuli may have facilitated processing and made it possible for avoidance to occur as early on as 100 ms. Further, some investigations have found support for the avoidance of threat at earlier delays (e.g., 200 ms; Koster et al., 2006; Koster et al., 2007) and other investigations have failed to find an avoidance bias at longer delays (e.g., 1250 ms; Bradley, Mogg, Falla, & Hamilton, 1998; Mogg, Bradley, Bono, & Painter, 2007). The tendency of the MVA-
High PTSD group to avoid MVA-related words is congruent with the current result suggesting that they easily disengage their attention from such words. Reasons for the control group displaying a tendency to avoid mild threat words are, however, less clear. Previous investigations have suggested that the dot probe task can yield unreliable results for healthy participants (Schmukle, 2005). Alternatively, participants in the control group may have processed mild threat words more quickly due to their familiarity and their grouping into one semantic category (i.e., MVA-related words). At 100 ms, attention may have shifted away from the mild threat words in favor of the non-semantically related neutral words.

The discrepancies found between the current results and the attentional bias literature for anxiety disorders may also have been due to the manipulation of SOA rather than stimuli exposure duration. In previous investigations, the presentation of stimuli for varying amounts of time may have confounded results such that a participant’s response would have been dependent on SOA, as well as the amount of time for which the stimuli were presented. The attentional biases found at 500 ms and 1250 ms in investigations manipulating exposure duration (e.g., Koster et al., 2004; Koster, Verschuere, et al., 2005; Salemink et al., 2007) may have reflected the strategic cognitive mechanisms associated with the presence of threatening stimuli in one’s visual field; in contrast, the current results may better reflect the automatic cognitive mechanisms associated with the initial processing of threat stimuli in one’s environment. Accordingly, Cisler and Koster’s framework (2010) may provide a general framework for the directionality and time course of attentional bias for threat; however, the specific time points (i.e., 100 ms, 500 ms, 1250 ms) at which each attention bias mechanism operates appears dependent on
several methodological factors (i.e., semantic vs. pictorial stimuli, masked vs. unmasked stimuli, manipulation of exposure duration vs. SOA). Similarly, when processing environmental cues, individuals may display an attentional bias for threat at different time points or in different ways (i.e., avoiding vs. attending) depending on contextual factors present at the time of cognitive processing. In other words, the attentional biases may depend more heavily on idiosyncratic variables than previously thought.

4.2 Group Differences in Attentional Bias

Contrary to the fourth and the fifth hypotheses, the strength of the orienting and disengaging indices did not differ based on group or threat level. Moreover, the traditional bias index (e.g., Koster, Verschuere, et al., 2005; MacLeod & Mathews, 1988) also suggested against between-group differences when accounting for SOA and threat level. The result differs from previous literature that demonstrated group differences in reaction time between individuals with PTSD and those without when assessed on several attentional bias measures (e.g., Bryant & Harvey, 1995; Harvey et al., 1996; McNally et al., 1990; Pineles et al., 2007, 2009). Specifically, current results are incongruent with past research making use of a sample of MVA survivors and a dot probe task (Bryant & Harvey, 1997); however, the previous Bryant and Harvey investigation cannot be directly compared to the current investigation because of differences in the procedure used to administer the dot probe task.

The majority of investigations highlighting reaction time differences between individuals with PTSD and those without made use of the emotional Stroop task. The robustness of the emotional Stroop effect in PTSD samples appears to have been overestimated in the literature. Research suggests that only 44% of peer-reviewed
published studies report group reaction time differences to threat words and that these studies tend to be published in higher impact journals (Kimble et al., 2009). Moreover, an examination of dissertation studies suggests that 75% of dissertations do not find reaction times suggestive of an attentional bias in individuals with PTSD specifically (Kimble et al., 2009). A similar review of the literature has not been conducted on investigations making use of the dot probe task. That said, contemporary studies using the dot probe task with anxiety samples have produced inconsistent results (Bockstaele et al., 2014) and the possibility that reaction time differences between individuals with and without PTSD are weak or unreliable cannot be excluded.

Assuming that group differences do exist in samples of individuals with and without PTSD, several explanations can be put forth to explain the current findings. The MVA-High PTSD group included MVA survivors with subsyndromal PTSD. It is possible that reaction times are highly sensitive to PTSD symptom severity such that only individuals endorsing full PTSD symptoms display reaction times indicative of an attentional bias (Bryant & Harvey, 1997). That said, subsyndromal PTSD in MVA survivors is associated with increased anxiety (e.g., Blanchard et al., 1995) and several investigations have found individuals with anxiety to display significantly different reaction times to threatening stimuli compared to individuals without anxiety (e.g., Koster, Verschuere, et al., 2005; MacLeod & Mathews, 1988; see Bar-Haim et al., 2007 for review).

The MVAs experienced by current participants may have been qualitatively less severe than MVAs experienced by participants in previous research. Previous investigations have recruited MVA survivors with PTSD from community hospital
settings and, on average, participants reported having been hospitalized for up to two weeks (Bryant & Harvey, 1995, 1997; Harvey et al., 1996). The current investigation only required the experience of a MVA that was severe enough to warrant filing of a police report. Accordingly, endorsement of a MVA was possible in the absence of a hospital admission. Further, despite reporting high PTSD symptoms, more than half the MVA-High PTSD group indicated having experienced an event that was more traumatic than the MVA.

The time elapsed since the MVA could also have impacted reaction times on the dot probe task. In previous investigations of MVA survivors identifying a significant difference in reaction time between the groups, accidents had occurred less than 5 months prior to the attentional bias assessment (Bryant & Harvey, 1997; Harvey et al., 1996). Moreover, previous research conducting assessments 6-24 months following an MVA failed to identify reaction times indicative of an attentional bias for threat (Devineni et al., 2004). In the current investigation, over 30 months had elapsed since the MVA. Due to the prominence of MVA related cues in the environment (e.g., roads, cars, reports of accidents in the news), habituation to such cues may have naturally occurred over time and weakened the strength of the attentional bias (Pineles et al., 2007, 2009), in turn reducing group differences in reaction time.

Finally, the personal relevance of the threat stimuli, or lack thereof, could have impacted the nature and strength of the attentional biases displayed by participants in the current investigation. Previous research using the emotional Stroop task (Riemann & McNally, 1995) and the dot probe task (Mogg, Bradley, Hyare, & Lee, 1998) suggests that attentional biases may largely be produced by that personal relevance rather than the
valence of the stimuli used to assess the biases. The mild threat stimuli (e.g., highway) in the current investigation may have been strongly personally relevant to the MVA-High PTSD group; however, the mild threat stimuli may also have been relevant to participants in the MVA-Low PTSD group and the Control group as a result of their familiarity (e.g., one may have to drive on a highway daily to get to work). As a result, differences in attentional biases may not have emerged between the groups. Similarly, the strong threat stimuli (e.g., blood) used in the current investigation may have been too general to produce a distinct attentional bias in the MVA-High PTSD group.

4.3. Group Differences in Attentional Pattern

Results of the current investigation demonstrated the presence of orienting and disengaging indices on both sides of zero depending on group and threat level. As a result, direct comparisons of orienting and disengaging indices may have yielded a regression towards the mean and cancelled out possible effects. Nonetheless, inferences can still be made about potentially different patterns of attention between the groups.

In the current investigation, the MVA-High PTSD group displayed a markedly different attention pattern than the control group and the MVA-Low PTSD group at 100 ms SOA. Specifically, the MVA-High PTSD group displayed facilitated disengagement from mild threat words. No such effect was found for strong threat words. Conversely, participants in the control group and the MVA-Low PTSD did not demonstrate a specific bias for mild threat words but displayed difficulty disengaging their attention from strong threat words. Providing that significant bias indices are different from zero and that non-significant bias indices (i.e., when a group does not show a specific attention bias) equal zero, the current results could be interpreted as suggesting that the attention bias indices
are significantly different between the groups; that said, additional research would strengthen the validity of such interpretations.

Hypothesis five was not directly supported; however, the current results suggest stimuli of different threat levels yield different attention patterns as a function of group. The mild threat words used in the current investigation were directly related to motor vehicles and road traffic but were not inherently threatening words. Conversely, the strong threat words broadly related to motor vehicle accidents (e.g., crash, blood) but better reflected the concept of general threat. Congruent with previous investigations, the finding that MVA survivors with high PTSD symptoms easily disengage from mild threat words but not strong threat words reflects an attentional bias for trauma-related threat but not general threat (Beck et al., 2001; Bryant & Harvey, 1997, Foa et al., 1991; McNally et al., 1990; Pineles et al., 2009). The current finding also strengthens previous assumptions suggesting that strongly personally relevant stimuli produce larger attentional biases than mildly personally relevant or neutral stimuli, irrespective of valence (Riemann & McNally, 1995).

In line with cognitive models of anxiety disorders, avoidance of trauma-related threat may provide temporary relief for MVA survivors with high PTSD symptoms; however, avoidance likely also interferes with the re-appraisal of threat, resulting in a rapid resurgence of anxiety and the maintenance of PTSD symptoms (Beck & Clark, 1997). The role of avoidance in PTSD is supported by clinical investigations suggesting that the most effective psychological treatments for PTSD are interventions requiring the client to engage with trauma-related threat (Bisson et al., 2007). Current findings are also in line with a recent US military investigation suggesting that avoidance of threat is
associated with increased PTSD symptoms 4 months following combat exposure (Sipos, Bar-Haim, Abend, Adler, & Bliese, 2013).

Although unexpected, the control group and the MVA-Low PTSD group both displaying difficulty disengaging their attention from strong threat words may be a key difference between individuals with and without PTSD. Theoretical models of attentional bias in anxiety emphasize that attending to imminent threat during early stages of processing may be a normal and adaptive response (Eccleston & Crombez, 1999; Mathews & Mackintosh, 1998; Mogg & Bradley, 1998). Several investigations have found evidence that control subjects engage with (i.e., avoidance or difficulty in disengagement) strongly threatening stimuli presented for a short period of time (i.e., < 500 ms; Koster et al., 2004; Koster, Verschuere et al., 2005; Wilson & MacLeod, 2003; Yiend & Mathews, 2001). Accordingly, individuals with PTSD may avoid trauma-related threat information while also failing to preferentially engage with generally threatening material in their environment. The current data does not allow for the establishment of causality; however, an individual’s failure to adaptively engage with threat stimuli present at the time of trauma may increase the risk of developing PTSD by interfering with cognitive processing and memory consolidation of the trauma (e.g., McCleery & Harvey, 2004; Van der Kolk, 1994). In parallel, previous research has shown that threat avoidance during an acute stressor predicts higher levels of PTSD symptoms at 1 year follow up (Wald et al., 2011). Threat avoidance prior to combat deployment has also been shown to predict higher levels of PTSD symptoms at the time of deployment (Beevers et al., 2011).

4.4. Methodological Implications
The attentional bias literature includes several discrepant findings. To date, no single theoretical model appears to have fully captured the cognitive processes involved in attentional bias for threat in anxiety pathologies and PTSD more specifically. As highlighted by the current results, divergences may in part be explained by methodological considerations. The current PTSD sample demonstrated a limited attentional bias for semantic threat. The selected semantic threat stimuli appear to have produced robust effects in previous research with the emotional Stroop task (Bryant & Harvey, 1995; Harvey et al., 1996); however, threatening images may be a more sensitive tool to detect attentional biases for threat using the dot probe task (Bardeen & Orcutt, 2011; Sipos et al., 2013; Wald et al., 2011) or the visual search task (Pineles, 2007, 2009). As previously argued, the qualitative nature of the threat stimuli used (i.e., images vs. words, subliminal vs. supraliminal) may also impact the time course of attentional bias for threat such that a specific SOA condition may produce different biases (e.g., facilitated attention and avoidance) in different investigations.

In the current investigation, no between group differences were found when directly comparing the groups based on the orienting and disengaging indices, as well as based on a more traditional bias index. Nonetheless, differences in attention patterns emerged between individuals with high PTSD symptoms and those without when evaluating the directionality of the orienting and disengaging indices compared to baseline. The contemporary dot probe paradigm may be more sensitive to attentional bias for threat and provide more precise results as to the directionality of the attentional bias in MVA survivors with PTSD (Bryant & Harvey, 1997). Accordingly, the contemporary
dot probe task would benefit from being used in future investigations of attentional bias for threat in anxiety pathologies.

**4.5 Clinical Implications**

The current investigation has potentially important treatment implications for MVA survivors with PTSD and individuals with PTSD more broadly. Simple and cost-efficient attention bias modification programs have been developed for the treatment of anxiety pathologies (Bar-Haim, 2010) and may prove beneficial for the treatment of PTSD. Attention bias modification programs have typically been used to re-train attention away from threat in generalized anxiety disorder and social anxiety disorder samples (e.g., Amir, Beard, Burns, & Bomyea, 2009; Amir, Beard, Taylor, Klumpp, & Elias, 2009; Schmidt, Richey, Buckney, & Timpano, 2009); however, current results suggest attention bias modification programs for individuals with PTSD may benefit from being designed to re-train attention towards threat rather than away from threat. Current results also reiterate the importance of using trauma exposure techniques in traditional clinical interventions for PTSD (e.g., cognitive-behaviour therapy, prolonged exposure therapy). Pending future research supporting the use of attention bias modification programs for PTSD, governmental bodies such as Saskatchewan Government Insurance may wish to integrate such programs in their post-MVA rehabilitation policies.

Avoidance of threat during acute stress has been posited as a risk factor for the development of PTSD (Beevers et al., 2011; Wald et al., 2011) and ensuring that individuals attend to life-threatening stimuli at the time of a MVA may help prevent the development of PTSD. Replications and extensions of the current finding that individuals
without PTSD engage with strong threat words whereas individuals with high PTSD symptoms do not may highlight the benefits of using attention bias modification programs as a preventive strategy. Indeed, governmental bodies issuing driving licenses may wish to incorporate the completion of such programs as a requirement for obtaining or renewing a license.

4.6 Limitations and Future Directions

The current investigation has several limitations that provide directions for future research. The sample size for the MVA-High PTSD group fell short of the originally desired sample; moreover, the majority of participants in the MVA-high PTSD group met criteria for probable subsyndromal PTSD but not full PTSD. The attention biases of MVA survivors with subsyndromal PTSD may differ from those of both MVA survivors without PTSD and MVA survivors with full PTSD (Bryant & Harvey, 1997). Future research using a contemporary dot probe task should seek to recruit a larger sample and distinguish between such groups.

The current sample was also self-recruited and the majority of MVA survivors who participated in the current investigation reported no PTSD symptoms. There may have been a self-recruitment bias such that only individuals with limited distress about their MVA participated in the research. Recruitment of participants through online community advertising and the psychology participant pool at the University of Regina also may have resulted in a sample of participants who experienced MVAs less severe than those traditionally reported by participants in MVA investigations (Bryant & Harvey, 1995, 1997, Harvey et al., 1996). Future research should seek to recruit MVA survivors in hospital settings in an attempt to ensure a minimum severity threshold for the
MVA. Participant recruitment in hospital settings would also help ensure that all participants have recently experienced a MVA (e.g., within a year).

The current investigation used the PCL-S self-report measure to assess PTSD DSM-IV-TR criteria (APA, 200). Several symptoms on the PCL-S are non-specific to PTSD (e.g., difficulty sleeping) and may have been endorsed in the absence of a clinical presentation for PTSD. The PCL-S has high convergent validity with the Clinician Administered PTSD Scale in samples of MVA survivors (Blanchard et al., 1996); however, a structured diagnostic interview would have been required to better support the clinical status of participants. Comorbid diagnoses were also not assessed in the current investigation but could have impacted the attentional bias for threat (e.g., Mogg & Bradley, 2005). Future investigations making use of structured diagnostic interviews should seek to control for comorbid diagnoses such as depression.

Important changes were recently made to the PTSD diagnostic criteria in DSM-5 (APA, 2013). A self-report measure (i.e., PTSD Checklist for DSM-5; Weathers, Litz, et al., 2013) and a structured diagnostic interview (i.e., Clinician Administered PTSD Scale for DSM-5; Weathers, Blake, Schnurr, Marx, & Keane, 2013) for DSM-5 PTSD symptoms have been made available since the beginning of data collection for the current investigation. The use of DSM-5 PTSD criteria likely would not have resulted in markedly different PTSD groups in the current investigation; however, given changes to the wording of PTSD symptoms, future research should rely on DSM-5 assessment tools.

Web-based data collection has been shown to be a valid approach for questionnaire-based research (Gosling, Vazire, Srivastava, & John, 2004); however, there does not appear to be research assessing the validity of an Internet administered dot probe
paradigm. Any difficulty associated with this administration channel is likely the result of differences in the testing environments, not the Millisecond software (Millisecond Software Inc., Seattle, WA). Specifically, there is a possibility that participants completed the dot probe task while being exposed to environmental distractions despite attempts made to control for environmental distractions in the current investigation (i.e., standardized instructions in regards to the testing environment, exclusion of outliers, asking participants to report careless responding). The presence of strongly personally relevant stimuli in the testing environment could have resulted in the participants allocating more attentional resources towards the environmental distracters than towards the stimuli presented on the computer screen. Accordingly, future research should seek to replicate current results using a laboratory administered dot probe task. Future research should also seek to increase ecological validity by having participants complete a dot probe task in an MVA-related context (e.g., in car). The presence of MVA-related contextual cues may provide a better assessment of the attentional biases present at the time of driving a vehicle. Further, MVA-related contextual cues may increase the personal relevance of the threat stimuli presented in the attentional bias task, in turn increasing the size of the bias.

Finally, assumptions of directionality made based on the current investigation would need to be verified using longitudinal design. Discrepant findings in the literature on attentional bias and PTSD may result from a change in the directionality of attentional bias over time. Future investigations of MVA survivors should seek to longitudinally assess the directionality of attentional bias as has previously been done in military samples (Beevers et al., 2011; Wald et al., 2011). Logistically, predicting which
individuals will become involved in a MVA is impossible; however, recruitment of research participants in emergency room settings could allow for the assessment of attentional bias immediately after the MVA and at multiple time points thereafter.

4.7. Conclusions

The current investigation was the first to assess the directionality and time course of attentional bias for threat in a sample of MVA survivors. The dot probe task yielded different results based on the procedure used to analyze the data. Direct comparisons of the attention bias indices between the groups did not support the presence of group differences. Nonetheless, a different attention pattern emerged between the groups when evaluating the directionality of the orienting and disengaging indices compared to baseline. Accordingly, the contemporary dot probe task appears to be a more sensitive measure of attentional bias and should be used in future investigations.

Results of the contemporary dot probe task provided evidence that MVA survivors with high PTSD symptoms display a different attention pattern than MVA survivors with low PTSD symptoms and non-MVA survivors during the early stages of cognitive processing (i.e., 100 ms). Specifically, MVA survivors with high PTSD symptoms appear to easily disengage (i.e., avoid) their attention from MVA-related stimuli, despite such stimuli not being inherently threatening. Furthermore, MVA survivors with high PTSD symptoms fail to engage with generally threatening stimuli, a seemingly normal response displayed by MVA survivors with low PTSD symptoms and non-MVA survivors. Replication of the current results would support attention bias modification treatment programs for MVA survivors with PTSD. The current investigation does not allow for the establishment of causality; however, failure to engage
with threatening stimuli at the time of the MVA may facilitate development of PTSD, which is further maintained by the avoidance of MVA-related stimuli. Such supposition would have to be verified through the use of a longitudinal research design, but provides initial direction for exploring attention bias modification programs as a tool to prevent development of PTSD.
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Footnotes

1 The STAI was not included in an appendix to avoid copyright violation. All other measures included in the current investigation are available in the public domain and are included in the appendices.
Appendices
Appendix A. Demographic Measures

If you would like to participate, please provide your email address below. Your contact information will only be used for data collection purposes.

Were you in a motor vehicle accident more than one month ago (30 days) where enough damage occurred that required you to (or should have required you to) file a police report or call the police? Y/N

If yes, how long ago did this accident occur? ________ Was this accident your first accident? Y/N If no, how many accidents have you been involved in previously? ________ Did you injure your head during the motor vehicle accident? ________

If yes, did you lose consciousness or “black out” as a result of the head injury?

Have you ever experienced any of the following stressful life events?
  o Natural disaster (e.g., earthquake, flood, tornado)
  o Any accident other than a motor vehicle accident where you or someone was badly hurt (e.g., plane crash, drowning, explosion)
  o Living, working, or doing military service in a war zone
  o Sudden and unexpected death of close friend or a loved one
  o Robbery with the use of a weapon
  o Physical assault
  o Sexual assault
  o Witnessed a severe physical or sexual assault
  o Life threatening illness (e.g., cancer, life threatening virus, spinal cord injury)
  o Any other threatening life event (e.g., lost in wilderness, severe animal bite):

If yes, was the motor vehicle accident the most traumatic event? Y/N

If another event was more traumatic, which event was the most severe? (USE ABOVE) ______________

Do you have any daytime vision problems that aren’t corrected by glasses or contacts? Y/N

Are you currently taking any psychoactive medication on a regular basis? Y/N
If yes, please list all medication that you are currently taking. ______________

Have you consumed any caffeine, alcohol, or drug in the past 24hrs? Y/N
If yes, please indicate what substance and how much. ______________
How old are you?
Please indicate your sex.
How many years (not necessarily consecutively) have you been in school?
Please indicate your current occupation.
Please indicate your marital status.
Please indicate your ethnicity.
Please indicate which city or town you currently live in.
Please indicate your first language.
Appendix B.

Attentional Control Scale (ACS)

Please rate as 1 for almost never; 2 sometimes; 3 often; and 4 would be always.

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<tr>
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<th>Almost never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
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<tbody>
<tr>
<td>1.</td>
<td>It’s very hard for me to concentrate on a difficult task when there are noises around.</td>
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<td>2.</td>
<td>When I need to concentrate and solve a problem, I have trouble focusing my attention.</td>
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<td>3.</td>
<td>When I am working hard on something, I still get distracted by events around me.</td>
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<td>4.</td>
<td>My concentration is good even if there is music in the room around me.</td>
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<td>5.</td>
<td>When concentrating, I can focus my attention so that I become unaware of what’s going on in the room around me.</td>
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<td>6.</td>
<td>When I am reading or studying, I am easily distracted if there are people talking in the same room.</td>
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<td>7.</td>
<td>When trying to focus my attention on something, I have difficulty blocking out distracting thoughts.</td>
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<td>8.</td>
<td>I have a hard time concentrating when I’m excited about something.</td>
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<td>9.</td>
<td>When concentrating I ignore feelings of hunger or thirst.</td>
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<td>10.</td>
<td>I can quickly switch from one task to another.</td>
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<td>11.</td>
<td>It takes me a while to get really involved in a new task.</td>
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<td>12.</td>
<td>It is difficult for me to coordinate my attention between the listening and writing required when taking notes during lectures.</td>
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<td>13.</td>
<td>I can become interested in a new topic very quickly when I need to.</td>
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<td>14.</td>
<td>It is easy for me to read or write while I’m also talking on the phone.</td>
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<td>15.</td>
<td>I have trouble carrying on two conversations at once.</td>
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<td>16.</td>
<td>I have a hard time coming up with new ideas quickly.</td>
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<td>17.</td>
<td>After being interrupted or distracted, I can easily shift my attention back to what I was</td>
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<td>18. When a distracting thought comes to mind, it is easy for me to shift my attention away from it.</td>
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<tr>
<td>19. It is easy for me to alternate between two different tasks.</td>
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<td>20. It is hard for me to break from one way of thinking about something and look at it from another point of view.</td>
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</table>
Appendix C.

Alcohol Use Disorders Identification Test (AUDIT)

Please circle the answer that is correct for you.

1. How often do you have a drink containing alcohol?
   Never
   Monthly or less
   Two to four times a month
   Two to three times a week
   Four or more times a week

2. How many drinks containing alcohol do you have on a typical day when you are drinking?
   1 or 2
   3 or 4
   5 or 6
   7 to 9
   10 or more

3. How often do you have six or more drinks on one occasion?
   Never
   Less than monthly
   Monthly
   Weekly
   Daily or almost daily

4. How often during the last year have you found that you were not able to stop drinking once you had started?
   Never
   Less than monthly
   Monthly
   Weekly
   Daily or almost daily

5. How often during the last year have you failed to do what was normally expected from you because of drinking?
   Never
   Less than monthly
   Monthly
   Weekly
   Daily or almost daily

6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?
   Never
7. How often during the last year have you had a feeling of guilt or remorse after drinking?
   - Never
   - Less than monthly
   - Monthly
   - Weekly
   - Daily or almost daily

8. How often during the last year have you been unable to remember what happened the night before because you had been drinking?
   - Never
   - Less than monthly
   - Monthly
   - Weekly
   - Daily or almost daily

9. Have you or someone else been injured as a result of drinking?
   - No
   - Yes, but not in the last year
   - Yes, during the last year

10. Has a relative or friend, or a doctor or other health worker been concerned about your drinking or suggested you cut down?
    - No
    - Yes, but not in the last year
    - Yes, during the last year
Appendix D.

Emotion Regulation Questionnaire (ERQ)

We would like to ask you some questions about your emotional life, in particular, how you control (that is, regulate and manage) your emotions. The questions below involve two distinct 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 item, please answer using the following scale:

1-----------------2-----------------3-----------------4-----------------5-----------------6-----------------7
strongly disagree neutral strongly disagree

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

PTSD Checklist – Stressor Specific Version (PCL-S)

The event you experienced was: _______________ on: _______________

Below is a list of problems and complaints that people sometimes have in response to stressful life experiences. Please indicate how much you have been bothered by that problem in the past month. Please rate as 1 for not at all; 2 a little bit; 3 moderately; 4 quite a bit, and 5 would be extremely.

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Not at all</th>
<th>A little bit</th>
<th>Moderately</th>
<th>Quite a bit</th>
<th>Extremely</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Repeated, disturbing memories, thoughts, or images of the stressful experience?</td>
<td></td>
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<td>2.</td>
<td>Repeated, disturbing dreams of the stressful experience?</td>
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<td>3.</td>
<td>Suddenly acting or feeling as if the stressful experience were happening again (as if you were reliving it)?</td>
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<td>4.</td>
<td>Feeling very upset when something reminded you of the stressful experience?</td>
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<td>5.</td>
<td>Having physical reactions (e.g., heart pounding, trouble breathing, or sweating) when something reminded you of the stressful experience?</td>
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<td>6.</td>
<td>Avoid thinking about or talking about the stressful experience or avoid having feelings related to it?</td>
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<td>7.</td>
<td>Avoid activities or situations because they remind you of the stressful experience?</td>
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<td>8.</td>
<td>Trouble remembering important parts of the stressful experience?</td>
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<td>9.</td>
<td>Loss of interest in things that you used to enjoy?</td>
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<td>10.</td>
<td>Feeling distant or cut off from other people?</td>
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<td>11.</td>
<td>Feeling emotionally numb or being unable to have loving feelings</td>
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<td>for those close to you?</td>
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<td>12. Feeling as if your future will somehow be cut short?</td>
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<td>13. Trouble falling or staying asleep?</td>
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<td>14. Feeling irritable or having angry outbursts?</td>
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<td>15. Having difficulty concentrating?</td>
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<td>16. Being “super alert” or watchful on guard?</td>
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<td>17. Feeling jumpy or easily startled?</td>
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Appendix F.

Word List

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<td>Deathbed</td>
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<td>Panic</td>
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<td>Wheel</td>
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<td>Mortality</td>
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<td>Death</td>
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110
Appendix G.

University of Regina Research Ethics Board Ethical Approval Forms

DATE:    July 25, 2013

TO:      Sophie Duranceau
          Psychology

FROM:    Dr. Larena Hoeber
          Chair, Research Ethics Board

Re:      An Examination of Attentional Bias for Threat in Motor Vehicle Accident Survivors with Posttraumatic Stress Disorder (File # 02S1314)

Please be advised that the University of Regina Research Ethics Board has reviewed your proposal and found it to be:

☐ 1. APPROVED AS SUBMITTED. Only applicants with this designation have ethical approval to proceed with their research as described in their applications. For research lasting more than one year (Section 1F), ETHICAL APPROVAL MUST BE RENEWED BY SUBMITTING A BRIEF STATUS REPORT EVERY TWELVE MONTHS. Approval will be revoked unless a satisfactory status report is received. Any substantive changes in methodology or instrumentation must also be approved prior to their implementation.

☐ 2. ACCEPTABLE SUBJECT TO MINOR CHANGES AND PRECAUTIONS (SEE ATTACHED). Changes must be submitted to the REB and approved prior to beginning research. Please submit a supplementary memo addressing the concerns to the Chair of the REB. **Do not submit a new application.** Once changes are deemed acceptable, ethical approval will be granted.

☐ 3. ACCEPTABLE SUBJECT TO CHANGES AND PRECAUTIONS (SEE ATTACHED). Changes must be submitted to the REB and approved prior to beginning research. Please submit a supplementary memo addressing the concerns to the Chair of the REB. **Do not submit a new application.** Once changes are deemed acceptable, ethical approval will be granted.

☐ 4. UNACCEPTABLE AS SUBMITTED. The proposal requires substantial additions or redesign. Please contact the Chair of the REB for advice on how the project proposal might be revised.

Dr. Larena Hoeber

cc:  Dr. R. Nicholas Carleton - Psychology

**supplementary memo should be forwarded to the Chair of the Research Ethics Board at the Office for Research, Innovation and Partnership (Research and Innovation Centre, Room 106) or by e-mail to research.ethics@uregina.ca**

OFFICE FOR RESEARCH, INNOVATION AND PARTNERSHIP
Regina, Saskatchewan, Canada S4S 0A2
Phone: 306.585.4775  Fax: 306.585.4893
www.uregina.ca/research
DATE: August 27, 2013

TO: Sophie Duranceau
    Psychology Department

FROM: Dr. David Senkow,
    Acting Chair, Research Ethics Board

Re: An Examination of Attentional Bias for Threat in Motor Vehicle Accident Survivors with Posttraumatic Stress Disorder File # 02S1314

This memo confirms approval of the changes outlined in your e-mail memo dated August 26, 2013.

Please contact us if you have any further questions.

Sincerely,

[Signature]

Dr. David Senkow

cc: Dr. R. Nicholas Carleton - Psychology