AN ANALYSIS OF TRAUMA-RELATED TIME DISTORTIONS

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Current theories of dissociation are deficient, in that diverse symptoms are grouped under one global classification. This thesis used a multi-pronged approach employing clinical and analogue studies to deconstruct one commonly reported peritraumatic dissociative symptom: time distortion. Study 1 tested the proposal that time slowing during a traumatic event would be associated with the development and maintenance of Posttraumatic Stress Disorder (PTSD). The findings indicated that peritraumatic time slowing was associated with more severe PTSD symptoms and a threefold increase in the probability of PTSD three months later. Study 2 examined qualitative aspects of time distortion experience during traumatic events. The results indicated that time slowing was linked with the anticipation of aversive outcomes of the event. Study 3 tested the hypothesis that increased arousal would be associated with overestimates of stimuli duration. The findings indicated that higher levels of arousal were associated with longer time judgments. Study 4 investigated hyperarousal in a naturalistic setting involving extreme stress in skydivers. Higher ratings of fear were associated with a tendency to overestimate event duration. Study 5 investigated hypnotically-induced temperature change and time perception. The results indicated that highly hypnotisable hypnotised participants overestimated stimuli duration following a warming suggestion. Studies 6a, 6b, 7 and 8 investigated whether emotional material was perceived differently to non-emotional material. Studies 6a and 6b demonstrated that the duration of emotionally negative material was overestimated relative to neutral or positive material. Study 7 examined the combined effect of valence and physiological arousal on time perception. The results suggested that arousal mediated the effect of valence on time perception. Study 8 employed clinical and non-clinical samples to investigate time perception for autobiographical memories. The results indicated that people currently experiencing PTSD indexed greater estimates of trauma memory duration. Study 9 examined the effect of perception of control on duration estimates. The results suggested that perceived lack of control over negative stimuli was associated with longer duration estimates. Together, the findings supported and extended existing models of time perception, and demonstrated that time distortions appear to be influenced by arousal, emotional valence, and avoidance reactions.

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ABSTRACT

Current theories of dissociation are deficient, in that diverse symptoms are grouped under one global classification. This thesis used a multi-pronged approach employing clinical and analogue studies to deconstruct one commonly reported peritraumatic dissociative symptom: time distortion. Study 1 tested the proposal that time slowing during a traumatic event would be associated with the development and maintenance of Posttraumatic Stress Disorder (PTSD). The findings indicated that peritraumatic time slowing was associated with more severe PTSD symptoms and a threefold increase in the probability of PTSD three months later. Study 2 examined qualitative aspects of time distortion experience during traumatic events. The results indicated that time slowing was linked with the anticipation of aversive outcomes of the event. Study 3 tested the hypothesis that increased arousal would be associated with overestimates of stimuli duration. The findings indicated that higher levels of arousal were associated with longer time judgments. Study 4 investigated hyperarousal in a naturalistic setting involving extreme stress in skydivers. Higher ratings of fear were associated with a tendency to overestimate event duration. Study 5 investigated hypnotically-induced temperature change and time perception. The results indicated that highly hypnotisable hypnotised participants overestimated stimuli duration following a warming suggestion. Studies 6a, 6b, 7 and 8 investigated whether emotional material was perceived differently to non-emotional material. Studies 6a and 6b demonstrated that the duration of emotionally negative material was overestimated relative

to neutral or positive material. Study 7 examined the combined effect of valence and physiological arousal on time perception. The results suggested that arousal mediated the effect of valence on time perception. Study 8 employed clinical and non-clinical samples to investigate time perception for autobiographical memories. The results indicated that people currently experiencing PTSD indexed greater estimates of trauma memory duration. Study 9 examined the effect of perception of control on duration estimates. The results suggested that perceived lack of control over negative stimuli was associated with longer duration estimates. Together, the findings supported and extended existing models of time perception, and demonstrated that time distortions appear to be influenced by arousal, emotional valence, and avoidance reactions.

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CHAPTER 1

AN INTRODUCTION TO INFORMATION PROCESSING IN POSTTRAUMATIC STRESS DISORDER

Introduction to Posttraumatic Stress Disorder

Psychological reactions to trauma have been the focus of study for many years (van der Kolk, Weisaeth, & van der Hart, 1996a). Although trauma reactions were traditionally classed as transient responses to extreme stress, emerging evidence indicates that initial reactions can lead to longer-term pathological responses (Shalev, 1996). Accordingly, by 1980 the diagnosis of Posttraumatic Stress Disorder (PTSD) was introduced in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1980). PTSD is defined as an anxiety disorder that involves reexperiencing, avoidance, and hyperarousal symptoms that must be present for at least one month after exposure to a potentially traumatic event. The lifetime incidence of PTSD in the population is thought to be between 8-20%, with rates in women almost twice as high than in men (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995).

Although a small proportion of people exposed to trauma develop chronic PTSD, most people experience an array of initial posttraumatic stress-type reactions in the initial period after trauma exposure. These reactions include emotional numbing or detachment (Harvey & Bryant,1998; Roemer, Orsillo, Borkovec, & Litz, 1998; Thompson et al., 2004; van der Kolk & Saporta,1991), a reduction in awareness of one's surroundings (Harvey & Bryant,1999), derealization (Davidson, Kudler, Saunders, & Smith, 1990; Harvey & Bryant,1999; McNally, 2003a), depersonalization (Birmes, Arrieu, Payen, Warner, & Schmitt, 1999; Harvey & Bryant,1999; Noyes & Kletti, 1977; Sims & Sims, 1998),

dissociative amnesia (Carlson, Armstrong, Loewenstein, & Roth, 1998; van der Hart, Brown, & Graafland, 1999; Vermetten & Bremner, 2000), intrusive recollections (Ehlers, Hackmann, & Michael, 2004; Ehlers et al., 2002; Hackmann, Ehlers, Speckens, & Clark, 2004; McMillen, North, & Smith, 2000; van der Kolk & Saporta,1991; Witvliet, 1997), avoidance (Basoglu, SalcIoglu, & Livanou, 2002; Creamer & Kelly, 1997; Davidson et al., 1990; McNally, 2003b), and hyperarousal (Chen et al., 2001; Foa & Riggs, 1995; Schell, Marshall, & Jaycox, 2004; van der Kolk,1996). Although such acute stress reactions occur frequently in the weeks following trauma, there is also strong evidence that the majority of these symptoms are temporary and that most people are able to readjust to their experience (Blanchard et al., 1997; Brom, Kleber, & Hofman, 1993; Hickling, Blanchard, Buckley, & Taylor, 1999; Johnsen, Eid, Lovestad, & Michelson, 1997; Ursano, Fullerton, Kao, & Bhartiya, 1995).

Despite the natural remission of most symptoms, there is suggestive evidence that the experience of some symptoms within one month of the trauma is a predictor of PTSD (Harvey & Bryant, 1998). To account for the diagnostic gap between symptoms occurring before one month and those occurring after, a new diagnosis of Acute Stress Disorder (ASD) was introduced in the 1994 edition of the Diagnostic and Statistical Manual of Mental Disorders (Koopman, Classen, Cardena, & Spiegel, 1995). This diagnosis also allows differentiation between those people experiencing temporary stress responses and those at risk of developing long-term PTSD (Koopman et al., 1995). Current DSM-IV

criteria for ASD requires the individual to have encountered an event involving actual or possible death or serious physical injury, with a response that involved either helplessness, horror, or intense fear. Three or more of five dissociative symptoms must be present, such as emotional numbing, derealization, depersonalization, reduced awareness of one's environment, or amnesia. In addition, the person must also reexperience the event (e.g., in the form of flashbacks, dreams, intrusions), show marked avoidance of trauma reminders (e.g., people, places, conversations), and experience increased arousal (e.g., insomnia, poor concentration, heightened startle response). The disturbance must occur within 4 weeks of the trauma, lasting a minimum of 2 days and no longer than 4 weeks. The key construct underpinning ASD is that dissociative responses during the trauma subsequently limit processing of trauma memories, thereby leading to PTSD (Harvey & Bryant, 2002; Spiegel, Koopman, & Classen, 1994).

The Role of Peritraumatic Dissociation

Peritraumatic dissociation involves dissociative reactions that occur during or shortly after the traumatic event. These acute reactions present as alterations in an individual's sense of time, person, and place, which interrupts normal information processing (van der Kolk et al.,1996b). During trauma, dissociation often presents as a subjective sense of time speeding up, slowing down, or standing still (Marmar, Weiss, & Metzler, 1998). Other common peritraumatic dissociative symptoms include disorientation

and confusion (Noyes & Kletti, 1977), changes in pain perception (Hillman, 1981), tunnel vision, body image distortion, and out-of-body experiences (Siegel, 1984).

Janet (1907) proposed that traumatic experiences that were incongruent with existing cognitive schema led to dissociated awareness. He argued that although this splitting of traumatic memories from awareness led to a reduction in distress, there was a loss of mental functioning because mental resources were not available for other processes. Janet proposed that adaptation following trauma requires integrating the fragmented memories of the trauma into awareness. These views have enjoyed renewed attention in recent times, and represent the basis for the current notion that trauma-induced dissociation is a pivotal trauma response (Nemiah, 1989; van der Kolk & van der Hart, 1989). In terms of peritraumatic dissociation, this perspective posits that dissociating trauma memories and associated affect leads to ongoing psychopathology because the critical memories cannot be accessed and emotional processing is impaired (Marmar et al., 1994). There is much support for this claim, with evidence that dissociation at the time of trauma predicts subsequent PTSD (Birmes et al., 2001b; Bremner & Brett, 1997; Koopman, Classen, & Spiegel, 1997; Solomon & Mikulincer, 1992; Tichenor, Marmar, Weiss, Metzler, & et al., 1996).

Despite this finding, there are large numbers of people who do experience peritraumatic dissociation and do not develop enduring difficulties relating to their trauma. For example, Barton and colleagues (1996) found that dissociation at the time of trauma

was not indicative of poorer outcome at 6 month posttrauma in motor vehicle accident survivors. Similarly, dissociative responses in rape victims were not correlated with the later development of posttraumatic stress disorder in female victims of rape (Dancu, Riggs, Hearst-Ikeda, Shoyer, & Foa, 1996). Further, prospective studies of ASD have indicated that although people with ASD are highly likely to develop subsequent PTSD, the majority of people who develop PTSD do not display initial ASD in the month after trauma (see Bryant, 2003). Therefore, there is suggestive evidence that dissociative reactions to trauma may not necessarily be a maladaptive response to trauma that leads to psychopathological conditions (Ludwig, 1993; Marmar et al., 1998; McNally, 2003b).

Overall, there is much confusion about the role of dissociation in trauma response. McNally (2003a) argues that the DSM-IV definition of dissociation as "a disruption in the usually integrated functions of consciousness, memory, identity, or perception of the environment " (American Psychiatric Association, 1994, p. 477) is in itself "abstract, global, and vague" (McNally, 2003a, p. 785). He argues that if an enhanced understanding of acute responses to trauma is to be achieved, researchers need to consider the constituents of dissociation separately, rather than grouping diverse symptoms under one global classification. Similarly, Bryant (2007) has argued that, "to delineate the exact mechanisms involved in peritraumatic dissociation, the construct of peritraumatic dissociation needs to be deconstructed into more specific factors" (p. 188). This thesis aims to systematically

investigate one common psychological phenomenon often considered as dissociative, time distortion, to further understand acute responses to trauma.

Time Perception

Time is a notion used to structure and organize past and present experience. Over an individual's life span various experiences are accrued, which are arranged and preserved in time to form a unique identity. Subjective distortions of time create serious threat to the organization and orientation that helps maintain an awareness of time and space, as well as a sense of self (van der Hart & Steele, 1997).

Time distortion is a commonly reported, yet understudied, peritraumatic dissociative symptom. Traumatic time distortion occurs in two major ways. First, it may be experienced while the trauma is occurring, where the individual experiences a sense of time slowing down, speeding up, or standing still. For example, aviators in stressful combat situations commonly report the experience of time moving slowly, particularly at the point of ejection from the aircraft (Carson, 1983). Second, time distortion occurs when the traumatized individual perceives that they are experiencing the event again, as in a "flashback". The reexperiencing of events within a flashback may also be perceived as slowing down, speeding up, standing still, or any combination of these. An excerpt from the autobiography of an Israeli woman who was burned in an attempted 'honour' killing attempt illustrates this experience: "Twenty-five years later I see these images again as if time has stopped. They are the last images of my life in my village in the West Bank.

They play out in slow motion, like films on television. They come back before my eyes constantly. I'd like to erase them as soon as the first one appears but I can't stop the film playing… Suddenly I felt a cold liquid running over my head and instantly I was on fire. Now it was like a movie that had been speeded up, images racing" (Souad, 2003, pp. 93-94). Accounts such as these highlight the presence of time distortion at crucial traumatic moments, and point to its possible role in the development and maintenance of PTSD.

Several studies have documented a relationship between the subjective experience of time distortion and the later development of PTSD. For example, Ursano and colleagues (1999) found that peritraumatic dissociative symptoms, including time distortion, increased the risk of subsequent PTSD by almost a factor of 5. Shalev and colleagues (1996) found that time distortion and derealization predicted the development of PTSD 6 months later. Although this relationship has been observed, there is little understanding about the reasons for the relationship. In fact, despite the large numbers of people who report trauma-related time distortion (Hillman, 1981; Marshall, Orlando, Jaycox, Foy, & Belzberg, 2002; Noyes & Kletti, 1977; Sterlini & Bryant, 2002; Ursano et al., 1999), accounts of this phenomenon remain largely theoretical. Very little experimental work has been performed on mechanisms underpinning time distortion in pathological trauma responses.

Cognitive Models of Time Perception

Theories of time perception have been developed from various backgrounds, including psychophysics (Allan & Kristofferson, 1974; Eisler, 1975), perception (Allan,

1979; Eisler, 1975; Fraisse, 1984), animal behaviour (Gibbon, 1977; Killeen & Fetterman, 1988), development (Levin & Zakay, 1989), neuropsychology (Chaston & Kingstone, 2004), and cognition (Block, 1990; Jones & Boltz,1989; Ornstein, 1969). These perspectives offer a range of theoretical interpretations. While this thesis recognizes the descriptive and explanatory value of these backgrounds, cognitive theories are the main focus of this thesis given their potential to address a range of symptoms underlying pathological trauma response.

Cognitive models recognize that duration estimates are considerably influenced by cognitive variables, such as attention and memory capacity, and that these variables can affect the way an event is experienced in real-time, as well as how the event is encoded and stored in memory for later retrieval. Contemporary cognitive models that have been influential in the field of psychological time include Ornstein's storage size hypothesis (1969), Block's contextual change hypothesis (1978), Zakay and Block's (1997) attentional-gate model and Jones and Boltz's (1989) model of dynamic attending. These models will be the focus of this review. Before reviewing these models in more detail, this chapter will first provide a more general overview of the two major ways of perceiving time: prospective and retrospective duration judgments.

Prospective and Retrospective Duration Judgments

In their meta-analytic review, Block and Zakay (1997) distinguished between prospective and retrospective duration judgments. Retrospective judgments presume that

during an event, temporal cues are inadvertently encoded. When subsequent time estimation is required, appropriate temporal information is extracted from memory. The results of the meta-analytic review indicated that memory-based models, such as Ornstein's storage size hypothesis and Block's contextual change models, most effectively account for retrospective temporal estimations, where the individual is only informed of the requirement to estimate time once the event is over. Prospective judgment refers to when an individual is aware of the need to estimate time in advance, and allocates attentional resources to the task. As such, attentional models, such as Zakay and Block's (1997) attentional-gate model, best explain prospective judgments (Block & Zakay, 1997). In their review of 20 experiments in this area, Block and Zakay (1997) concluded that prospective judgments are generally judged to be longer, and are less variable, than retrospective time judgments.

Retrospective Models of Time Perception

Ornstein's (1969) storage size hypothesis is used to account for judgment of duration equivalent to or greater than 10 seconds. This view considers perceptions of interval duration to be a function of the amount of space it occupies in memory. A more complex event will require more space in memory. An increase in the amount of space occupied is thought to result in an increased temporal estimation. There has been mixed support for this view. While some studies (Hogan, 1975; Schiffman & Bobko, 1974) have

found that perceived duration increases as a function of stimulus complexity, others have reported contradictory findings (Loftus, Schooler, Boone, & Kline, 1987; Poynter, 1983).

To overcome some of the shortcomings of the storage size hypothesis while explaining memory-based temporal judgments, Block (1978) proposed a contextual change model. According to this hypothesis, the individual uses an internal cognitive device to tally the number of contextual changes (e.g., moods, thoughts, cognitive processes) that occurred during a given time period, and uses a complexity output to estimate the duration. It is assumed that estimated duration increases as a function of increased complexity.

Prospective Models of Time Perception

All prospective models of temporal information processing consider that humans possess a timing mechanism, such as a clock or pacemaker, that emits a pulse or 'click' at a certain rate (Grondin, 2001). There are a number of similar temporal information processing models (Gibbon & Church, 1984; Killeen & Weiss, 1983; Treisman, 1963; Zakay & Block, 1997), however, Zakay and Block's (1997) attentional-gate model is described here because of its consideration of the influence of arousal on time perception – a factor associated with the experience of trauma.

Zakay and Block's (1997) model consists of the following components: pacemaker, attentional gate, switch, cognitive counter, working memory store, and reference memory. They purport that a hypothetical pacemaker emits pulses at a given rate, and this rate is affected by only one variable: level of arousal. Higher levels of arousal are thought to

increase the pacemaker's pulse rate and result in an overestimation of temporal duration. If an individual focuses attention solely on time, pulses travel uninterrupted to the cognitive counter, which are then reassigned to a working memory store. Conversely, if an individual is engaged in another task or if the processing demands are too great, the pulse rate is reduced (and may stop altogether), and this interruption to the pacemaker's pulse rate is thought to result in fewer pulses reaching the cognitive counter, and subsequent underestimation of the target duration. Given a fairly neutral task, such as categorizing cards into groups (where arousal should be fairly low), the general finding from prospective paradigms is that people tend to underestimate the actual time that has elapsed (Block & Zakay, 1997; Chaston & Kingstone, 2004; Grondin, 2001).

Other Influential Models of Time Perception

In addition to physiological arousal, body temperature has also been linked with time perception by way of a temperature-sensitive timing mechanism. Weardon and Penton-Voak (1995) reviewed 14 studies in this area. They found that in the majority of experiments, time estimates tended to increase with rises in body temperature above normal, while they deceased when body temperature was lowered below normal. Weardon and Penton-Voak argued that temperature and arousal states are linked, in that higher body temperature may increase level of arousal, while gradual cooling decreases arousal. They further proposed that if participants are suddenly exposed to a painfully cold situation, they

might experience cold stress, which would increase arousal as opposed to the effects of gradual cooling.

Jones and Boltz (1989) proposed a unique model of time estimation – the dynamic attending approach – that differs from other attentional models in the sense that it does not involve any central timing mechanism. They propose that events in and of themselves have temporal structure to a degree, and the way in which an individual attends to these naturally occurring cues will influence time estimation. They proposed two attending modes for events of high and low structural coherence: a future-oriented attending mode and an analytic attending mode, respectively. Events with high structural coherence afford some degree of familiarity and predictability, and allow the individual to forecast when the event will end. Events with low structural coherence on the other hand, offer low predictability as to their time course, and the individual is unable to generate expectancies as to when they might end. While using the analytic attention mode, a processing strategy is employed that involves grouping or categorizing information according to perceptual details to make sense of events.

These models, though necessarily useful in their consideration of attentional factors on time judgments, fail to take into account the role of emotions and the valence of the stimuli in information processing (Angrilli, Cherubini, Pavese, & Manfredini, 1997). This omission is surprising given the large amount of evidence indicating that emotions are

involved in the cognitive processing and appraisal of information (Damasio, 1994; Grey, Holmes, & Brewin, 2001; Mathews & MacLeod, 1994, 2002).

Distorted Time Perception and Development of Pathological Trauma Responses

Although there is extensive clinical evidence to suggest that time disturbances are common in trauma survivors (Baker et al., 2003; Hunter, Phillips, Chalder, Sierra, & David, 2003; Noyes & Kletti, 1977; van der Hart & Steele, 1997; van der Kolk et al.,1996b), experimental evidence in traumatized populations is relatively scarce. Some evidence for the role of attention, emotional valence, and arousal on time perception that has relevance to traumatic experience has been obtained from non-clinical samples. These variables are considered to be particularly relevant to trauma, since extensive evidence has been documented indicating that trauma survivors have an attentional bias towards threat and away from positive or neutral stimuli (Bryant & Harvey, 1997; van der Kolk et al.,1996b), and that hyperarousal is common after trauma (Nixon & Bryant, 2003; Sterlini & Bryant, 2002; van der Kolk & Saporta,1991). Given the involvement of strong emotional reactions in traumatic experience, it is proposed that emotional valence will have particular relevance to both attention and arousal, and subsequently the way that the event is temporally encoded.

Angrilli and colleagues (1997) performed an experiment on non-clinical undergraduate students to investigate the effect of attention, arousal, and affective valence on time perception. Stimuli comprised slides standardized for arousal and affective valence

in the following combinations: pleasant low-arousal, pleasant high-arousal, neutral, unpleasant low arousal, unpleasant high arousal. Heart rate was used as a measure of attention, while skin rate conductance was used to differentiate high and low arousal. The results of their study indicated that in general, level of attention was greater for negative slides than positive slides. Existing models of attentional temporal judgment predict that increased attentional demands should cause the estimated duration to be underestimated. In contrast to this prediction, the experiment indicated a significant difference between duration estimates at low and high levels of arousal for the slides of 2 second duration. At levels of low arousal participants tended to underestimate negative low arousal slides and overestimated positive low arousal slides – consistent with expectations. However, at high levels of arousal participants tended to underestimate positive slides and overestimate negative slides – inconsistent with expectations.

Angrilli and colleagues proposed that the aversive nature of the negative slides activated an avoidance response in the initial stages of processing. It was argued that participants' inability to escape the perceived threat led to protracted duration and the projection time was overestimated. For the slides of 4 and 6 seconds duration, underestimation of slide duration at high levels of arousal was observed, which was consistent with attentional models. The authors suggested that in the initial stages of processing, a dual process mechanism might be activated, which is responsible for action tendency. If the stimulus is pleasant, an approach response may be activated and the

duration is perceived as being too brief. If the stimulus is unpleasant an avoidance response may be activated, and the duration perceived as lasting too long. Angrilli and colleagues concluded that for 'long' durations, the attentional model tends to be most appropriate. To date, it is unknown how time is perceived over longer periods at even higher levels of arousal, such as those experienced during a traumatic event.

It is evident that attention, arousal and emotional valence play a role in the encoding, processing, and retrieval of trauma memories. It is also possible that time distortion may influence defensive or adaptive strategies to avoid or approach. However, while prevailing theories of time perception are highly descriptive, they provide little explanation of the role of arousal and affective valence on time judgments, particularly in traumatized populations. While current models attribute the impact of available attention to overestimation or underestimation of time, they do not describe the processes through which such disruption occurs. There is suggestive evidence that time distortions may serve an avoidance function (Angrilli et al., 1997). In order to investigate this possibility in more detail, it is necessary to study factors associated with avoidance behaviours and time distortion.

Methodological Issues

An evaluation of the existing literature has illuminated a number of methodological issues which bear upon this research program. This chapter will now review these issues.

Retrospective vs. Prospective Time Estimation

Models of time perception have identified two ways of perceiving time: as it is passing, and once the period has ended. This program of research will employ both paradigms to investigate the effect of different trauma-related variables that have been implicated in time distortions. The use of both methodologies is important since trauma survivors may either prospectively notice the temporal distortion as the trauma is actually happening, also referred to as 'time-in-passing', or after it has ended, also known as 'time-in-memory' (Hancock & Weaver, 2005; Roeckelein, 2000). This will allow systematic investigation of trauma-related time distortions from both perspectives in order to further understand the qualitative and quantitative aspects of the phenomenon.

Experimental Stimuli

Ethical concerns preclude exposing participants to situations which involve a life-threatening level of danger. Therefore, many of the experiments in this program of research will manipulate factors that prevailing theories posit influence time distortion (e.g., arousal, temperature). Hypnosis will also be used as a means of modifying factors which would normally be difficult to control outside the laboratory. Hypnosis is employed because of its demonstrated capacity to modify subjective experiences through suggestion. This thesis also uses populations who are naturally exposed to conditions that provide an opportunity to study time distortion. Specifically, novice skydivers experience marked arousal during their skydiving, and allow for controlled assessment of time perception.

Finally, since it is extremely difficult to index peoples' perception of time as the trauma is occurring, participants' memory of event duration post trauma is studied in trauma-exposed populations with and without PTSD.

Within the laboratory setting, the program of research will utilize simple stimuli, such as auditory tones to measure basic time perception and allow an uncontaminated investigation of variables, such as physiological arousal and body temperature. Many experimental stimuli commonly employed in trauma research contain inherent confounds with regard to the estimation of time. For example, having participants talk about an event in order to induce arousal requires a higher level of cognitive processing, which could interfere with the task of timekeeping. Further, it is difficult to control the complexity and number of contextual changes of such stimuli, so the use of simple auditory stimuli will allow the manipulation of variables of interest without engaging cognitive processes that compete with and interfere with time estimation.

Sample Selection

Psychopathology and contextual factors, which cannot be controlled, often confound interpretation of findings in clinical populations. Accordingly, this thesis will conduct a proportion of the research program in laboratory-based studies using non trauma-exposed controls, to allow experimental factors to be controlled and manipulated in participants who do not suffer posttraumatic stress reactions. In order to index time perception associated with pathological trauma response, it is also necessary to examine

trauma-exposed individuals with varying levels of post-trauma adjustment by comparing individuals without PTSD to those with a current diagnosis of PTSD. Finally, it is necessary to investigate the effect that recovery from PTSD may have on the perception of time to determine whether time is perceived more accurately as PTSD symptomatology subsides.

Implications for the Program of Research

The issues that have been outlined in this review highlight that existing models of time perception do not adequately specify the mechanisms underpinning peritraumatic time distortion. Further, the relationship of time distortion to postraumatic adjustment has not been adequately clarified by existing models or empirical work. Existing models acknowledge the role of memory factors, attention to time, and level of arousal on time perception, but fail to take into account the role of emotions in this information processing. Existing models also fail to explain the adaptive functions of time distortions and its possible role in our survival. This thesis represents a theoretically driven program of research that aims to further understand the implications of experiencing peritraumatic time distortions generally, and to elucidate the factors associated with trauma-related time distortions.

Chapter 2 presents two studies that aim to provide a general understanding of the nature and prevalence of traumatic time distortions in clinical samples. Study 1 is a prospective study, which explores the experience of time slowing at the time of the trauma

and the development of PTSD 3 months later. Although this relationship has been demonstrated in previous studies, Study 1 attempted to provide a more robust measure of the relationship by conducting a multi-site study involving a very large sample. Study 2 reports a more detailed study of the correlates of time distortion in a sample of chronic PTSD participants. Together, these studies set the platform for the thesis by outlining the incidence and nature of time distortion following a traumatic experience.

A major aim of this thesis is to systematically examine mechanisms that mediate time distortion characteristic of trauma survivors at different levels of posttrauma adjustment. As discussed in this chapter, there is evidence that increased levels of arousal lead to overestimations of time. Research to date has employed various methods to induce arousal, such as tempo, click trains, and caffeine. With regard to research on trauma-related time distortions, such methods have limited applicability. Accordingly, Chapter 3 of this program of research investigates the possible role of arousal and physiological states in trauma-related time distortions using methods that are more aligned with the processes involved in trauma responses. Study 3 employed a hyperventilation procedure to induce physiological symptoms similar to panic states to investigate the effect of increased arousal on time perception. Recognizing that laboratory-induced stress is limited, Study 4 studied novice skydivers who experience extreme arousal and fear to investigate the relationship between arousal and fear in a more ecologically valid setting. Study 5 investigated the proposal that increased body temperature leads to time distortion by using hypnosis in a

non-clinical sample to modify subjective body temperature. Across these three experiments, Chapter 3 tests the proposition that arousal and temperature will directly influence time perception.

There is suggestive evidence in non-clinical populations that at high levels of arousal, time distortions may serve an approach/avoidance mechanism (Angrilli et al.,1997). This evidence further suggests that the emotional valence of the stimuli plays an important role in whether it will be perceived as being too short (if the stimuli is positive) or too long (if it is negative). Chapter 4 describes studies that focus on the interactive influence of emotional valence and arousal. Although previous research has pointed to the role of arousal in time distortion, little research has addressed how arousal influences emotional events. Studies 6a and 6b compared participants with varying degrees of trauma exposure and symptomatology on duration estimates of a visual slideshow, standardized for emotional valence (negative, neutral), complexity, and contextual change. Study 7 investigated whether physiological arousal could mediate or moderate the effects of emotional valence on time perception. Specifically, physiological arousal was either increased using a hyperventilation procedure, or reduced using a slow-breathing technique, before exposing participants to a negative or neutral version of a slideshow. In Study 8, the perceived length of time was estimated when participants spoke about emotional autobiographical events (positive, negative, and neutral) to further investigate the effect of emotional valence on time perception. Three distinct groups of participants (PTSD,

recovered PTSD, trauma-exposed controls, and non trauma-exposed controls) were compared in order to investigate the effect of current and prior PTSD on the accuracy of time perception.

Chapter 5 aimed to establish other potential factors inherent in traumatic situations that may be implicated in overestimation or underestimation of time. Study 9 investigated how the perception of being able to control or being unable to control the duration of an aversive stimulus affects time perception. Participants were led to believe that they could control the projection time of stressful stimuli and it was investigated whether aversive stimuli was perceived to last longer if participants believed they had no control over the duration of exposure.

This initial chapter has established some of the essential theoretical and empirical issues that must be taken into account in an analysis of traumatic time distortions. This program of research aims to methodically examine the variables isolated in this review, and to critically examine existing theories in consideration of the findings obtained. This thesis turns now to the experimental studies conducted in this research program.

CHAPTER 2

A CLINICAL PROFILE OF TIME DISTORTION

STUDY 1 AND STUDY 2

General Introduction

Longitudinal research on time distortion has broadly focused on peritraumatic dissociative symptoms as a whole. There is a noticeable dearth of research focusing specifically on the role of time distortion alone in the development and maintenance of PTSD. Further, no studies to date have examined what was actually happening during the trauma when the time distortion occurred. To this end, this thesis commences with a prospective study that maps the relationship between time distortion and PTSD, and a qualitative investigation of factors associated with time perception in the context of a traumatic experience.

Study 1

A Prospective Study of Time Distortion

Introduction

Study 1 was designed to test the proposal that the experience of time slowing during a traumatic event is associated with the development and maintenance of PTSD. Specifically, the study involved interviewing people about their current posttraumatic stress reactions shortly after trauma exposure and their perception of time during the trauma. To determine the relationship between traumatic time distortion and later PTSD, these individuals were interviewed about their posttraumatic stress symptoms again three months after the trauma. In accordance with the proposal that time distortion impedes processing of the event and prevents resolution of posttraumatic stress symptoms, it was predicted that the experience of time slowing would be associated with initial posttraumatic stress symptoms and would be predictive of symptoms three months later.

Method

Participants

Randomized admissions to five level 1 trauma centres across Australia were recruited into the study between April 2004 and April 2006. The study was approved by the Research and Ethics Committee at each hospital. Inclusion criteria for the study were no brain injury or mild traumatic brain injury (MBTI: American Congress of Rehabilitation

Medicine, 1993) aged between 18 and 70 years of age; could understand and speak English proficiently; and had a hospital admission of greater than 24 hours following traumatic injury. Individuals were excluded from the study if they had moderate or severe head injury; were currently psychotic or suicidal; were non Australian visitors, cognitively impaired, or under police guard. Individuals who met entry criteria were randomly selected using an automated, random assignment procedure, stratified by length of stay. There were 655 participants approached, and 463 agreed to participate. Participants comprised 353 males and 110 females of mean age 37.97 years (SD = 14.11). The mean Injury Severity Score (ISS) was 11.59 (SD = 7.92). Participants spent an average of 13.21 (SD = 13.82) days in hospital and 75 participants had an ICU admission. Types of injury included transport accidents (n = 309); falls (n = 65), assaults (n = 34), work related accidents (n = 30), and other injuries (n = 26). Individuals who refused to participate in the current study did not differ from participants in terms of gender [χ^2 = .1.10, df = 1, ns], days in hospital [$t(653) = .07$, ns], ISS [$t(653) = .74$, ns], or presence of an ICU admission [$\chi^2 = 2.71$, df=1, ns]. Refusers were younger than participants [$t(653)=3.25$, $p=.001$].

Three months after the initial assessment, attempts were made to contact all participants by telephone. In total, 432 participants took part in the 3 month follow-up assessment, which represented 92% of the initial sample. The 3 months follow-up sample included 328 males and 104 females with mean age of 37.95 years (SD = 14.25). Participants and non-participants in the 3-month follow-up assessment did not differ on

days in hospital [t(462) = 0.17, ns], injury severity [t(462) = 0.60, ns], or age [t(462)=0.62, ns]. Participants who participated (M = 22.55, SD = 19.04) had lower initial CAPS-2 scores than non-participants (M = 30.47, SD = 22.81), [t(462) = 3.00, $p < .005$].

Measures

Clinician Administered PTSD Scale-2: Posttraumatic stress was assessed by clinical interview using the Clinician Administered PTSD Scale-2 (CAPS-2; Blake et al., 1995). The CAPS-2 is a structured clinical interview that indexes the 17 symptoms described by the DSM-IV PTSD criteria. Each symptom is rated on a five-point scale in terms of the severity and frequency of the symptom in the past week.

Hospital Anxiety and Depression Scale: Anxiety and depression was assessed using the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983). The HADS is a 14-item self-report measure designed to assess anxiety and depression in general hospital settings. Somatic symptoms are omitted to avoid confounding with physical injury. It has sound discriminant validity, internal consistency and a stable factor structure (Bjelland, Dahl, Tandgen Haug, & Neckelmann, 2002). HADS items are scored on a 4-point scale (0 = “not at all”, 4 = “most of the time”).

Physical Reactions Scale: Panic reactions were assessed using the Physical Reactions Scale (PRS; Falsetti & Resnick, 1992), which is a 16-item self-report measure of DSM-IV panic symptoms. Participants were asked to rate each item on a 6-point scale (0 = “not at all", 5 = “extremely”) how severely they experienced each panic symptom at the time of the trauma.

Time Distortion Scale: Time distortion was indexed using item 3 of the Peritraumatic Dissociative Experiences Questionnaire (PDEQ; Marmar, Weiss, & Metzler, 1997). The PDEQ is a 10-item inventory that indexes a range of dissociative responses that occur during a traumatic experience; the PDEQ possesses strong concurrent validity with measures of posttraumatic stress and general tendencies for dissociation (Marmar et al., 1997). Item 3 asks the respondent to rate on a 5-point scale (1 = "not at all true", 5= "extremely true") the extent to which they believe that, "My sense of time changed – things seemed to be happening in slow motion." Endorsement of this item was defined as a score of at least 3 ("somewhat true").

Procedure

Following written informed consent obtained while the patient was an inpatient, mental health clinicians administered a series of questions about the traumatic injury. These included any loss of consciousness (in minutes), and level of pain that participants experienced during the traumatic injury (1 = "not pain", 10 = "extreme pain"). In addition, data were obtained from medial records concerning resting heart rate at time of admission, age, type of traumatic injury, and injury severity score. Participants were then assessed for posttraumatic stress symptoms using the CAPS-2. Participants then completed the HADS, PRS, and time distortion question.

Results

Participant Characteristics

Full summaries of statistical analyses are presented in Appendix 1. There were 15 (3.2%) participants who met criteria for ASD in the initial assessment. There were 38 (9.5%) who met criteria for PTSD at the 3-month assessment. In terms of time distortion, 89 (19.2%) participants reported time slowing down during their traumatic experience.

Time Distortion and Psychopathology

Table 2.1 presents the mean participant characteristics according to time distortion experience. Multiple comparisons indicated that participants who reported time slowing down scored higher on acute CAPS, HADS-Depression, HADS-Anxiety, PRS, as well as 3-month CAPS, HADS-Depression, and HADS-Anxiety.

The number and proportion of participants who reported time slowing and subsequently developed PTSD at 3 months is presented in Table 2.2. Participants reporting time slowing were more likely to meet criteria for PTSD at 3 months than participants without time slowing, Fisher exact test, $p = .001$; odds ratio, 3.20 [95% confidence interval, 1.61 – 6.40]. A sense of time slowing as a predictor of PTSD at 3 months had a sensitivity of 42% and specificity of 93%.

Table 2.1

Mean Participant Characteristics According to Time Distortion Experience

Variable	Time Slowing		No Time Slowing			
	M	*SD*	*M*	*SD*	*t*	
Age	38.18	13.30	37.92	14.31	0.16	
Days Since Injury	119.83	1175.07	2.15	89.18	0.93	
Pain	13.80	6.70	14.19	6.32	0.48	
Heart Rate	85.55	17.22	84.65	18.17	-0.42	
Loss of Consciousness[a]	0.84	1.33	0.66	1.12	-1.11	
Acute CAPS-2	35.08	24.64	20.95	17.41	-5.09	***
Acute HADS-A	6.89	4.75	5.03	3.82	-3.31	***
Acute HADS-D	6.21	4.67	5.11	3.84	-2.26	*
PRS	27.26	17.28	14.67	12.88	-6.35	***
3-Month CAPS-2	26.77	19.37	16.21	14.08	-4.82	***
3-Month HADS –A	7.80	5.39	5.33	4.22	-3.63	***
3-Month HADS-D	6.23	5.33	4.45	3.76	-2.50	**

Note. [a]Loss of Consciousness measured in minutes. CAPS-2 = Clinician Administered PTSD Scale-2, HADS-A = Hospital Anxiety and Depression Scale – Anxiety Subscale, HADS-D = Hospital Anxiety and Depression Scale – Depression Subscale, PRS = Physical Reactions Scale, *$p < .05$, **$p < .01$, ***$p < .001$.

Table 2.2

Time Slowing and PTSD Development

	Time Slowing	No Time Slowing
PTSD	16 (4%)	23 (6%)
No PTSD	66 (16%)	304 (74%)

Discussion

The results of Study 1 support the proposal that the experience of time slowing during trauma is associated with current and ongoing symptoms of posttraumatic stress. More specifically, the results indicated that the experience of time moving in slow motion during the trauma is not only associated with more severe acute PTSD symptoms, depression, anxiety, and higher physical reactions, but is also associated with a threefold increase in the probability of having PTSD three months later. This is consistent with the proposal that the experience of time slowing impedes accurate processing of the trauma memory, and henceforth impedes trauma recovery.

Study 2

Time Slowing and the Experience of Trauma

Introduction

The Introduction of this thesis highlighted the approach/avoidance hypothesis of time slowing (Angrilli et al., 1997) This hypothesis posits that people will overestimate time when they are dreading an unwanted outcome. Study 2 was designed to identify specific factors associated with the experience of time slowing down. In particular, this study interviewed people about their current posttraumatic stress reactions and their perception of time during the trauma, and what was happening at the time they experienced the distortion. In accordance with the proposal that time distortion is an avoidance mechanism that protects the individual, it was predicted that the experience of time happening in slow motion would be associated with anticipating an unwanted outcome and the experience of pain.

Method

Participants

Participants with and without PTSD were recruited from the Traumatic Stress Clinic at Westmead Hospital. The sample comprised 26 participants (17 females, 9 males) of mean age 40.00 years (SD = 12.15) following motor vehicle accidents (n = 14) and assaults (n = 12). Inclusion criteria included (a) involvement in a non-sexual assault or motor

vehicle accident, (b) proficiency in English, (c) aged between 16 and 65 years, and (d) no diagnosis of organic mental disorder, psychosis or substance abuse.

Procedures

Following written informed consent, participants were administered the CAPS, Beck Anxiety Inventory (BAI; Beck & Steer, 1990) and Beck Depression Inventory II (BDI-II; Beck, Steer, & Brown, 1996). Participants were also interviewed concerning time perception during their traumatic event. Specifically, they were asked to indicate if time slowed down, hastened, or was perceived normally. Additionally, they were interviewed about their experiences during the traumatic event. Specifically, they were asked whether during the traumatic experience when the time distortion occurred they (a) "were anticipating what was about to happen", or (b) "were in pain". They were asked to write a short comment on the specific qualitative aspects of these experiences.

Results

Participant Characteristics

Full summaries of analyses are reported in Appendix 1. Sixteen participants met criteria for PTSD and 10 did not. Twelve participants reported that time slowed down during the traumatic event and 14 reported that it did not. Mean participant characteristics according to whether they reported time slowing are presented in Table 2.3. Participants who reported slowed time had higher BAI scores than those who did not report slowed time.

Table 2.3
Mean Participant Characteristics According to Time Distortion Experience

Variable	Time Slowing		No Time Slowing		
	M	*SD*	*M*	*SD*	*t*
Age	41.71	11.67	37.25	11.35	-0.99
Months Since Trauma	29.21	30.77	53.42	60.92	1.31
CAPS-2	56.43	35.52	31.67	26.95	-1.98
IES-Intrusion	22.50	11.29	18.50	3.92	-1.16
IES-Avoidance	20.29	11.28	16.92	6.26	-0.92
BDI-II	26.79	18.45	18.08	8.58	-1.50
BAI	33.36	18.84	14.08	6.61	-3.36**

Note. BAI = Beck Anxiety Inventory, BDI-II = Beck Depression Inventory-II, CAPS-2 = Clinician Administered PTSD Scale-2, IES-A = Impact of Events – Avoidance, IES-I = Impact of Event Scale – Intrusions. *$p < .01$.

Trauma Experiences and Slowed Time

Table 2.4 presents the number and proportion of participants who reported slowed time and anticipation of the outcome of the traumatic event. Chi square analysis indicated that participants who anticipated the outcome of the traumatic event were more likely to have reported slowed time than those who did not anticipate the outcome, [$\chi^2(N = 26) = 4.47$, $p < .05$].

Table 2.4

Time Slowing and Anticipation of Outcome

	Time Slowing	No Time Slowing
No Anticipation	6 (23%)	10 (39%)
Anticipation	8 (31%)	2 (7%)

Table 2.5 presents the number and proportion of participants who reported slowed time and experience of pain during the traumatic event. Chi square analysis indicated that participants who experienced pain were no more likely to have reported slowed time than those who did not experience pain [$\chi^2(N = 25) = 1.92$, ns].

Table 2.5

Time Slowing and Experience of Pain

	Time Slowing	No Time Slowing
No Pain	9 (36%)	4 (16%)
Pain	5 (20%)	7 (28%)

Discussion

The results of Study 2 support the proposal that the experience of time slowing during trauma is associated with anticipating a negative outcome. This finding is consistent with the approach/avoidance hypothesis proposed by Angrilli and colleagues (1997). Anticipating a negative outcome was associated with time seeming to move too slowly, as the individual may have wished to avoid the event, but because they could not, it was perceived as lasting too long. This finding highlights the role of negative expectations of event outcome and time perception.

General Discussion

The convergent findings of Studies 1 and 2 provide support for the proposal that time distortion is linked to anticipation of an aversive outcome, initially proposed by Angrilli and colleagues (1997). Study 1 demonstrated that experiencing time moving in slow motion at the time of the trauma was related to higher levels of initial posttraumatic stress, anxiety, and depression. Furthermore, the results indicate that the experience of traumatic time distortion was highly predictive of the development of PTSD three months later. These findings accord with those of Shalev and colleagues (1996), who found that traumatic time distortion was associated with the development of PTSD 6 months later. The higher levels of traumatic stress experienced by individuals who reported time distortion indicates that the highly aversive nature of the trauma is associated with the experience of time slowing. The greater level of distress endured by these participants may have led to the perception of the situation as lasting too long. This experience in turn may contribute to less than optimal processing of the event, and maintenance of PTSD over time. Alternately, the perception of the event lasting longer may be linked to other variables, such as arousal or dread of the outcome, which in turn led to the subsequent PTSD.

Study 2 linked the experience of time moving in slow motion with anticipation of impending circumstances. This finding provides further evidence that time slowing is associated with awareness of aversive outcomes. The awareness of the threatening

outcome may lead to an exaggerated perception of time because the desired avoidance does not occur, and this contributes to the perception of time slowing. It is worth noting that some comments from participants pointed to potential adaptive functions of this time slowing. First, time slowing may motivate the individual to hasten their behaviour to escape the situation more quickly. This was demonstrated in qualitative comments made by one participant: "I knew I had to get out quickly, but could not do it as quickly as I would have liked. So while I was still in the danger zone where I could have been killed, it seemed to take forever but in reality was only around 40 seconds. It seemed like 5 minutes". Further, time slowing may also provide the individual with more perceived time, allowing them to consider ways to problem-solve the traumatic experience. The desire for problem-solving is reflected in the comments made by another participant: "I felt that I was trapped in circumstances beyond my control and that I was alone. I could not do anything to help the injured person and I looked (for) information to make any real judgment or decision concerned with potential consequences". These two examples demonstrate potential functions served by time distortions.

Implications for the Program of Research

The studies presented in this chapter highlight the role of time distortion in the development and maintenance of PTSD, and provide support for the avoidance function served by traumatic time distortions. The results also implicate anticipation of event

outcome as playing a role in traumatic time distortions. These issues will be addressed in more detail in subsequent chapters of this thesis.

CHAPTER 3

TIME DISTORTION AND AROUSAL

STUDIES 3, 4 & 5

General Introduction

Pacemaker theories of time perception suggest that time judgments are influenced by level of arousal, a factor commonly associated with traumatic experience. Pacemaker theories assume an internal timing mechanism, such as a clock or pacemaker, which emits a pulse or 'click' at a certain rate (Grondin, 2001). According to Zakay and Block (1997), higher levels of arousal increase the pacemaker's pulse rate and result in an overestimation of temporal duration or the experience of clock time moving more slowly than subjective time. Several studies have shown that level of arousal can affect time perception. Arousal levels have been manipulated in a number of ways, including having participants ingest caffeine (Gruber & Block, 2003), listen to click trains (Penton-Voak, Edwards, Percival, & Wearden, 1996), tones (Wearden, Pilkington, & Carter, 1999), or ambient noise varying in intensity (Delay & Mathey, 1985). These studies provide valuable empirical evidence for the role of arousal in time perception; however, such benign methods of inducing arousal have limited application to the study of trauma-induced time distortions, because they do not replicate the stronger arousal changes, such as panic states, that manifest during a traumatic event.

Psychological stress has also been linked with changes in body temperature in human (Falcon-Lesses & Proger, 1930; Petersdorf & Beeson, 1961; Sheldon, 1959; Ziegler & Cash, 1938). As detailed in Chapter 1, temperature change has also been associated with the phenomenon of time distortion, by way of a temperature sensitive mechanism linked

with the pacemaker (Wearden & Penton-Voak, 1995). Accordingly, the studies presented in this chapter further explore the relationship between arousal, temperature, and time perception in clinical, non-clinical, and analogue samples using more ecologically valid means to understand trauma-related time distortions.

Study 3

The Effect of Hyperarousal on Time Perception

Introduction

Physiological arousal in trauma is often reflected in panic-like symptoms (Nixon & Bryant, 2003). In order to simulate arousal changes that occur during a traumatic event, the present study employed a hyperventilation provocation test (Hornsveld, Garssen, & van Spiegel, 1995), which requires participants to breathe rapidly for a prolonged period. This induction was administered on account of its ability to induce symptoms similar to panic states, such as rapid heart beat, dizziness, trembling, hot flashes, parasthesias, tension, sweating, and breathlessness (Nixon & Bryant, 2005). Participants were required to estimate time during an initial stage of the experiment, and then estimate time during a subsequent period prior to which half of the participants hyperventilated for 3 minutes. It was predicted that participants in the hyperventilation condition would overestimate time compared to participants who did not hyperventilate. Furthermore, it was predicted that increases in time estimates would be associated with arousal-induced reactions secondary to the breathing induction.

Method

Design

A 2 (Group: Low Arousal, High Arousal) x 2 (Time: Prior to Induction, After Induction) repeated measures design was employed, with a repeated measure on the second factor.

Participants

Participants were 106 first-year Psychology students from the University of New South Wales who participated in the study for course credit. There were 60 females and 46 males of mean age 20 years (SD=3.81).

Measures

Participants were administered a modified version of the PDEQ (Marmar et al., 1997) and the PRS (Falsetti & Resnick, 1992) to index dissociative and physical reactions during the 3 minute breathing induction. The PRS indexes panic attack symptoms and was used to index level of arousal during the hyperventilation task.

Procedure

There were two stages in this experiment ('Stage 1' and 'Stage 2'). Participants were required to listen to a 4 second 440 Hz tone and reproduce the duration of the tone in both stages. The 4 second tone was created using Audacity 1.2.4b software, which was then converted to a wav file and played to the participant on a Pentium 4 IBM compatible laptop using Windows Media Player. The timing apparatus comprised a timer (measuring

to 100th of a second) connected to a University Audio Generator (model UAG-22D) and speakers. Connected to these components was a handheld device with a button, which when pressed, caused the audio generator to emit a 440 Hz tone. The timer indexed how long the button was pressed. Participants were assigned either to a 'low arousal' or 'high arousal' condition. At Stage 1, all participants completed the PDEQ and then listened to the 4 second tone and immediately reproduced it. Stage 2 occurred approximately 40 minutes later. At this stage, participants in the 'low arousal' condition were instructed to sit quietly for 3 minutes and to breathe normally. The Stage 1 procedure was then repeated. Participants in the 'high arousal' condition hyperventilated for 3 minutes by following instructions on an audiocassette that prompted them to breathe deeply every 2 seconds. They then repeated the Stage 1 procedure. All participants then completed the PDEQ and PRS with regard to how they felt during the 3 minute breathing induction.

Results

Manipulation Check

Full summaries of statistical analyses are presented in Appendix 2. To check that the hyperventilation task achieved the desired arousal, planned comparisons were conducted between groups on the PDEQ and PRS. Table 3.1 presents the mean levels of dissociative experiences (PDEQ) and physical reactions (PRS) for each group. The 'high arousal' group indexed significantly greater levels of dissociative experiences [$F(1, 104) = 63.94$, $p = <.01$] and physical reactions [$F(1, 104) = 76.12$, $p = <.01$] than the 'low arousal'

group. This finding suggests that the hyperventilation task was successful in markedly increasing arousal.

Table 3.1

Breathing Induction Reactions

	PDEQ	PRS
Low Arousal	11.81 (1.78)	3.15 (2.05)
High Arousal	18.83 (6.14)	13.17 (8.10)

Note. PDEQ = Peritraumatic Dissociative Experiences Questionnaire, PRS = Physical Reactions Scale.

Tone Duration Estimates

A difference score was calculated for each participant by deducting the second estimate of tone duration from the first. Planned comparisons between arousal conditions indicated that participants in the high arousal condition made longer reproductions of the tone at Stage 2 (M = -.34, SD = .69) than participants in the low arousal condition (M = -.04, SD = .71) [$t(53) = 2.260$, $p < .05$]. Further, greater difference scores (of time estimations) were associated with increases in PDEQ scores (r = -.34, p = .01) and PRS scores (r = -.42, $p < .01$) for the hyperventilation group, but not for the 'low arousal' group (r = -.02, $p > .01$; and r = -.07, $p > .01$, respectively).

Discussion

Consistent with predictions, participants in the high arousal group made longer reproductions of the tone following hyperventilation. Further, these differences were associated with a greater number of reported physical reactions and dissociative experiences during the hyperventilation task. These findings provide support for pacemaker theories. These data suggest that increasing arousal by hyperventilating led the pacemaker to 'click' at a faster rate, so that at the end of a given period, time is overestimated. These findings accord with other studies that have found that increasing arousal led to significant increases in duration estimates (Delay & Mathey, 1985; Gruber & Block, 2003; Penton-Voak et al., 1996; Wearden et al., 1999).

Apart from PDEQ scores at Stage 1, measures of pre-existing emotional states were not obtained, and therefore it is not possible to determine the potential influence of individual difference factors on time perception. Additionally, the differences observed in this experiment, although significant, were rather small. Hornsveld and colleagues (1995) recommend a minimum of 3 minutes of hyperventilation to elicit physical symptoms. Future research should consider the effect of longer periods of hyperventilation on time perception. Additionally, there is a need to investigate factors leading to time distortions in more ecologically valid, naturalistic settings. Accordingly, Study 4 describes an experiment conducted in a naturalistic setting involving novice skydivers, to further investigate the role of extreme arousal on time perception.

Study 4

How Time Flies: Emotional Valence, Arousal and Time Perception in a Naturalistic Setting

Introduction

Retrospective judgments are often more akin to reports of traumatic time distortions, as the trauma-exposed individual commonly becomes aware that time perception has changed during or after the event. Using a retrospective paradigms, Loftus, Schooler, Boone, and Kline (1987) found that participants overestimated the duration of a stressful video of a bank robbery. In contrast, Kellaris and Mantel (1996) found no difference between time judgments in participants who were administered either relaxing or arousing music. Gruber and Block (2003) found that caffeine-induced arousal did not influence retrospective time judgments. One of the difficulties in previous studies of arousal in time perception is that ethical constraints preclude inducing extreme stress in laboratory settings. To overcome this difficulty, Study 4 employed a naturalistic high stress condition involving novice skydivers who were participating in their first jump. Novice skydivers experience extreme arousal and can experience dissociative experiences (Sterlini & Bryant, 2002). Skydivers' levels of fear and excitement were indexed prior to the jump. Soon after landing estimates of fear and excitement during the jump were re-assessed, as well as estimates of how long they thought their experience lasted. Following Angrilli et

al. (1997), it was predicted that temporal estimates would increase with fear and decrease with excitement.

Method

Participants

The sample comprised 76 participants (37 females, 39 males) of mean age 28 years (*SD* = 9.6) who were undertaking their first skydive.

Procedure

After providing written informed consent, participants completed a demographics questionnaire and were asked to rate their level of fear for the upcoming jump (0 = “not at all frightened”, 100 = “very frightened”), and level of excitement for the upcoming jump (0 = “not at all excited”, 100 = “very excited”). Participants were not told that they would be asked to estimate how long they perceived their experience to last. Participants proceeded immediately to the plane, were taken to 14,000 feet, and completed their jump. Within 30 minutes of returning to the ground, participants were asked to rate how frightened they were during the jump (0 = “not at all frightened”, 100 = “extremely frightened”), and how excited they were during the jump (0 = “not at all excited”, 100 = “extremely excited”). They were also asked to estimate (in minutes) how long they thought their entire experience (“from the moment you began putting on the skydiving gear to the moment you landed”) lasted.

Results

Of the 76 original participants, 1 outlier was excluded and 12 had missing data. On average, participants reported moderate fear prior to (M = 35.81, SD = 26.22) and during (M = 44.33, SD = 31.35) the jump. In contrast, participants tended to report high levels of excitement prior to (M = 80.95, SD = 17.06) and during (M = 87.78, SD = 16.63) the jump. On average, participants estimated that preparing and making the skydive took 35.22 minutes (SD = 29.45).

Based on the number of variables, the level of significance was adjusted to .01. How long participants thought the event lasted was positively and significantly correlated with increased fear prior to the jump (r = .48, p < .01) and during the jump (r = .54, p < .01), and negatively correlated with increased excitement prior to the jump (r = -.32, p < .01). How long participants thought the event lasted was marginally negatively associated with increased excitement during the jump (r = -0.09, p < .05).

Discussion

Consistent with the initial hypothesis, increased levels of fear prior to and during the skydive were associated with increased estimates of event duration. These results suggest a relationship between the extent to which one fears skydiving and how long the experience was perceived to last. This interpretation accords with the proposition of Angrilli et al. (1997) that situations that are avoided are perceived with time overestimation because the outcome is more strenuously anticipated. This model has relevance to

observations that people report exaggerated time estimates during traumatic experience (Hillman, 1981; Marshall et al., 2002; Noyes & Kletti, 1977; Ursano et al., 1999), who may exaggerate time because they are anxiously awaiting the end of the ordeal. The prediction that excitement would be associated with underestimates of time perception was also supported in terms of pre-dive excitement and marginally in terms of post-dive excitement. This pattern accords with Angrilli et al.'s (1997) approach/avoidance model of time perception. Not only does fear lead to increased time perception, the more excited one is about an imminent event, the shorter it seems to last.

Measures of pre-existing emotional states were not obtained, and it is therefore difficult to ascertain how trait mood states may have influenced time perception. Additionally, the time taken to accomplish specific components of the skydive was not objectively measured, and therefore inferences about absolute overestimation or underestimation of time cannot be made. Despite these limitations, the present study provides supportive data for the avoidance model of time perception. Although skydiving is not a traumatic experience, both trauma survivors and skydivers engage in retrospective biases in time estimation under conditions of high arousal, and therefore skydivers represent a useful population to study models of time perception associated with trauma.

Study 5

The Influence of Hypnotically-Induced Temperature Change on the Perception of Time

Introduction

Understanding the mechanisms underpinning time distortion is difficult in the context of trauma because the many extraneous factors cannot be controlled. Accordingly, there is a need to test current theories of time distortion under controlled experimental conditions. Since Hoagland's (1933) observations of his wife's altered perception of time during a fever last century, researchers have sought to further understand the role of temperature change in human timing. These investigations have largely focused on whether time perception is dictated by an internal clock, or a pacemaker, which emits a pulse or a 'click' for each unit of time. There is evidence to support the idea that humans possess such a mechanism (Malapani & Fairhurst, 2002; Penton-Voak et al., 1996; Treisman & Brogan, 1992; Treisman, Cook, Naish, & MacCrone, 1994; Treisman, Faulkner, Naish, & Brogan, 1990), and further, that it may be sensitive to temperature change (Baddeley, 1966; Bell, 1965; Hoagland, 1933; Wearden & Penton-Voak, 1995). Past research in this area has employed an assortment of methods to induce temperature change, many of which by today's standards are considered highly unethical. For example, to change body temperature, researchers have subjected participants to hot rooms (Bell & Provins, 1963; Lockhart, 1967), cold rooms (Lockhart, 1967), warm water (Bell, 1965),

vapour suits (Fox, Bradbury, Hampton, & Legg, 1967), heating helmets (Hancock, 1993), and cold water immersion (Bell, 1975). In a review of all published data on time perception and body temperature, Wearden and Penton-Voak (1995) observed that time estimates tend to increase with rises in body temperature above normal, while they decease when body temperature is lowered below normal. Body temperature theories are particularly relevant to trauma survivors. Extreme responses to trauma, such as intense fear, helplessness and horror, lead to psychological stress and there is evidence to suggest that such stress may cause elevations in core body temperature (Oka, Oka, & Hori, 2001).

In order to further investigate this phenomenon while circumventing ethical constraints, Study 5 used hypnosis as a means of instigating temperature change. Hypnosis has the proven capacity to alter subjective body temperature (Maslach, Marshall, & Zimbardo, 1971; Piedmont, 1983; Roberts, Kewman, & MacDonald, 1973). It is not uncommon for people to underestimate the duration of the hypnotic experience (Bowers, 1979; Naish, 2003). These findings are consistent with attentional models of time perception, which predict that the more engaged an individual is in the task, the fewer attentional resources are available for time keeping, and time is underestimated. Participants have also been shown to distort time for discrete intervals within the hypnotic experience (Dyer, Kurtz, & Strube, 1999; Kurtz & Strube, 2003; Mozenter & Kurtz, 1992), however, the direction of such changes in time judgment is less clear for discrete periods. Mozenter and Kurtz (1992) used a prospective paradigm to examine the effect of

hypnotizability (high, low, and simulator) and hypnotic condition (wake and hypnotic) on time estimation under hypnosis. They also included a simulator condition to determine whether beliefs about contextual demands altered participants' duration estimates. Three trials were performed in which participants judged and verbally estimated the duration of four "short" randomly presented intervals (30, 60, 120, and 240 seconds) that were filled with white noise. Mozenter and Kurtz predicted a significant two way interaction between hypnotizability and hypnotic condition across the four intervals. There was partial support for this hypothesis for two of the time intervals (60 and 120 seconds), with high hypnotizables making longer duration estimates during hypnosis, and no effect observed in low hypnotizables and simulators. Results for the three groups in the waking state were not significant, consistent with expectations and other research in hypnosis (Jasinski, 1987; Tebecis & Provins, 1974).

Intervals that are 'filled' with stimuli, such as white noise, have been shown to be judged as longer than 'empty' ones (Goldfarb & Goldstone, 1963). In order to extend Mozenter and Kurtz's (1992) study, Dyer, Kurtz, and Strube (1999) used a prospective paradigm with both empty and filled intervals to rule out the effect of stimulus presentation. Dyer and colleagues reduced the number of target intervals to three (30, 60, and 120 seconds), increased the number of trials from three to five, and employed a more robust measure of hypnotizability susceptibility (the Stanford Hypnotic Susceptibility Scale: Form C). Following on from Mozenter and Kurtz (1992), Dyer and colleagues predicted

significant two way interactions between hypnotizability and hypnotic condition across all three intervals for both filled and empty periods. Furthermore, they predicted a significant main effect for filled versus empty intervals, with participants generally overestimating time more in the filled intervals. Interestingly and contrary to expectations, a two-way interaction was found in women only. Dyer and colleagues acknowledge that this difference may have simply been chance variability, as there were no significant differences between males and females in their hypnotizability scores. In addition, the second hypothesis predicting a difference between "empty" and "filled" intervals was not supported. Dyer and colleagues concluded that perhaps the use of white noise was not essentially different to that of an "empty" period, as participants in both conditions reported similar experiences with regard to cognitive processing during the intervals (e.g., letting their thoughts wander).

In contrast to the studies by Mozenter and Kurtz (1992) and Dyer, Kurtz, and Strube (1999), which found partial support for the effects of hypnotizability and condition on time judgment, Kurtz and Strube (2003) found no effect for hypnotizability, but found partial support for hypnotic condition. In their study, participants in the hypnosis condition tended to underestimate time, consistent with predictions from experimental work on attentional models (Block, 1990). The most noticeable difference between these studies is that the latter did not employ a repeated measure on condition, thereby minimizing the effect of implicit expectations on responding. Interestingly, using this method Kurtz and Strube

found that participants tended towards duration estimates in the opposite direction – underestimating interval duration as opposed to overestimating. In contrast to Kurtz and Strube (2003), Mozenter and Kurtz (1992) and Dyer, Kurtz, and Strube (1999) used a repeated measure on the non-hypnotic/hypnotic condition, meaning that people were exposed to the same time judgment task both when they were hypnotized and when they were not. According to Stam and Spanos (1980), one of the risks of using a repeated measure on the hypnotic condition is the implicit suggestion that participants are supposed to show more of a particular response while hypnotized than when awake, or in this case, lead to overestimations of intervals while hypnotized.

Study 5 investigated the role of hypnotizability (low vs. high), hypnotic context (non-hypnotized vs. hypnotized), and the effect of temperature change (cold vs. hot) on short 'filled' periods (3, 6, and 9 seconds), with a repeated measure on temperature change. Based on the findings of previous hypnosis studies, significant three-way interactions between hypnotizability, hypnotic context, and temperature induction in their effect on duration estimates were predicted. Specifically, it was predicted that highly hypnotizable participants in the hypnosis condition would significantly overestimate the total duration of three time periods following a suggestion to increase their body temperature, and would underestimate the total duration of three time periods following a cooling suggestion.

Method

Design

A 2 (Hypnotizability: High, Low) x 2 (Condition: Hypnosis, Wake) x 2 (Induction: Warming/Cooling, Cooling/Warming) x 2 (Tone Order: 6s, 3s, 9s or 3s, 9s, 6s) design was implemented. The dependent variable was the combined total of the estimate for the 3 tones.

Participants

Thirty-three high (13 males and 20 females, M age = 19.48 years, SD=5.02) and 34 low (14 males and 20 females, M age = 20.06 years, SD=5.15) undergraduate psychology students from the University of New South Wales participated in the study in return for course credit. Participants were preselected for this experiment on the basis of their scores on a 10-item tailored version of the Harvard Group Scale of Hypnotic Susceptibility, Form A (HGSHS:A; Sheehan & McConkey, 1979; Shor & Orne, 1962) and on a 10-item tailored version of the Stanford Hypnotic Susceptibility Scale, Form C (SHSS:C; Hilgard, Crawford, Bowers, & Kihlstrom, 1979; Weitzenhoffer & Hilgard, 1962). High hypnotizable participants scored 7–10 on the tailored HGSHS:A (M = 8.74, SD = 0.92) and 8–10 on the tailored SHSS:C (M = 8.40, SD = 0.93); low hypnotizable participants scored 0–3 on the tailored HGSHS:A (M = 1.18, SD = 0.92) and 0–3 on the tailored SHSS:C (M = 1.10, SD = 1.03).

Measures

Harvard Group Scale of Hypnotic Susceptibility, Form A: This measure consists of a 10-item tailored version of the Harvard Group Scale of Hypnotic Susceptibility, Form A (Sheehan & McConkey, 1979; Shor & Orne, 1962). This adaptation is widely used for group administration, and is subjectively scored.

Stanford Hypnotic Susceptibility Scale, Form C: This measure consists of a 10-item tailored version of the Stanford Hypnotic Susceptibility Scale, Form C (Hilgard et al., 1979; Weitzenhoffer & Hilgard, 1962). This scale involves difficult hypnotic items to more effectively differentiate between participants high or low in hypnotizability. Both scales were used to determine levels of hypnotizability in order to preselect high and low hypnotizable participants for the study.

Procedure

Participants initially sat in a comfortable, high-backed armchair. Following written informed consent, participants were administered the SHSS:C induction procedure, and then administered the SHSS:C suggestions of hand lowering, finger lock, age regression, and mosquito hallucination. The hypnotist then gave a deepening suggestion, and then induced temperature change (cooling and warming were counterbalanced) using a scripted suggestion. The 'warming' suggestion was as follows:

> "Now as you sit there, relaxed and comfortable, I want you to notice something interesting happening. You will notice yourself getting warmer. That's right, you

> are becoming warmer and warmer. With every breath you let out, your whole body is becoming much hotter than it was. You might be surprised how hot you are becoming… in your head, in your chest, and even in parts of your body that you haven't noticed… Take a moment and just notice how hot it feels in here…. It's like the heating has been turned up and you nearly feel like sweating…. Feel how hot your body is becoming…"

Alternatively, the cooling suggestion was as follows:

> "Okay, now as you sit there, relaxed and comfortable, I want you to notice something else happening. You will notice yourself getting colder. That's right, you are becoming colder and colder. With every breath you let out, your whole body is becoming much colder than it was. You might be surprised how cold you are becoming… in your head, in your chest, and even in parts of your body that you haven't noticed… Take a moment and just notice how cold it now feels in here…. It's like the cooling has been turned on and you nearly feel like shivering…. Feel how cold your body is becoming…"

The hypnotist waited 10 seconds, and then said (for the warming suggestion) "Now on a scale of 1 to10, where 1 means "very cold" and 10 means "very hot", can you tell me how hot you feel right now?" For the cooling suggestion the hypnotist asked "Now on a scale of 1 to10, where 1 means "very hot" and 10 means "very cold", can you tell me how cold you feel right now?" After recording the rating, the hypnotist then instructed "Now as

you sit there, I want you to listen to some brief tones, and I want you to tell me how long you think they last. Just estimate how long each goes for." Three tones of differing lengths, presented in two fixed random orders (6, 3, 9 seconds/ 3, 9, 6 seconds) were used instead of one longer tone, in order to circumvent expectancy effects. Each tone was created using Audacity 1.2.4b software before being converted to a wav file and played to the participant, one at a time, on a Pentium 4 IBM compatible laptop using Inquisit 2.0 software. Following the presentation of each tone, the participant was asked "How long did that last?", and the hypnotist recorded the response. The hypnotist then administered the suggestion for the opposite temperature suggestion, and repeated the procedure using the previously alternate tone order. Finally, the hypnotist cancelled the temperature change suggestion and terminated the hypnosis session.

Results

Manipulation Check

Full summaries of statistical analyses are presented in Appendix 2. As a manipulation check, correlations were performed between HGSHS:A and SHSS:C scores, and ratings of how warm or cold participants felt. There were strong significant positive correlations between HGSHS:A scores and how warm ($r = .48$, $p < .001$) or cold ($r = .43$, $p < .001$) participants felt, and SHSS:C scores and how warm ($r = .52$, $p < .001$) or cold ($r = .51$, $p < .001$) participants felt. These correlations indicated that those participants higher

in hypnotic susceptibility experienced greater subjective changes in body temperature than those lower in hypnotic susceptibility.

Temperature Induction

Prior to testing the major hypothesis, the duration estimates for the three time periods (totalling 18 seconds) were combined to form one total score. Overall, there was no effect of order of temperature induction. Receiving either the warming or cooling suggestion first did not influence duration estimates for the warming condition [t (56.21) = -1.43, p > .05], or the cooling condition [t (72) = .16, p > .05]. On average, participants reported moderate warmth during the warming procedure (M = 6.20, SD = 1.24) and moderate coolness during the cooling procedure (M = 6.33, SD = 1.44). Order of temperature induction did not influence how warm [t (72) = -1.45, p > .05] or cold [t (72) = .22, p > .05] participants felt.

Tone Duration Estimates

Tone duration estimates are presented in Table 3.2. A 2 (Hypnotizability) x 2 (Hypnotic Condition) x 2 (Temperature Induction) repeated measures ANOVA indicated significant main effects for Hypnotizability [F (1, 69) = 7.51, p < .01] and Hypnotic Condition [F (1, 69) = 9.57, p < .005]. There was also a significant three-way interaction effect between Temperature Induction, Hypnotizability, and Hypnotic Condition, Wilks' Lambda = .94, [F (1, 69) = 4.63, p = .035]. Post-hoc comparisons using repeated measures ANOVA on high and low hypnotizable participants separately indicated a significant

interaction effect between Temperature Induction and Hypnotic Condition for high hypnotizable participants, Wilks' Lambda = .86, [F (1, 34) = 5.65, p < .05]. A paired-samples t-test revealed highs who were hypnotized made longer estimates of the tones following the warming suggestion compared to the cooling suggestion,[t (16) = 2.10, p = .05].

Table 3.2

Mean Tone Duration Estimates

Hypnotizability	Context	*n*	*M*	*SD*
		Warming		
High	Hypnotic	17	30.94	16.18
Low	Hypnotic	19	21.89	9.14
High	Nonhypnotic	19	20.42	5.99
Low	Nonhypnotic	18	17.47	2.57
		Cooling		
High	Hypnotic	17	24.45	8.48
Low	Hypnotic	19	21.24	7.48
High	Nonhypnotic	19	21.47	5.95
Low	Nonhypnotic	18	17.36	3.04

Discussion

Highly hypnotizable participants during hypnosis made longer estimates of the tones following the warming induction. The subjective experience of an increase in body temperature significantly altered the perception of time, leading to longer duration estimates. This finding is consistent with previous research on body temperature and time perception, which has found that elevating body temperature above normal leads to acceleration of the pacemaker, thereby leading people to overestimate how much time has elapsed (Bell, 1965; Hoagland, 1933; Wearden & Penton-Voak, 1995).

Interestingly, although high hypnotizable participants in the hypnosis condition significantly overestimated the duration of the tones following the warming induction compared to the cooling induction, time estimates for these participants were also found to increase after the cooling induction, but to a lesser degree. One possible explanation of this finding is that the stimuli used were intervals that were filled with a tone. There is evidence to suggest that filled intervals are judged to be longer than empty intervals (Goldfarb & Goldstone, 1963). It is possible that 'filling' the estimated period with a tone altered the factors that influence time estimation.

These findings have relevance to time distortions commonly reported by trauma survivors. Depending on the nature of the traumatic event, core body temperature may be changed directly by the source of threat (e.g., fire), or as a result of the physical action the individual engages in response to the stressor (e.g., running away). In addition,

psychological distress due to emotional responses to the event, such as fear, helplessness, and horror, may cause elevations in core body temperature (Oka et al., 2001), resulting in the perception that time is passing by too slowly because of the effect of elevated body temperature, and consequently, arousal on the pacemaker, and a desire for the experience to end.

The main limitation of this study is that actual changes in body temperature were not measured. As such, it is impossible to determine the extent to which the duration estimates observed in the high hypnotizable participants during hypnosis were due to actual changes in temperature with an effect on pacemaker output, or if the observed effects were largely due to subjective changes in body temperature. Future research should measure a range of psychophysiological indices, including both temperature and arousal, to further clarify the role of temperature change on time perception, and the factors that mediate or moderate time distortions.

These limitations notwithstanding, Study 5 implicates temperature change in the development of time distortions. The use of hypnosis represents a valuable means of inducing subjective temperature change, and provides a valid method of understanding time perception under controlled conditions.

General Discussion

The convergent findings of the studies presented in this chapter bear application to reports of distorted time perception commonly observed in trauma survivors (Hillman, 1981; Marshall et al., 2002; Noyes & Kletti, 1977; Ursano et al., 1999). The experience of time slowing in trauma may occur because the level of physiological arousal or temperature due to psychological distress has increased, thereby causing the pacemaker to pulse at a faster rate. This increase in pacemaker activity leads to overestimations of time. For example, the fight or flight response becomes activated in times of perceived danger, which in turn may cause body temperature to increase (Oka, et al., 2001). The pedestrian who leaps out of the path of a wayward vehicle may report that the whole event seemed to last forever because of the effect that increased body temperature has on accelerating the internal clock. This may lead time to be judged as moving more slowly because the individual must then wait for clock time to catch up with subjective time

Implications for the Program of Research

This chapter has detailed studies conducted under a variety of conditions with the objective of indexing the processes associated with how level of arousal and body temperature contribute to time distortions commonly observed in trauma survivors. The observed findings can be accounted for by pacemaker and avoidance theories of time perception. Such experimental endeavours represent a progression towards the development of an empirically-based understanding of trauma-related time distortions.

Beyond the processes of arousal, there is a need for experimental investigation of the role of emotional processes that may mediate how long the trauma is perceived to last. This thesis now turns to investigate the role of emotional valence on time perception.

CHAPTER 4

TIME DISTORTION AND EMOTIONAL VALENCE

STUDIES 6a, 6b, 7, & 8

General Introduction

There is emerging evidence to suggest that the valence of the stimuli plays a role in the perception of time. Most research in this area has utilized prospective paradigms, which assume a pacemaker-accumulator system which keeps track of time units. Emotionally arousing stimuli are thought to have an accelerating effect on the pacemaker, which leads emotional events to be overestimated at the end of a given period (Droit-Volet, Brunot, & Niedenthal, 2004). It has been further proposed that time perception may be an adaptive response, responsible for approach/avoidance tendencies (Angrilli et al., 1997).

To date, very little research into the role of arousal or emotional valence in retrospective judgments exists. An analysis of the few studies that exist in this area reveals conflicting results. Gruber and Block (2003) used caffeine to induce arousal to investigate subsequent effects on retrospective and prospective judgments. While use of caffeine had a significant effect on prospective judgments, no effect was found for retrospective judgments. Loftus, Schooler, Boone, and Kline (1987) required participants to watch a stressful film of a bank robbery, and found that participants overestimated the film's duration. A second experiment reported in the same manuscript presented the bank robbery scenario under low and high stress conditions. It was found that increasing levels of arousal led negatively valenced stimuli to be further overestimated.

In contrast to Gruber and Block's (2003) study, which did not find that increasing levels of arousal resulted in overestimations in time, it is possible that Loftus et al.'s (1987)

significant results could be attributed to the fact that their studies involved emotional stimuli. Given these conflicting findings, the role of arousal and emotional valence in retrospective time judgments requires further research.

Study 6a

The Influence of Emotional Valence on Retrospective Time Judgments in a Non-Clinical Sample

Introduction

To further understand retrospective time judgments and the processes that mediate time distortions, Experiment 6a aimed to investigate whether the duration of emotional material was perceived differently to non-emotional material. A non-clinical sample was used to help to clarify the role that emotional valence plays in normal time perception and in turn elucidate factors that contribute to traumatic time distortions. Recognizing the relevance of the contextual change model to retrospective time estimation (Block, 1978), the current study improved on the Loftus (1987) study by employing stimuli that were standardized for complexity and contextual change, and also including non-emotional control stimuli for comparison purposes. It was expected that participants exposed to negatively valenced emotionally arousing stimuli would overestimate time compared to those exposed to emotionally neutral stimuli.

Method

Design

A single factor between groups design was employed, in which participants were shown either a negative or neutral version of a slideshow.

Participants

Participants were 58 first-year psychology students from the University of New South Wales who participated in return for course credit. There were 37 females and 21 males of mean age 20.17 years (SD = 4.59).

Materials

The stimuli were derived from stimuli compiled by Heuer and Reisberg (1990), and later modified by Cahill and McGaugh (1995). The two versions each consisted of 12 identical slides, except that each was accompanied by different auditory narration. Each slide was accompanied by one narrated sentence. Both stories depicted a mother taking her young son to visit his father who works as a laboratory technician in a local hospital. In the negative version, the boy is caught in an accident, which severely injures him by severing his feet, and he is rushed to the emergency room of the hospital. Surgeons struggle to save the boy's life, and are eventually able to reattach his severed feet. In the neutral version, en route to the hospital the boy observes a minor accident, which captures his attention. At the hospital surgeons rehearse a disaster drill procedure, which involves creating realistic looking injuries on actors to simulate wounded patients. The narrated story was identical for the first 4 slides, and similar for the final 3 slides of both presentations. Although the narrated story for the middle five slides was different in order to create the differing level of emotional arousal, Cahill and McGaugh (1995) were careful to match the two stories for

comprehensibility and complexity, as well as ensuring equivalent grammatical and syntactic sentence structure.

Measures

Participants completed the BDI-II (Beck et al., 1996), and the BAI (Beck & Steer, 1990) to assess levels of depression and anxiety.

Procedure

After providing written informed consent, participants were informed that the study was concerned with "individual differences in how people remember different events". They were not informed that the study was concerned with perception of time, as a retrospective study was employed. Following this, participants completed the self-report measures. Participants were then randomly assigned to either the negative or neutral valence condition, and seated directly in front of a Pentium 4 IBM compatible computer on which the appropriate slideshow was played. They were instructed to watch the slideshow from beginning to end, and that the slideshow would begin once they pressed the spacebar. Participants were informed that upon the completion of the slideshow they would be "asked a few questions about it".

Each slideshow lasted 2 minutes and 45 seconds. Upon completion of the slideshow, participants were required to estimate its duration by selecting from a list of options ranging from 1 minute and 45 seconds to 4 minutes and 0 seconds, and increasing in 15 second increments. Participants were also asked to rate the intensity of emotional

valence for the story on a 9-point scale (–4 = “extremely negative”, +4 = “extremely positive”).

Results

Participant Characteristics

Full summaries of statistical analyses are provided in Appendix 3. Mean participant characteristics as a function of slideshow condition are presented in Table 4.1. Planned comparisons indicated that participants shown the neutral version did not differ from those shown the negative version on age [$t(56) = -.11$, $p > .05$], BDI-II [$t(56) = 1.77$, $p > .05$], or BAI [$t(56) = .94$, $p > .05$] scores.

Table 4.1

Mean Participant Characteristics

Valence	Neutral	Negative
Age	20.10 (4.83)	20.24 (4.41)
BDI-II	11.10 (7.89)	7.69 (6.75)
BAI	10.55 (5.79)	8.86 (7.78)

Note. Standard deviations are presented in parentheses. BAI = Beck Anxiety Inventory, BDI-II = Beck Depression Inventory-II.

Slideshow Duration Estimates

A one-way ANOVA of time estimates indicated that participants shown the negative version (M=183.10, SD=31.15) significantly overestimated the length of the slideshow relative to those shown the neutral version (M = 166.03, SD = 31.29), F(1, 56)=4.30, p <.05. Further, time estimations increased as perceived negativity of the story increased (r = -.31, p < .05).

Discussion

Consistent with expectations, participants who watched the emotionally distressing version of a slideshow perceived it to last longer than participants who were shown the emotionally neutral version. Additionally, the more unpleasant the slideshow was judged to be, the longer it was perceived to last. These findings accord with the approach/avoidance theory of time perception, which posit that the more emotionally unpleasant a stimulus is the more one may wish to avoid it; the inability to avoid the stimulus then leads to judging the event as lasting longer.

Study 6b

The Influence of Emotional Valence on Retrospective Time Judgments in a Clinical Sample

Introduction

Study 6b was designed to investigate the effects of trauma exposure and emotional valence on duration estimates in a clinical sample. Avoidance theories of prospective time perception posit that highly arousing negative events are perceived to last longer than highly arousing positive events (Angrilli et al., 1997) due to the activation of an avoidance mechanism. The relationship between emotional valence and time perception in retrospective judgments is less clear, particularly with regard to how long negative events are perceived to last following exposure to a traumatic event. Following from the significant finding of Study 6a, it was predicted that clinical participants shown the emotionally distressing version of the slideshow would overestimate its duration compared to those shown the emotionally neutral slideshow. Further, it was predicted that there would be a significant interaction between emotional valence and PTSD status, with participants diagnosed with PTSD overestimating the duration of the negative slideshow, compared to trauma-exposed non-PTSD participants.

Method

Design

A 2 (Group: PTSD and trauma-exposed non-PTSD) x 2 (Valence: Negative and Neutral) design was employed.

Participants

The study included 30 PTSD (17 male, 13 female) and 30 trauma-exposed non-PTSD (14 male, 16 female) participants recruited through the Traumatic Stress Clinic at Westmead Hospital. The PTSD groups comprised individuals who had agreed to participate in the experiment prior to short-term cognitive-behavioral treatment at the PTSD Unit. Trauma-exposed non-PTSD participants were recruited by way of an advertisement placed within Westmead Hospital, and at the University of New South Wales. These individuals had never received a diagnosis of nor received treatment for PTSD. All participants were reimbursed $50 in return for their time and travel expenses.

Inclusion criteria for the study were as follows: (a) exposure to a traumatic event involving real or threatened death or serious injury to the self or another; (b) no diagnosis of traumatic brain injury, organic mental disorder, or psychosis; (c) aged between 18-70 years, and (d) proficiency in English. Participants had been exposed to a range of disorders, including motor vehicle accidents (n = 18), physical assault (n = 16), witness to death or serious injury (n = 9), armed robbery (n = 4), falls (n = 2), industrial accidents (n = 2), and other (n = 6).

Materials

The materials comprised of the two slideshows by Cahill and McGaugh (1995), as described in Study 6a.

Measures

Participants were administered the CAPS-2 (Blake et al., 1995) to determine PTSD diagnostic status. Self-report measures that were completed included the IES-Intrusion and IES-Avoidance subscales (Horowitz, Wilner, & Alvarez, 1979), the BDI-II (Beck et al., 1996), and the BAI (Beck & Steer, 1990).

Procedure

The procedure for Study 6b followed the procedure detailed for Study 6a, with the exception that participants were administered the CAPS-2 and IES prior to completing the self-report measures.

Results

Participant Characteristics

Full summaries of statistical analyses are presented in Appendix 3. Mean participant characteristics as a function of group are shown in Table 4.2. Independent samples t-tests were conducted to examine group differences. Groups did not differ significantly on age [$t(57) = -1.30$, $p > .05$] or months since trauma [$t(56) = .91$, $p > .05$].

The PTSD group scored significantly higher than the trauma-exposed non-PTSD group on the combined frequency and intensity of CAPS symptoms [$t(46.54) = -11.44$, $p <$

.001]. The PTSD group also scored significantly higher on IES-Intrusion [t (55) = -6.32, p < .001], IES-Avoidance [t (55) = -9.11, p < .001], BDI-II [t (57) = -6.57, p < .001], and BAI [t (48.19) = -4.82, p < .001].

Table 4.2

Mean Participant Characteristics

	PTSD	Trauma-Exposed Non-PTSD
Age	38.04 (2.36)	33.57 (1.91)
Months since trauma	44.04 (12.21)	59.89 (31.61)
CAPS total	64.96 (4.14)	13.36 (2.40)
IES-Intrusion Subscale	23.39 (1.56)	8.32 (1.65)
IES-Avoidance Subscale	24.39 (1.57)	6.21 (1.33)
BDI-II	29.00 (2.41)	10.50 (2.00)
BAI	26.08 (2.80)	10.96 (1.90)

Note. Standard deviations presented in parentheses. BAI = Beck Anxiety Inventory, BDI-II = Beck Depression Inventory-II, CAPS-2 = Clinician Administered PTSD Scale-2, IES-A = Impact of Events – Avoidance, IES-I = Impact of Event Scale – Intrusions.

Slideshow Duration Estimates

Mean time estimates for each slideshow are presented in Table 4.3. A 2 (Participant Group) x 2 (Slideshow Valence) ANOVA of perceived duration of the slideshows indicated main effects for Slideshow Valence [F (1, 56) = 4.84, p < .05] and Participant Group [F (1, 56) = 8.38, p < .01]. Participants shown the negative version made longer estimates of slideshow duration than those shown the neutral version. The PTSD group made longer estimates of slideshow duration than the trauma-exposed non-PTSD group. Emotionality ratings were significantly negatively correlated with slideshow valence (r = -.45, p < .001).

Table 4.3

Mean Slideshow Duration Estimates

Valence	Neutral	Negative
PTSD	148.00 (30.46)	180.00 (45.36)
Trauma-Exposed Non-PTSD	136.00 (26.27)	142.00 (28.27)

Note. Standard deviations are presented in parentheses.

Discussion

Consistent with expectations, participants shown the emotionally distressing version of the slideshow overestimated the duration, relative to the emotionally neutral version. Unexpectedly, there was also a main effect for trauma group. Participants with a current diagnosis of PTSD overestimated slideshow duration relative to trauma-exposed non-PTSD participants, regardless of emotional valence. The prediction that the PTSD group would further overestimate the duration of the emotionally distressing version compared to the trauma-exposed non-PTSD group was not supported. One possible explanation for this finding is that PTSD participants generally have higher levels of arousal, which in turn, has a stronger effect on the pacemaker. As such, even relatively neutral events may be overestimated because of an accelerated pacemaker effect. In addition, an avoidance response may have been activated due to general negative expectancy predictions of event outcome, even for the neutral version of the story.

The findings presented in Study 6a provide support for the hypothesis that emotionally distressing events are perceived to last longer than emotionally neutral events. Further, this study demonstrated that independent of emotional valence, people with a current diagnosis of PTSD generally overestimate time, compared to trauma-exposed non-PTSD participants.

Study 7

The Influence of Emotional Valence and Arousal on Time Perception in a Non-Clinical Sample

Introduction

Following on from Studies 6a and 6b, Study 7 investigated the effects of arousal on emotional valence, which, as previously demonstrated in Chapter 3, was associated with distortions in time perception. Although the negative version of the slideshow depicted distressing events, this manipulation may not have adequately elevated arousal. To examine this question, either a relaxed or aroused state was induced before showing participants the slideshows. Hyperventilation was considered to be an effective means of inducing arousal because of its known ability to induce symptoms similar to panic states (Hornsveld et al., 1995). Measures of skin conductance levels and heart rate were obtained as manipulation checks because of their capacity to index arousal (Greenwald, Cook, & Lang, 1989). It was hypothesized that increasing physiological arousal through hyperventilation would intensify the effect of valence for the negative slideshow (and lead to greater time overestimation), while relaxation would reduce the effect of valence.

Method

Design

A 2 (Valence: Negative, Neutral) x 2 (Arousal Induction: Relax, Hyperventilate) design was employed.

Participants

Participants were 60 first-year psychology students from the University of New South Wales who participated in return for course credit. There were 34 females and 26 males of mean age 19.78 years (SD = 2.62).

Materials

The materials comprised the two slideshows by Cahill and McGaugh (1995), as described in Study 6a.

Measures

Participants completed the BDI-II (Beck et al., 1996), and the BAI (Beck & Steer, 1990) to assess levels of depression and anxiety. They also completed the PDEQ (Marmar et al., 1997) to assess state dissociation at the beginning of the experimental session. After the breathing induction, they were administered the PDEQ and the PRS (Falsetti & Resnick, 1992) to index dissociative and physical reactions during the 3 minute breathing induction. The PRS indexes panic attack symptoms and was used to index level of arousal during the breathing induction.

Procedure

Following written informed consent, participants were randomly assigned to one of four conditions: Neutral/Relaxation, Neutral/Hyperventilation, Negative/Relaxation, or Negative/Hyperventilation. As a manipulation check, skin conductance levels and heart rate were indexed using Bioview V2.11 equipment (Melbourne, Australia) that was interfaced with a Pentium 4 IBM compatible personal computer and sampled at 2 Hz per channel. Heart rate was recorded using an optical blood flow transducer attached to the earlobe, and the mean SCL (μV) was recorded using Grass 9mm silver/silver chloride electrodes attached to the nondominant finger.

Participants were instructed to sit quietly while the equipment recorded baseline levels for 3 minutes, and then the breathing procedure commenced for a further 3 minutes. In the relaxation condition, participants followed instructions on an audiocassette designed to induce relaxation. It prompted participants to breathe 8 breaths per minute. In the hyperventilation condition, participants followed instructions on an audiocassette prompting them to breathe quickly and deeply for 3 minutes, so that a total of 26 breaths per minute were expelled. Finally, participants were required to remain seated and watch one version of the slideshow. As in Experiment 6a, participants were asked to select how long they perceived the slideshow to last and how emotional they found the story to be. They were also asked to rate how pleasant or unpleasant they found the breathing procedure to be on the 9-point scale used in Experiment 6a.

Results

Manipulation Checks

Full summaries of statistical analyses are presented in Appendix 3. SCL and heart rate during baseline, induction, and the slideshow phases were measured to check that the breathing induction had the desired effect (see Table 4.4)**.** Separate 2 (Condition: Hyperventilation vs. Relaxation) x 3 (Phases: Baseline, Breathing Induction, Slideshow) repeated measures ANOVAs of SCL and heart rate were performed. In terms of SCL, there was a significant main effect for Phase [F (2, 57) = 12.83, p < .001], and a significant Condition x Phase interaction effect [F (2, 57) = 6.24, p < .005]. Participants reported higher SCL during the breathing induction than baseline (p < .001) and the slideshow (p < .001). Whereas participants in the Hyperventilation condition reported greater SCL during the breathing induction than baseline (p < .001), participants in the Relaxation condition reported comparable SCL across baseline and breathing induction. In terms of heart rate, there was a significant main effect for Phase [F (2, 57) = 23.67, p < .001], and a significant Condition x Phase interaction effect [F (2, 57) = 16.30, p < .001]. Participants reported higher heart rates during the breathing induction than baseline (p < .001) and the slideshow (p < .001). Whereas participants in the Hyperventilation condition reported greater heart rates during the breathing induction than baseline (p < .001), participants in the Relaxation condition reported comparable SCL across breathing induction and baseline.

Table 4.4

Skin Conductance Response and Heart Rate Levels

	Skin Conductance		Heart Rate	
Stage	*M*	*SD*	*M*	*SD*
		Relaxation		
Baseline	9.87	5.27	75.88	11.89
Breathing Induction	10.33	6.09	77.51	11.73
Slideshow	10.37	5.81	77.80	11.82
		Hyperventilation		
Baseline	8.47	3.63	75.16	11.11
Breathing Induction	10.37	4.31	87.84	13.79
Slideshow	9.56	3.78	76.35	11.43

Slideshow Duration Estimates

A 2 (Valence: Negative vs. Neutral) x 2 (Condition: Hyperventilation vs. Relaxation) ANOVA of time judgments indicated a significant Valence x Condition interaction effect, F (1, 56) = 5.19, $p < .05$. Figure 1 indicates that whereas participants in the Hyperventilation and Relaxation conditions did not differ in time judgments of the

neutral story, participants in the Hyperventilation condition perceived the negative story to be longer than participants in the Relaxation condition ($p < .05$). As was found in Experiment 6a, time estimations increased as the perceived negativity of the story increased ($r = -.45$, $p < .05$). Additionally, time estimations increased as perceived negativity of the breathing procedure increased ($r = -.32$, $p < .05$).

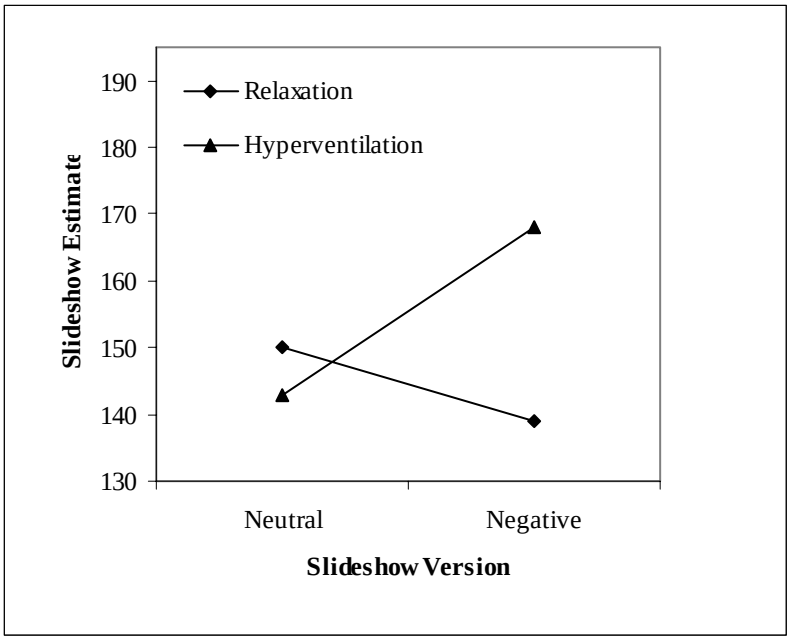

Figure 4.1. Mean slideshow duration estimate of neutral and negative slideshow versions after relaxation or hyperventilation induction

Discussion

Consistent with expectations, participants who were shown the negative version of the slideshow reported higher duration estimates of the slideshow following hyperventilation, compared to those who relaxed prior to watching the emotional version. The association between perceived unpleasantness of the breathing induction and slideshow duration estimate indicates that an unpleasant physiological state intensifies the effect of negative valence on retrospective time judgments.

In the previous two experiments, it was found that people shown a negative stimulus made longer time estimates relative to people who watched a neutral stimulus. Further, the more negative the story was perceived to be, the longer participants perceived it to last. Study 7 found that increasing arousal prior to the negative stimulus led to greater time overestimation, which further supports the proposal that the negativity of the experience is linked to time overestimation. These findings are consistent with previous research that has used prospective designs (Angrilli et al., 1997; Droit-Volet et al., 2004; Loftus et al., 1987). The findings also converge with reports of exaggerated experiences of time during traumatic and stressful events (Marshall et al., 2002; Noyes & Kletti, 1977; Sterlini & Bryant, 2002; Ursano et al., 1999). Emotional valence may influence changes in time perception in variable ways. Consistent with Angrilli at al.'s (1997) avoidance hypothesis, it is possible that participants wished the slideshow to terminate because of its aversive content, and thereby overestimated its duration. This interpretation is also

supported by evidence that event endings that occur later than anticipated lead to temporal overestimations (Jones, Boltz, & Klein, 1993).

It is possible that the present findings could also be accounted for by Ornstein's (1969) storage size hypothesis. The PTSD participants generally made longer estimates of slideshow estimates relative to trauma-exposed non-PTSD participants. It may be argued that due to higher levels of distress in the PTSD sample, the stimuli may have been more salient and memorable for the PTSD participants. If this was so, it is plausible that PTSD participants remembered more about the slideshows, and made an estimate based simply on how much they remembered about the event (Ornstein, 1969). Using the same stimuli that was employed in these studies, Cahill and McGaugh (1995) found that participants remembered more of the negative than neutral version of the slideshow after a 2 week interval. Although memory for the stimuli were not tested in the present study, it is possible that participants remembered more of the negative version than of the neutral version. According to the storage size hypothesis, if more space is occupied in participants' memories then time should be overestimated. However, in the only other study of retrospective time judgments and negative emotional valence, time estimates were not related to the amount of information that people could recall, or the accuracy of those memories (Loftus et al., 1987). Complexity may extend beyond memory for the event. Block's (1978) contextual change model posits that an internal cognitive device tallies the number of contextual changes, and these contribute to time overestimation; it is possible

that the physical changes caused by hyperventilating added to the contextual changes, which led to the slideshow seeming longer than the relaxation condition.

There are several limitations to Studies 6a, 6b, and 7. First, participants' memory for the various components of the slideshow was not objectively measured, and it may be possible that the reason they perceived the negative version to be longer was because they simply remembered more information from that slideshow. Moreover, although participants generally found the negative version of the slideshow negative, it was not comparable to a traumatic event. The hyperventilation induction may not have been powerful enough, and future studies should consider more potent means to induce aversive states. Accordingly, Study 8 of this thesis further investigated the role of emotional valence on time perception, by indexing perception of time for traumatic autobiographical memories.

Study 8

Perceived Duration of Traumatic Autobiographical Memories

Introduction

Study 8 investigated time perception of different emotional events in participants with and without PTSD. Participants from three levels of trauma exposure and symptom level were recruited: PTSD, Recovered PTSD, and Trauma-exposed Non-PTSD. These groups were selected in order to determine baseline levels of time distortion in PTSD, and presence of time distortion at varying levels of posttrauma adjustment. Participants were asked to focus on positive, neutral, and traumatic autobiographical memories, and were required to estimate the duration of their memory. On the basis of avoidance models of time perception (Angrilli et al., 1997), it was predicted that participants who had been exposed to a traumatic event and displayed higher levels of PTSD symptomatology would overestimate how long they focussed on a traumatic memory relative to positive or neutral event.

Method

Design

A 3 (Group: PTSD, recovered PTSD, trauma-exposed non-PTSD) x 3 (Valence: highly negative, highly positive, neutral) design was employed, with a repeated measure on the second factor.

Participants

Participants comprised 21 males and 24 females of mean age 34.22 years (SD = 11.29) who were either trauma-exposed non-PTSD (n = 15), recovered PTSD (n = 15), or PTSD (n = 15). The trauma exposed non-PTSD participants were recruited by advertisement. These participants had never sought treatment for difficulties relating to the trauma. The recovered PTSD participants had previously met diagnostic criteria for PTSD, and had resolved their PTSD. The PTSD participants were currently diagnosed with PTSD.

Measures

Participants were administered the CAPS-2 (Blake et al., 1995) to determine PTSD diagnostic status. Self-report measures included the IES-Intrusion and Avoidance subscales (Horowitz et al., 1979), the BDI-II (Beck et al., 1996), and the BAI (Beck & Steer, 1990).

Procedure

After providing written informed consent, participants were administered the CAPS-2 by a clinical psychologist, following which they completed the self-report measures. All participants were asked to nominate their trauma memory. They then nominated a positive and a neutral event that occurred within 3 years of the traumatic event. Participants were informed that the study was concerned with perception of time. They were seated directly in front of a Pentium 4 IBM compatible personal computer on which

Inquisit 2.0 operated the experiment. Participants read instructions on the monitor that informed them that they would be asked to talk about each memory, one at a time, until the computer instructed them to stop. They were also informed that after the computer indicated that they should stop talking about the memory, they would be asked to estimate how long they had spoken about that memory. In addition, they were instructed that while they were talking they would be required to press the spacebar each time they thought 10 seconds had elapsed. The order of trauma, positive, and neutral memories were counterbalanced. Participants spoke for 60 seconds for each memory. After requiring the participant to estimate how long they had spoken about each memory (in seconds), they provided 9-point Likert scale ratings of the valence (-4 = "extremely negative", 4 = "extremely positive") and emotional intensity (-4 = "no emotional reaction", 4 = "intense emotional reaction") of their memory.

Results

Participant Characteristics

Full summaries of statistical analyses are presented in Appendix 3. Mean participant characteristics are provided in Table 4.5. Oneway ANOVAs indicated that groups did not differ significantly on months since trauma [F (2, 38) = .49, p > .05], months since the positive event [F (2, 38) = .36, p > .05], or months since the neutral event [F (2, 38) = .47, p > .05]. Groups differed significantly in terms of age [F (2, 42) = 4.96, p < .05], total CAPS scores [F (2, 42) = 47.92, p < .001], BDI-II [F (2, 41) = 9.16, p < .01], BAI [F

(2, 40) = 5.87, p < .01], IES-Intrusion [F (2, 41) = 9.48, p < .001], and IES-Avoidance [F (2, 41) = 23.09, p < .001].

Table 4.5

Mean Participant Characteristics

Variable	PTSD		Recovered PTSD		Trauma-Exposed PTSD	
	M	*SD*	*M*	*SD*	*M*	*SD*
Age	31.13	12.32	40.67	10.89	28.87	7.33
Months Since Trauma	58.65	80.03	75.65	55.63	47.31	87.43
CAPS-2	52.20	15.33	17.33	14.18	8.20	8.38
IES-I	20.65	10.22	6.60	5.88	9.93	10.35
IES-A	22.29	8.18	7.60	7.73	5.20	5.80
BDI-II	24.21	10.00	10.73	11.23	9.00	9.93
BAI	20.54	9.35	13.67	10.15	8.00	9.40

Note. BAI = Beck Anxiety Inventory, BDI-II = Beck Depression Inventory-II, CAPS-2 = Clinician Administered PTSD Scale-2, IES-A = Impact of Events – Avoidance, IES-I = Impact of Event Scale – Intrusions.

Follow up analyses revealed that the PTSD group had significantly higher scores than both comparison groups on the CAPS, the BDI, IES-Intrusion, and IES-Avoidance ($p < .01$). The PTSD group scored higher on the BAI than the trauma-exposed non-PTSD group ($p < .01$), but scored comparably to the recovered PTSD group ($p > .05$). The recovered PTSD group scored comparably to the trauma-exposed non-PTSD group on all measures ($p > .05$). The recovered PTSD group was older than the PTSD and trauma-exposed non-PTSD groups ($p < .05$).

Estimated Duration of Memories

A multivariate analysis of variance (MANOVA) between order of valence presentation on time estimates indicated no significant effects for perceived length of time spoken about positive, negative, or neutral memories, or the number of times the spacebar was pressed for positive, negative, or neutral memories. Accordingly, order of presentation was not considered a factor in subsequent analyses.

Mean estimates for memory duration are presented in Table 4.6. A 3 (Participant Group) x 3 (Memory Valence) repeated measures ANOVA of perceived duration of the recalled memories indicated a significant Participant Group x Memory Valence interaction effect [$F(4, 84) = 3.40$, $p < .05$. Follow-up oneway ANOVAs conducted within each participant group indicated that whereas participant groups did not differ in their perceived duration of positive [$F(2, 42) = .36$, $p > .05$] or neutral [$F(2, 42) = .58$, $p > .05$] memories, participants groups did differ in perceived duration of trauma memories [$F(2, 42) = 4.51$, p

<.05]. The PTSD group made significantly longer estimates of trauma memory duration than the trauma-exposed controls [$t(28) = -2.15$, $p < .05$], and the recovered groups [$t(28) = -2.15$, $p < .05$]. Additionally, trauma-exposed controls underestimated how long they spoke about their trauma memory compared to the neutral memory [$t(14) = -2.38$, $p < .05$]. Further, the PTSD group overestimated their trauma memory relative to the neutral memory [$t(14) = 2.49$, $p < .05$], and marginally more than their positive memory [$t(14) = -.21$, $p = .05$] (see Figure 4.2).

Pearson-product moment correlations were performed to investigate the relationship between the emotional intensity experienced by the participant when speaking about each event and how long it was perceived to last. There was no significant relationship between the emotional intensity experienced and perceived duration for either the positive [$r = -.08$, $p > .05$], trauma [$r = -.23$, $p > .05$], or neutral [$r = .09$, $p > .05$] memory.

Table 4.6

Mean Perceived Duration and Frequency of Spacebar Presses for Memory Valences by Treatment Group

	Positive	Negative	Neutral
	Perceived Duration (s)		
Trauma-exposed control	48.33 (18.00)	43.00 (8.82)	48.67 (11.09)
PTSD recovered	54.47 (44.53)	42.53 (14.39)	47.80 (24.12)
PTSD	59.33 (39.05)	85.33 (75.75)	58.00(42.42)
	Frequency of Spacebar Presses		
Trauma-exposed control	8.40 (6.43)	7.73 (4.06)	6.53 (2.07)
PTSD recovered	5.47 (2.33)	6.13 (3.30)	6.40 (1.96)
PTSD	6.07 (2.94)	5.47 (2.00)	6.20 (2.40)

Note: Standard deviations appear in parentheses

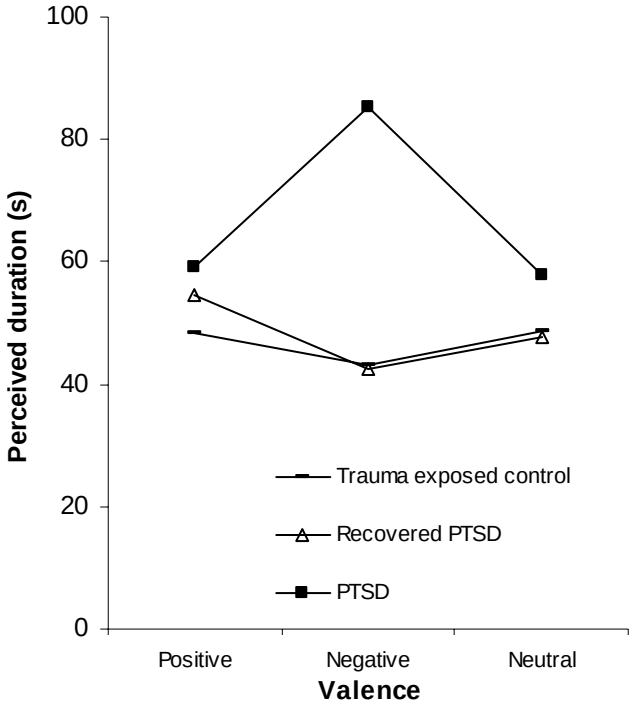

Figure 4.2. Perceived Length of Time Spoken for Personal Memories

Frequency of Spacebar Presses

A 3 (Participant Group) x 3 (Memory Valence) repeated measures ANOVA of spacebar presses indicated no significant main [F (2, 42) = 1.33, p <.05] or interaction effects [F (4, 84) = 1.75, p <.05]. Descriptive statistics are presented in Table 4.6. Participants did not relate their time estimates for each memory to how many times they pressed the spacebar for the either the positive, negative, or neutral memories, indicating

that duration estimates are not simply a function of how many times the spacebar was pressed.

Discussion

Consistent with expectations, participants currently experiencing PTSD overestimated how long they spoke about their trauma memory in comparison to the other groups, and in comparison to their positive and neutral memories. There were no differences between groups in the number of times participants pressed the spacebar. That is, although all groups demonstrated comparable time-keeping skills, they differed in their perception of how long their trauma memories lasted. The finding is consistent with approach/avoidance theories of time perception, which predict that when a stimulus is highly distressing, time intervals may be judged as longer due to a desire to avoid the stimulus (Angrilli et al., 1997; Campbell & Bryant, 2007). This tendency in people with PTSD may account, in part, for the distress associated with trauma memories in PTSD because these individuals perceive the memories to last longer than trauma memories recalled by people without PTSD. Recent cognitive models of PTSD posit that PTSD is maintained by catastrophic appraisals that individuals make about their trauma memories (Ehlers & Clark, 2000). One form of catastrophizing may be their overestimation of how long the distressing memories last. An unexpected finding was that trauma-exposed control participants underestimated how long they spoke about their trauma compared to the neutral event. This finding suggests that trauma memories themselves are not distinctive in

terms of time distortion. This conclusion is supported by the pattern that recovered PTSD participants did not overestimate how long they spoke about their trauma memories. Together, these data point to current distress about trauma memories as a key factor in overestimating how long people believe they think about a trauma memory.

The finding that recovered PTSD participants did not overestimate the duration of the trauma memories suggests that resolution of the stress reaction is associated with more accurate time estimates. Consistent with the approach/avoidance model, it is possible that the memory no longer activates an avoidance response, and the memory's duration is not overestimated. Treatment studies have shown that successful resolution of PTSD is associated with understanding the memory in the context of other details of the trauma experience (Foa, Rothbaum, Riggs, & Murdock, 1991). It is possible that the enhanced cohesion of the trauma memory after PTSD resolution results in less overestimation of memory duration. Surprisingly, it was found that the reported emotional intensity experienced by participants while recounting the event was not correlated with how long they perceived they spoke about the autobiographical memory. The measure of emotional intensity may not have been sensitive enough to index the range of emotional responses. It is possible that fear, sadness, and anger reactions may be associated with different distortions of time of trauma memories. Future research should measure the range of emotional responses, as well as psychophysiological indices of emotion and arousal, to more closely index the relationship between time distortion and specific emotional states.

The design of this study incorporated both prospective and retrospective models. Although there were no differences between groups in their prospective estimates of the 10s intervals, as indexed by frequency of spacebar presses, a difference between groups existed in retrospective estimates of the 1-minute period. It may be argued that one method of evaluating how long the period lasted was to retrospectively estimate how many words were spoken for each memory, and an output based on word count generated. This method would be consistent with retrospective models of time estimation, which posit that increased complexity of the event is associated with an increase in perceived duration (Block, 1978). It may be argued that PTSD group may have had more to say about the traumatic event, particularly since the event had a greater impact on them as evidenced by higher scores on all self-report measures and as such may have spoken more words during the 1-minute period than the comparison groups. Future studies should consider recording narratives and performing word counts for each memory to index this possibility.

General Discussion

The findings of the four studies presented in this chapter converge with reports of exaggerated experiences of time during traumatic and stressful events (Marshall et al., 2002; Noyes & Kletti, 1977; Sterlini & Bryant, 2002; Ursano et al., 1999). These four studies provide supportive data for the role of emotional valence in time perception and for the avoidance model of time perception.

With regard to prospective and retrospective time judgments, the paradigm employed in the design of these studies was predominantly retrospective. To date, only one study has been published in the area of emotional valence and retrospective time judgments (Loftus et al., 1987). The findings of all four studies in this chapter converge with Loftus et al.'s (1987) findings that people retrospectively judge negative or stressful events to last longer than they actually have. Together, studies 6a, 6b, 7, and 8 demonstrate that retrospective time distortions occur for stressful events, both non-autobiographical and autobiographical in nature.

The finding from Study 8 that recovered PTSD participants did not overestimate the perceived duration of their trauma compared to PTSD participants implicates the moderating role of reduction of distress and arousal in time perception. Considering the distress caused by trauma memories for people with PTSD, the issue of perceived duration of these memories appears important.

Implications for the Program of Research

The convergent findings from studies in this chapter have clarified the role of emotional valence in mediating time distortion for distressing stimuli, and elucidated some of the factors influential in ongoing time distortions for the traumatic event demonstrated by people with PTSD. The studies in this chapter utilized both prospective and retrospective paradigms to explore these processes in more detail. The links between emotional valence and retrospective time judgments have been explored under a variety of conditions, and provide an ecologically valid method of investigating time distortions in trauma survivors. Beyond the processes of arousal and emotional valence, there is a need for experimental investigation into additional emotional processes which commonly occur prospectively during trauma, which may mediate how long the trauma is perceived to last. This thesis now turns to investigate the role of perception of control over aversive events on time perception.

CHAPTER 5

THE INFLUENCE OF PERCEIVED LOSS OF CONTROL ON THE PERCEPTION OF TIME

STUDY 9

Study 9

Time Distortion and Perceived Loss of Control

Introduction

Many traumatic events involve the anticipation of an unwanted outcome, such as the car driver waiting to skid into a tree or the assault victim waiting for a gun to be fired. According to avoidance theories of time perception (Angrilli et al., 1997), anticipating an outcome that one cannot control may lead to overestimation of time. Feeling that one cannot control the outcome of a traumatic event is strongly associated with PTSD, and indeed, the sense of helplessness is defined in Criterion A of the PTSD diagnostic criteria (American Psychiatric Association, 1994).

Traumatic events, by their very nature, are associated with a perceived lack of control. Inability to control the aversive outcome of the event is associated with the later development of PTSD (Dunmore, Clark, & Ehlers, 1999; Volpicelli, Balaraman, Hahn, Wallace, & Bux, 1999). There is some evidence to suggest that individuals who are low in internal locus of control tend to overestimate the duration of filled intervals (Krishnan & Saxena, 1984). To further investigate the influence of perceived control on subjective time, Study 9 employed neutral and highly arousing negative and positive slides with the illusion of being able to 'control' the projection time of duration of half of the slides. In accordance with avoidance theories of time perception, it was predicted that an inability to avoid the slides would have a stronger effect on the pacemaker, leading to the perception that time is

moving too slowly. Specifically, it was hypothesized that a lack of control over the highly arousing negative slides would be associated with longer estimates of slide duration, relative to 'controllable' slides.

Method

Design

A 2 (Perceived Control Order: Control 1st, Could Not Control 1st) x 2 (Perceived Control: Could Control, Could Not Control) x 3 (Valence: High Arousal Positive, High Arousal Negative, Neutral) design was employed, with a repeated measure on the latter two factors.

Participants

The study included 53 first year psychology students from the University of New South Wales, who participated in the study for course credit. There were 18 males and 35 females, of mean age 19.96 years (SD = 4.34).

Materials

International Affective Picture System: Thirty-two slides from the International Affective Picture System (IAPS, 1997) were selected. The IAPS consists of photographic stimuli, standardized for emotional valence and arousal. Five groups of slides that were homogeneous for arousal and emotional valence according to IAPS normative data (Lang, Bradley, & Cuthbert, 1999) were selected in the following combinations: Six High Arousal Negative (Valence = 1.0 - 4.0; Arousal = 6.5 - 7.5) slides representing mutilated bodies and

burns victims, 6 High Arousal Positive (Valence = 6.5 - 8.5; Arousal = 6.5 - 7.5) slides representing erotic and non-erotic exhilarating scenes, 12 Neutral (Valence = 4.5 - 5.5; Arousal = 2.5 - 3.0) slides representing household objects, 4 Low Arousal Negative (Valence = < 4; Arousal = 3.0 - 4.0) slides representing sombre people and polluted environmental scenes , and 4 Low Arousal Positive (Valence = > 7; Arousal = 3.0 - 4.0) slides representing pleasant environmental scenes and people. The low arousal slides were used as random filler slides, and were excluded from statistical analysis. The full list of slide descriptions and their norms are presented in Appendix 4.

The 32 slides were organized into four different presentation orders. Within each order the slides were presented in blocks of 8. Each block of 8 consisted of 3 neutral, 2 low arousal negative/positive, and 3 high arousal negative/positive slides, all randomised within each block. The slides were presented using Inquisit 2.0.

Measures

Peritraumatic Dissociative Symptoms Questionnaire: Participants were administered a modified version of the PDEQ (Marmar et al., 1997). Participants completed the PDEQ at the beginning of the experimental session to assess trait dissociation in relation to tendencies to generally dissociate, and again at the end to assess dissociative experiences during the experiment.

Physical Reactions Scale: Participants were administered the PRS (Falsetti & Resnick, 1992) following the slide presentations to index physical reactions to the slides. The PRS

indexes panic attack symptoms and was used to index level of arousal during the experiment.

Procedure

Following written informed consent, participants were allocated to one of four presentation orders. Participants were informed that the experiment was concerned with their perception of time. The participant was informed that

"You have the option to 'control' some of the slides. The slides will be presented in blocks of 8, and the computer will tell you in advance which blocks you can control and those that you cannot. For the slides that you can control, you are able to press the spacebar which will remove the slide from the screen a short time after pressing it". Participants were informed that they either could or could not control the first block of 8 slides. They were also informed that whether or not they tried to remove the slide from the screen, they must watch the slide until it disappeared. Their task was to estimate on a 12-point scale (range: 1s - 12s) how long they thought the slide was displayed for. As a manipulation check, the participant was then asked to indicate how much control they perceived they had over the slides on a 10-point scale (1 = "no Control", 10 = "total control"). Participants then completed the second PDEQ and the PRS, and the session was terminated.

The perception of control was an illusion facilitated by the random filler (low arousal) slides. Participants were never able to 'control' the duration of test stimuli presentation, which were all presented for 4s. The random filler slides were presented for

either 8 or 12 seconds, and could be removed from the screen if the participant pressed the spacebar. The random filler slides were chosen to be longer than the test stimuli to give the participant a greater length of time to make the decision to try to remove it, thereby facilitating the illusion that if they did not press the spacebar for the higher arousal slides they may be presented for longer than desired.

Results

Participant Characteristics

Mean participant characteristics and ratings of perceived control are presented in Table 5.1. A paired samples t-test of PDEQ scores before and during the experiment indicated that PDEQ scores during the experiment were significantly higher during than prior to the experiment, $t(52) = -1.53$, $p < .05$.

Mean Slide Duration Estimates as a Function of Valence and Control Option

The mean slide duration estimates are presented in Table 5.2. A 2 (Perceived Control Order) x 2 (Perceived Control) x 3 (Valence) repeated measures ANOVA on tone estimates indicated a significant Perceived Control x Valence interaction effect, Wilks' Lambda = .81, $F(1, 52) = 5.91$, $p < .01$. Follow-up paired-samples t-tests indicated that high arousal negative slides that were perceived as uncontrollable were judged to last longer than those slides that were perceived as controllable, $t(52) = -2.56$, $p < .05$.

Table 5.1

Mean Participant Characteristics

	N	Mean	Standard Deviation
$PDEQ_1$	53	15.00	4.70
$PDEQ_2$	53	16.53	5.56
PRS	53	6.08	6.95
Perceived Control	53	6.04	2.30

Note. $PDEQ_1$ = Peritraumatic Dissociative Experiences Questionnaire (Baseline), $PDEQ_2$ = Peritraumatic Dissociative Experiences Questionnaire (During Experiment), PRS = Physical Reactions Scale.

Relationship Between Perception of Control, Measures, and Duration Estimates

Pearson correlation coefficients calculated between slide duration estimates and perceived control ratings (adopting a p value of <.01) indicated a significant negative correlation between perceived control and high arousal negative slides [r = -.37, n = 53, p < .01]. The less control participants felt they had, the longer they perceived the negative slides to last. In addition, PDEQ scores during the experiment and average slide duration estimates were significantly correlated for high arousal negative 'no control' slides [r = .39, p < .01]. Greater alterations in attention and awareness during the experiment were associated with longer estimates of negative slide duration.

Table 5.2

Mean Slide Duration Estimates

Valence	Could Control		Could Not Control	
High Arousal Negative				
Control 1st	3.58	(1.02)	3.90	(1.30)
Control 2nd	3.18	(1.20)	3.58	(1.20)
Total	3.39	(11.12)	3.75	(1.25)
High Arousal Positive				
Control 1st	3.56	(.84)	3.49	(.92)
Control 2nd	3.54	(1.07)	3.34	(.93)
Total	3.60	(1.00)	3.44	(.92)
Neutral				
Control 1st	3.43	(.66)	3.38	(.95)
Control 2nd	3.35	(.81)	3.59	(.77)
Total	3.43	(.77)	3.52	(.88)

Note. Standard deviations are presented in parentheses

Discussion

High arousal negative slides that were perceived as uncontrollable were overestimated relative to the neutral and positive slides. Subjective ratings of perceived control were correlated with how long the negative slides were perceived to last, such that not feeling able to control the duration of the negative slides was associated with those slides being judged to last longer. These results support both pacemaker theories and avoidance theories of time perception (Angrilli et al., 1997; Zakay & Block, 1997). Specifically, perceived inability to control negative stimuli may stimulate the pacemaker to pulse at a faster rate, so that the perceived duration of the experience is perceived as longer. Alternately, not being able to control the aversive experience may heighten the need for avoidance, and this may contribute to time overestimation. This finding also has relevance to the time distortions reported by trauma survivors, in that when an individual is not able to escape from aversive events, time is judged as lasting too long.

Implications for the Program of Research

This chapter has detailed a study performed in a laboratory setting to further investigate the role of perceived control over aversive stimuli in the perception of time. The observed findings can be accounted for by pacemaker theories of time perception, and in part by avoidance models. This study provides empirical advancement in the understanding mechanisms involved in trauma-related time distortions under controlled conditions.

CHAPTER 6

MAJOR DISCUSSION

A central aim of this thesis was to deconstruct a common peritraumatic dissociative symptom – time distortion - to further inform models of dissociation. Current models of dissociation are deficient, in that diverse symptoms are grouped under one global construct (Bryant, 2007; McNally, 2003a), which has little explanatory power and is not advancing current understanding of PTSD. This thesis systematically investigated trauma-related time distortions using a multi-pronged approach, involving both clinical and analogue studies. Two factors, arousal and avoidance, were investigated because of their known involvement with the development and maintenance of PTSD, and their link with time perception in non-clinical studies. The ten studies in this thesis delineate the mechanisms of time distortions and set a framework for the agenda of future studies to examine this issue.

Study 1 was a prospective study designed to test the proposal that time slowing during a traumatic event would be associated with the development and maintenance of PTSD. Participants were interviewed within a week of a traumatic injury, and again three months later. The findings of Study 1 indicated that the experience of time slowing during the trauma was associated with more severe PTSD symptoms, as well as a threefold increase in the probability of PTSD being maintained three months later. The results of this large multi-site study are consistent with smaller studies (Birmes et al., 2001a; Shalev et al., 1996), and provide robust support for the conclusion that time slowing predicts subsequent PTSD. The finding that time distortion is associated with more severe initial post-traumatic stress symptoms, anxiety, and depression, and a threefold increase in the probability of

developing PTSD 3 months later underscores the need to understand the mechanisms underpinning time distortion in the context of a traumatic experience. These results suggest that time distortion may impede accurate processing of a traumatic event, and thereby contribute to subsequent PTSD.

Study 2 interviewed people about the qualitative aspects of their experience of time distortion during the traumatic event. It was found that the experience of time slowing was linked with the anticipation of aversive outcomes of the event, and this in turn highlighted the possible protective avoidance mechanism that time distortion may serve. Together, Study 1 and Study 2 set the platform for the focus on both arousal and avoidance in time distortion, and its role in the development and maintenance of PTSD.

Study 3 investigated time distortion in the context of a laboratory-induced panic-like state to test the hypothesis that increased arousal would be associated with overestimates of event duration. The hyperventilation provocation test was used as a means of inducing hyperarousal, and participants were required to reproduce the duration of a standard tone. The findings indicated that participants in the 'high arousal' condition overestimated tone duration relative to participants in the 'low arousal' condition. Additionally, participants in the 'high arousal' condition reported greater panic-like symptoms and dissociative reactions during the hyperventilation procedure, which were associated with overestimation of time. These findings provided support for pacemaker theories of time perception that predict that higher levels of arousal lead the pacemaker to

pulse at a faster rate, and time overestimation to result. Study 4 extended the findings of Study 3 by investigating hyperarousal in a naturalistic setting involving extreme stress. Novice skydivers rated levels of subjective fear and excitement before and after their jump, and estimated the duration of the skydive experience after landing. It was found that higher levels of fear were associated with a tendency to overestimate the duration of the skydive experience, and that there was a trend towards underestimation of event duration if higher levels of excitement were reported.

Study 5 sought to investigate the role of temperature change on time perception. Subjective temperature change was hypnotically induced in a laboratory setting to test the hypothesis that increases in temperature would be associated with accelerated pacemaker rate, leading to the experience of time slowing. The results suggested that highly hypnotisable participants who increased their body temperature under hypnosis made longer estimates of tone duration, which supported both pacemaker and avoidance theories.

Studies 6a, 6b, 7 and 8 extended the findings of the previous studies by investigating the role of valence in time perception. Specifically, it was investigated whether emotional material was perceived differently to non-emotional material. Study 6a compared time estimates of standardised emotionally negative and neutral slideshows in a non-trauma exposed sample, with the results suggesting that the negative slideshow was perceived to last longer than the neutral slideshow. Study 6b extended the research of Study 6a to trauma-exposed participants. The results supported the findings of Study 6a.

However, an unexpected finding was that people with PTSD tended to overestimate the duration of the slideshow, independent of valence. This finding was attributed to people with PTSD generally having higher levels of arousal, leading to a general acceleration of pacemaker output. Study 7 extended studies 3, 6a, and 6b, by examining the combined effect of valence and physiological arousal on time perception. The results suggested that participants who were shown the negative version of the slideshow reported longer duration estimates of the slideshow following hyperventilation, compared to those who relaxed prior to watching the emotional version. This pattern of results points to a mediating effect of arousal on time distortion when exposed to emotional stimuli.

Following on from Studies 1, 6a, 6b, and 7, Study 8 employed clinical and non-clinical samples to extend the valence studies by using personally relevant autobiographical narratives as the stimuli. Consistent with expectations, people currently experiencing PTSD made longer duration estimates of how long they narrated their trauma memory. Additionally, recovered PTSD participants did not overestimate the duration of trauma memory narratives. It was theorized that this overestimation of time in participants with PTSD is one form of catastrophic appraisal driven by heightened distress about the trauma memory and linked with the maintenance of the disorder.

Study 9 examined perceived lack of control over slide duration and how long the slide was perceived to last. Consistent with expectations, the results suggested that a perception of being unable to control (remove) highly arousing negative stimuli was

associated with longer duration estimates. This finding has relevance to time distortions commonly reported by trauma survivors in such situations.

This thesis now turns to a discussion of the pertinent findings of the program of research in relation to time perception and posttraumatic stress. Measurement and methodological limitations, as well as future directions for research, will be acknowledged and considered.

Role of Avoidance

Study 2 deconstructed the notion of time distortion to examine possible mechanisms contributing to time slowing during trauma. It was found that participants who experienced time slowing were more likely to have been anticipating the outcome of the event compared to those who did not experience time slowing. Furthermore, Study 4 demonstrated a positive relationship between fear levels before and during a skydive and estimations of how long the experience lasted. Inherent in one's initial skydive are many risks that the individual may appraise prior to and during the jump (e.g., "the plane may crash", "the parachute may not open", "I may get injured upon landing", or "I may die"). Higher levels of fear were hypothesised to be associated with anticipating such negative outcomes. There is substantial evidence to suggest that peritraumatic appraisal of danger is fundamental in determining whether or not an event will lead to PTSD (McNally, 2003a). Additionally, compared to objective measures of threat, subjective ratings of perceived danger or distress have been shown to be superior in predicting PTSD symptomatology (Basoglu et al., 1994;

Blanchard et al., 1995; Ehlers, Mayou, & Bryant, 1998). Studies 2 and 4 related directly to such subjective measures of perceived threat and to the avoidance model of time perception (Angrilli et al., 1997) generally. Riskind (1997) developed the 'looming vulnerability' paradigm to explain the function of time and anticipation of danger in anxiety. When threats are appraised as rapidly approaching, Riskind proposes that the individual experiences a sense of imminent vulnerability to harm, and will overestimate the probability, cost, and controllability of feared outcomes. In Study 2, anticipation was associated with the perception of time slowing, as were high levels of fear during a skydive in Study 4. When such perceived threat is high, the individual may experience an avoidance response based on perception of impending doom and anticipation of the outcome of the event, and a desire the event to end more quickly than it does. This response can lead to the subjective sense that time is slowed.

It has been proposed that time distortion serves as a defence mechanism that allows the individual 'more time' to evaluate the situation and to make plans to escape from or avoid the outcome of the trauma (Hancock & Weaver, 2005). In the majority of studies outlined in this thesis, participants retrospectively reported the experience of time distortion. Pillimer (2003) proposed that autobiographical memories may serve directive functions which inform individuals about situations that are safe and which should be avoided. Drawing on Herman's (1992) work on stages of recovery from trauma, Pillimer proposed that directive functions of memory take place in the first stage of recovery, which

involves the goal of protecting safety in the future. Pillimer proposed that the individual experiences vivid images and memories of sources of threat which must be confronted or avoided to preserve future safety. Further, he states that acting on these directives by establishing a safe environment facilitates recovery from trauma. A subjective experience of time lengthening when spontaneously remembering the event or experiencing it in the form of a flashback could allow for problem-solving to avoid such events in the future, with the disturbance in time perception associated with the trauma remaining until the disorder is in the recovery stage. Relatedly, Dunmore, Clark, and Ehlers (1999) found that mental planning (such as thinking of ways to protect oneself, influence the perpetrator, or escape) was related to the onset of PTSD, but not the maintenance. This finding further supports the interpretation of Study 2 and the hypothesis that time slowing may, in part, serve a coping function.

Further, Study 8 demonstrated that compared to people whose PTSD had recovered, people with a current diagnosis of PTSD estimated speaking about their trauma for longer than they actually did. This was despite comparable ongoing time-keeping skills between all groups. According to Ehlers and Clarke (2000), PTSD is maintained by catastrophic appraisals. Believing that one's trauma or time spent thinking about one's trauma is longer than objective time could be one form of catastrophic appraisal, driven by a motivation to avoid thinking about certain aspects of the event. Recovered participants did not overestimate trauma narrative duration. Much research has shown that recovery from

PTSD via therapy reduces avoidance symptomatology and facilitates emotional processing. The finding that the recovered PTSD participants in this thesis reported reduced time overestimation highlights the important relationship between current distress and time distortion.

Study 9 examined the issue of being exposed to highly arousing negative stimuli and the perception of not being able to control it. Although in this study participants could have chosen to avoid exposure to the stimuli (e.g., by not participating in the study), the results raised an interesting relationship between time perception and feelings of control. The major finding of Study 9 was that highly arousing negative stimuli that were perceived as having a "controllable" duration were judged to be briefer than the same stimuli that were "not controllable". These findings speak to the avoidance model of time perception, and highlight the need for further investigation into time distortion and one's perception of control over the outcome of the anticipated event.

Emotional Valence, Arousal, and Time Perception

Several studies in this thesis focused on high arousal because of the evidence that dissociative symptoms are associated with elevated physiological arousal (Friedman, 2000; Nixon & Bryant, 2005; Nixon & Bryant, 2006; Sterlini & Bryant, 2002).

Role of Arousal

By employing a hyperventilation procedure, this thesis has demonstrated that increased arousal does result in time overestimation. Arousal has been demonstrated to be

linked with time perception through its effect on the pacemaker. Several findings point to the importance of arousal in time distortion, and supported the proposition that increased arousal leads the "pacemaker" to pulse at a faster rate leading to overestimations of time. Additionally, the pacemaker may be sensitive to temperature change (Baddeley, 1966; Bell, 1965; Hoagland, 1933; Wearden & Penton-Voak, 1995). Study 5 provided evidence that hypnotized participants gave greater verbal estimates of interval durations following a warming suggestion. Traumatic events by their very nature lead to psychological stress, which in turn has been implicated in elevations in body temperature (Oka et al., 2001). Traumatic environmental conditions may also lead to increases in body temperature and arousal, such as fire or hyperthermia. These convergent studies implicate the key role that hyperarousal may play in traumatic time distortions, and lead to important theoretical and clinical implications, which will be discussed later in this thesis.

Role of Emotion and Arousal

Studies 6a and 6b found that people presented with a negative stimulus in the form of a slideshow made longer time estimates relative to people who watched a neutral slideshow. Further, the more negative the story was judged to be, the longer participants perceived it to last. Study 6b found that participants with a current diagnosis of PTSD overestimated slideshow duration relative to trauma-exposed non-PTSD participants, regardless of emotional valence. Furthermore, Study 7 indicated that increasing arousal prior to exposure to the negative stimulus led to greater time overestimation, while

decreasing arousal moderated the effect of emotional valence. The convergent findings of Studies 6a, 6b, and 7 suggest that the negativity of the experience, combined with unpleasant physical symptoms, is linked to time overestimation, and highlights the role that hyperarousal plays in the perception of time.

Schnell, Marshall and Jaycox (2004) investigated associations between the PTSD symptom clusters of reexperiencing, avoidance, numbing, and hyperarousal. They found hyperarousal to be the best predictor of symptom severity, and directly influenced all other PTSD symptom clusters. As the various studies in this thesis demonstrate, elevated arousal is also associated with time slowing. Elevated arousal has also been associated with reexperiencing symptoms, as well as flash-back type reactions (Nixon & Bryant, 1995). Flashbacks are themselves a type of time distortion in that the individual becomes disoriented in time and place (Brewin, Dalgleish, & Joseph, 1996), and tends to experience it in the present tense (Hellawell & Brewin, 2004). Evidence for the link between elevated arousal and time distortion emerged in Study 8, which demonstrated that compared to participants with a current diagnosis of PTSD, recovered participants did not experience time distortions with regard to recounting the traumatic event. Study 1 demonstrated that time distortions are linked with the development and maintenance of PTSD, and it is possible that this occurs through its relationship with hyperarousal.

Integrating Traumatic Time Distortion with Time Perception Models

The studies in this program of research provided novel findings demonstrating that temporal distortions tend to occur under conditions of high arousal, both prospectively and retrospectively. This pattern of findings has implications for understanding peritraumatic time distortions in the context of prevailing models of time distortion. Prospective timing models, such as the attentional-gate model proposed by Zakay and Block (1997), assume that the individual is aware of the passing of time during a given interval, and seeks to subjectively measure it in some way. With regard to peritraumatic time distortion, this indicates that during a period of heightened arousal, the pacemaker is activated to pulse at a faster rate. As the trauma is occurring the individual may be focussing on temporal aspects of the experience, and may be aware that external time appears to be moving more slowly than internal time, and consequently experiencing time as moving too slowly. This highlights the issue of anticipation and avoidance within prospective time estimation, and for models of prospective time perception. If the conclusion of an event is being anticipated, this could lead the pacemaker to pulse at an even faster rate, and lead to more exaggerated perceptions of time slowing, to the point that it may even be perceived to stand still. Consequently, if the individual perceives the event as lasting too long, an avoidance mechanism linked to survival may be activated which serves to alert the victim that escape is paramount for survival.

Furthermore, the findings in this thesis point to important factors often observed in the context of trauma that can be understood in terms of existing models of time perception. Study 2 demonstrated that individuals who did not anticipate the outcome of the trauma were less likely to experience time slowing. If a traumatic event is so sudden that the individual cannot anticipate the conclusion of the trauma, time distortion may be less likely to occur. On the other hand, if there is an opportunity for the individual to cognitively appraise the situation and anticipate what is about to happen, time slowing is more likely to occur, which in turn may promote survival. Therefore, time distortions within prospective paradigms may be better explained by more complex cognitive factors and emotions than existing models describe.

In terms of retrospective time judgments, prevailing models implicate the complexity of the event with regard to the number of contextual changes that occur during a given period and the amount of space the event occupies in memory. Various studies in this program of research (e.g., Studies 6a, 6b, and 7) demonstrated that when arousal and emotional valence were manipulated, retrospective time slowing occurred when physiological arousal was high and emotional valence was negative. Presumably, these two factors add to the complexity of an event in that a greater number of emotional processes will occur, leading to overestimations of time; however, existing models of retrospective time judgments do not attempt to explain such processes and their effect on time perception. These convergent findings point to the need for retrospective models to

account for and explain the individual and combined roles of internal (e.g., emotions and arousal) and external (e.g., environmental) factors in time perception.

Overall, whereas the major theories of time perception partially explain the findings of the studies presented in this program of research, they do not explain them all. Existing theories are lacking in terms of the role of emotions, emotional valence, arousal, and avoidance in predicting and explaining time distortions. The studies in this thesis go some way towards extending prevailing theories both in terms of prospective and retrospective time judgments.

Measurement and Methodological Issues

Sample Selection

The trauma-exposed participants who were recruited to take part in the studies presented in this thesis had experienced a range of traumatic events, including but not limited to MVAs, assaults, robberies, and injuries. Consequently, the findings in this program of research offer a broad overview of general processes that may moderate or mediate trauma-related time distortions. This thesis recognizes that the use of individual trauma sub-types may expose qualitative differences in time distortions. Terr (1983) proposed that momentary versus prolonged traumas may produce different distortions in awareness. There is evidence that dissociation is more prevalent following severe trauma, including interpersonal and sexual assault (Zatzick, Marmar, Weiss, & Metzler, 1994). Accordingly, the dearth of sexual assault survivors in the present studies may limit the

generalizability of the findings to time distortion in other trauma survivor populations. Future studies should examine time distortion in homogeneous trauma populations.

This thesis also recognizes that the non-trauma exposed participants for some of the studies in the research program were recruited from a university setting, and in some aspects may not be representative of the general population. For example, these participants may have a higher level of intelligence or more education. Accurate time perception is dependent on factors such as memory and attentional capacity, and there is substantial evidence that posttraumatic stress is associated with deficits in such areas (Bremner et al., 1993). Therefore, it is possible that the results of some studies in this thesis may be confounded by individual differences in intelligence or working memory capacity.

Sample Size

The samples sizes employed in the clinical studies in this thesis were modest. This may have restricted the potential detection or magnitude of group differences. In addition, the groups were not matched for gender, age, or education level. There is some evidence to suggest gender differences and age effects in time estimation accuracy (Block, Hancock, & Zakay, 2000; Block, Zakay, & Hancock, 1998). Additionally, gender differences are also commonly observed in treatment-seeking (Gavrilovic, Schützwohlm, Fazel, & Priebe, 2005). Future research in this area should endeavour to replicate these studies using larger samples matched for gender, age, and education level.

Time Estimation Methods

Prospective methods of time estimation occur when the individual is aware in advance of the requirement to measure time in some way. As such, a number of variables can affect duration judgments, such as level of attention paid to the task, and whether or not particular individuals chose to engage in a counting strategy. It is possible that some individuals may not have been paying full attention to some of the tasks in experiments in this program of research, particularly when the stimuli were particularly unpleasant or distressing. This could influence duration estimates and compromise the results of the studies. Future studies should aim to include memory tests to verify that participants had been paying full attention to the stimuli.

In addition, enquiries were not made to determine whether participants were using a counting strategy in any of the studies. Although this could perceivably be an issue, Wearden and Penton-Voak (1995) posit that counting is a cognitive activity exclusive to humans and that variations in the output of the hypothetical pacemaker would lead to changes in the basic count unit as well. Therefore, even if individuals were using a counting strategy, if the pacemaker is sped up, the individual's count rate should also be faster. However, future studies in this area should aim to ascertain whether individuals are using a counting strategy, the method of the strategy, and control for strategy use in statistical analyses.

This thesis also employed retrospective estimation methods, which are thought to be influenced by the amount of space an event occupies in memory (Ornstein, 1969) and the number of contextual changes within an event period (Block, 1978). Retrospective duration estimates are also heavily influenced by memory variables. This factor presents a potential measurement issue when examining time distortion in traumatic events, as people experiencing PTSD may experience amnesia for important parts of the event. Furthermore, traumatic events by their very nature are often more complex than neutral or positive events because of the emotions involved and salience of traumatic cues. In these ways, the trauma itself presents as a potential confound and it is difficult to identify the mechanism involved in the temporal distortion. Future studies should aim to index word counts for valence and log contextual changes within events and control for these in design and analysis.

It could be argued that the reproduction method used in Study 3, and the verbal estimation method used in Study 5, are not a valid methods of estimating time. Several authors have proposed that verbal estimation and reproduction of time result in dissimilar time estimates (Clausen, 1950; Danziger & Du Preez, 1963; Schiff & Thayer, 1970), however, according to Zakay (1993b) no qualitative differences between the two are observed. Furthermore, various studies (Thomas & Weaver, 1975; Treisman, 1963; Zakay, 1993a, 1993b; Zakay & Yehoshua, 1989) have demonstrated that in prospective studies, such as Studies 3 and 5, time intervals are generally underestimated. Accordingly, the results of Angrilli and colleagues (1997) study demonstrated a distinct underestimation

in the reproduction method compared to the verbal estimation method. However, both Studies 3 and 5 demonstrated overestimation of intervals using a reproduction method following hyperventilation, and a verbal estimation method following a hypnotic induction and warming suggestion. One explanation for the finding in Study 3 is that the pacemaker emitted pulses at a faster rate during the hyperventilation condition. It is also possible that the hyperventilation procedure had an effect on other processes which could influence the current findings, such as attention to the stimuli or reproduction, the decision process, or the motor response. Such factors may also be in play during Study 5, and could influence the way time is experienced. Nevertheless, these data accord with other studies finding overestimations of time with increased arousal (Penton-Voak et al., 1996; Wearden et al., 1999) and increases in body temperature (Baddeley, 1966; Bell, 1965; Hoagland, 1933; Wearden & Penton-Voak, 1995).

This thesis also recognizes that with regard to peritraumatic dissociation, all subjective accounts are retrospective and therefore subject to distortions of memory. It is impossible to determine whether perception of time during a traumatic event was distorted, or whether distortion occurs when retrospectively recalling the event (Terr, 1983). Inaccurate memories can contain as much imagery and produce as much affect as accurate memories (Bryant & Harvey, 1998; Terr, 1983). To understand the phenomenon in real-time, future studies should aim to examine time distortions during predictable traumatic stress, such as in military, police, and surgical training environments.

Additional Methodological Issues

It is also noted that some of the measures employed in this thesis may not have been sensitive enough to capture the range of emotional responses. For example, in Study 8 participants were asked to rate the emotional intensity of their memory using a 9-point Likert scale (-4 = “no emotional reaction” to 4 “intense emotional reaction”). It is possible that fear, sadness, and anger reactions may be associated with different distortions of time of trauma memories. Future research should measure a range of emotional responses, as well as psychophysiological indices of emotion and arousal, to more closely index the relationship between time distortion and specific emotional states.

Finally, this thesis recognizes that the cognitive paradigm used to explore the mechanisms of time distortion is somewhat limited, and does not point to specific neuroanatomy of the phenomenon. McNally (2003a) proposed that to further understand dissociative symptoms, future studies should also aim to clarify the functional neuroanatomy associated with time distortions by employing the techniques of functional magnetic resonance imaging [fMRI] or positron emission tomography [PET] in a laboratory setting. This thesis recognizes the value of this approach. However, the studies presented in this thesis are the first steps into this foray and are possibly the most effective way to initially understand the mechanisms of time distortion in trauma.

Clinical Implications and Future Directions

Although the clinical literature points to peritraumatic time slowing, there is very little empirical research to understand the phenomenon. This thesis highlighted the core factors contributing to traumatic time distortions, and is suggestive of several clinical implications.

The finding that time slowing is associated with the development of PTSD in Study 1 points to potential means of early identification of those who are high risk for PTSD development by indexing in the acute phase whether patients perceived time slowing during the traumatic event. The finding that individuals with PTSD perceived that recalling a trauma memory lasted longer than those who had recovered from PTSD suggests that PTSD patients may endure more stress in recalling memories because they perceive them as lasting longer. Therapy techniques that include a focus on reminding patients of the realistic context in which they are recalling the event (e.g., Ehlers & Clark, 2000) may facilitate more accurate time perception of the recollection.

A number of studies in this thesis pointed to overestimation of the duration of intervals associated with highly arousing negative stimuli. In particular, Study 8 demonstrated a link between how long memory focus for events was perceived to last and negative emotional valence. Participants with a current diagnosis of PTSD tended to overestimate the duration of their autobiographical trauma narrative. It was proposed that such overestimation is one form of catastrophic appraisal that maintains anxiety. In

consideration of the high levels of distress experienced by people with PTSD while recounting trauma memories, modifying the subjective duration of such memories may be an important focus for therapy. Alternatively, the development of an intervention to promote subjectively greater time spent focusing on positive events compared to traumatic events should be considered. In addition to cognitive strategies, introducing relaxation strategies early in intervention to reduce arousal symptoms associated with ongoing time distortions may prove useful.

Overall, the studies presented in this thesis delineate the mechanisms associated with traumatic time distortions. This information can be useful in therapeutic situations, particularly with regard to psychoeducation, correcting any negative beliefs associated with time distortions the patient may hold, and may help the clinician to normalize previously inexplicable symptoms.

Concluding Comments

There is much conflict in the literature about the concept of dissociation. The traditional view of peritraumatic dissociation is that it serves a defence mechanism that protects the individual against unwanted or unpleasant sensations and experience, and that it is linked with the development and maintenance of PTSD (van der Hart & Steele, 1997). Conversely, there is suggestive evidence that dissociative reactions may not necessarily lead to psychopathological conditions. Trauma researchers have recently argued that not enough is known about dissociation, and the way in which various reactions commonly

grouped together interact or do not interact, and the unique individual role played by each dissociative psychological reaction. This program of research provided support for dissociation theories that suggest that dissociative reactions during trauma are predictive of the development and maintenance of PTSD (e.g., Beere, 1995; Spiegel, 1997; Spiegel, Koopman, & Classen, 1994; van der Kolk & van der Hart, 1989).

The aim of this thesis was to deconstruct a peritraumatic dissociative symptom to further research in the area of dissociation generally. The objective of elucidating processes that influence trauma-related time distortions using a variety of methods within a cognitive framework has largely been achieved. This research program has supported and built on existing models of time perception, and applied them to the context of traumatic experience. This thesis has demonstrated that trauma-related time distortions are influenced by arousal, emotional valence, and avoidance reactions; future models of time distortion in the context of trauma need to accommodate these factors to adequately integrate current models of posttraumatic dissociation with contemporary models of time perception.

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APPENDICES

Appendix 1

A CLINICAL PROFILE OF TIME DISTORTION

STUDIES 1 & 2

Consent Form - Study 1

SYDNEY WEST
Area Health Service

PARTICIPANT INFORMATION

Title of Project:
Screening for Psychopathology Following Injury

Names of Investigators:
Professor Richard Bryant and Leah Campbell

What is the purpose of the study?:
The purpose of this project is to identify how well individuals adjust following being injured and what factors influence this adjustment. Previous experience has shown that although most people who are injured cope well with their experience, some find it a real struggle. This research aims to identify the factors which may increase or decrease one's risk for developing mental health problems following injury. By doing this, this research aims to improve future patient care.

Who will be invited to enter the study?:
All adult patients who are admitted to Westmead Hospital following a traumatic injury will be invited to participate.

What will happen on the study?:
If you decide to participate, participation in this project will involve answering questions about your medical and psychological history, your experience of the event that caused your injuries, how you are currently feeling and about how you think you'll cope with the injuries. A research nurse will ask you most of the questions and then she will ask you to complete a few questions by yourself. On average, this assessment will take about 45-60 minutes. Some of this interview will be audiotaped so the researchers can evaluate the content of your reports. Then at 3 months the researcher will contact you and ask you a number of questions about whether you have been feeling anxious or depressed. These questions usually take about 20-30 minutes to answer but more time may be required if you are having some symptoms. Also at 3 months, you will be sent some questionnaires which will assess your quality of life, general anxiety/depression level and how much alcohol you're drinking. These questionnaires should only take about 10-15 minutes to complete. We'll send you a reply paid envelope for you to post them back to us.

Are there any risks?:
Some people may find that talking about their accident is upsetting, especially those who are feeling depressed or anxious. However, all researchers in this project are trained mental health clinicians who will help you to decrease any distress that is experienced.

Confidentiality
Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will only be disclosed with your permission or except as required by law. If you give

us your permission by signing this document, we plan to publish the results in professional journals. In any publication, information will be provided in such a way that you cannot be identified.

Do you have a choice?:
Your decision whether or not to participate is fully voluntary, will not influence your eligibility for treatment, and will not prejudice your future relations with Westmead Hospital. If you decide to participate, you are free to withdraw your consent at any time and discontinue participation without prejudice.

Complaints

If you have any concerns about the conduct of the study, or your rights as a study participant, you may contact the Westmead Hospital Patient Representative, Ms Jillian Gwynne Lewis, Telephone No 9845 7014 or email jillian_lewis@wsahs.nsw.gov.au

Contact details

If you have any problems while on the study, please contact **Professor Richard Bryant-**
Working hours Telephone No –9385 3640

CONSENT TO PARTICIPATE IN RESEARCH

Title of Research Project:
Screening for Psychopathology following injury

Name of Researcher: Professor Richard Bryant and Leah Campbell

1. I understand that the researcher will conduct this study in a manner conforming with ethical and scientific principles set out by the National Health and Medical Research Council of Australia and the Good Clinical Research Practice Guidelines of the Therapeutic Goods Administration.

2. I acknowledge that I have read, or have had read to me the Participant Information Sheet relating to this study. I acknowledge that I understand the Participant Information Sheet. I acknowledge that the general purposes, methods, demands and possible risks and inconveniences which may occur to me during the study have been explained to me by _____ ("the researcher") and I, being over the age of 16 years or over the age of 14 years but under the age of 16 years (delete as applicable), acknowledge that I understand the general purposes, methods, demands and possible risks and inconveniences which may occur during the study.

3. I acknowledge that I have been given time to consider the information and to seek other advice.

4. I acknowledge that refusal to take part in this study will not affect the usual treatment of my condition.

5. I acknowledge that I am volunteering to take part in this study and I may withdraw at any time.

6. **I acknowledge that this research has been approved by the Sydney West Area Health Service Human Research Ethics Committee.**

7. **I acknowledge that I have received a copy of this form and the Participant Information Sheet, which I have signed.**

Name of participant _____Date of Birth _____

Address of participant _____

Name of parent or guardian (where applicable) _____

Address of parent or guardian (where applicable) _____

Signature of participant _____Date: _____

Signature of parent or guardian (where applicable) _____ Date: _____

Signature of researcher _____ Date: _____

Signature of witness _____ Date: _____

Statistical Summaries – Study 1

Table A 1.1

Summary Table for Differences Between Groups for Participant Characteristics in Terms of Time Distortion Experience at Initial Assessment and Three-Month Follow-up

Dependent Variable	(I)	(J)	t	df	Sig.	Mean diff. (2-tailed)	SE	95% CI (I-J)
				Initial Assessment				
Age	NTD	TD	-0.16	462	.875	-0.26	1.67	-3.54, 3.01
Days Since Injury	NTD	TD	1.92	459	.055	117.68	61.29	-2.78, 238.13
Pain	NTD	TD	0.48	398	.631	0.39	0.82	-1.21, 1.99
Heart Rate	NTD	TD	-0.42	451	.677	-0.90	2.17	-5.16, 3.35
Loss of Consciousness[a]	NTD	TD	-1.24	451	.217	-0.17	0.14	-0.47, 0.10
CAPS-2	NTD	TD	-6.28	460	.000***	-14.13	2.25	-18.55, -9.71
HADS-A	NTD	TD	-3.79	440	.000***	-1.86	0.49	-2.28, -0.90
HADS-D	NTD	TD	-2.26	440	.024*	-1.10	0.48	-2.05, -0.14
PRS	NTD	TD	-7.60	450	.000***	-12.58	1.66	-15.84, -9.33
				3-Month Follow-Up				
CAPS-2	NTD	TD	-5.86	460	.000***	-10.56	1.80	-14.10, -7.02
HADS-A	NTD	TD	-4.22	378	.000***	-2.48	0.59	-3.63, -1.32
HADS-D	NTD	TD	-3.09	378	.003**	-1.67	0.54	-2.73, -0.61

Note. [a]Loss of Consciousness measured in minutes. NTD= No Time Distortion, TD= Time Distortion. CAPS-2 = Clinician Administered PTSD Scale-2, HADS-A = Hospital Anxiety and Depression Scale – Anxiety Subscale, HADS-D = Hospital Anxiety and Depression Scale – Depression Subscale, PRS = Physical Reactions Scale. *$p < .05$, **$p < .01$, ***$p < .001$.

Table A 1.2

Chi-square Summary Table for Differences in PTSD Diagnosis at Three-Months on Time Distortion Experience

	Value	df	Asymp. Sig. (2 sided)	Exact Sig (2 sided)	.Exact Sig. (1 sided)
Pearson Chi-Square	11.834	1	.001		
Continuity Correction	10.432	1	.001		
Likelihood Ratio	10.076	1	.002		
Fisher's Exact Test				.001	.001
Linear-by-linear Association	11.805	1	.001		
Number of Valid Cases	409				

Consent Form - Study 2

SYDNEY WEST
Area Health Service

PARTICIPANT INFORMATION

Title of Project:
Screening for Psychopathology Following Injury

Names of Investigators:
Professor Richard Bryant and Leah Campbell

What is the purpose of the study?:
The purpose of this project is to identify how well individuals adjust following being injured and what factors influence this adjustment. Previous experience has shown that although most people who are injured cope well with their experience, some find it a real struggle. This research aims to identify the factors which may increase or decrease one's risk for developing mental health problems following injury. By doing this, this research aims to improve future patient care.

Who will be invited to enter the study?:
All adult patients who are admitted to Westmead Hospital following a traumatic injury will be invited to participate.

What will happen on the study?:
If you decide to participate, participation in this project will involve answering questions about your medical and psychological history, your experience of the event that caused your injuries, how you are currently feeling and about how you think you'll cope with the injuries. A research nurse will ask you most of the questions and then she will ask you to complete a few questions by yourself. On average, this assessment will take about 45-60 minutes. Some of this interview will be audiotaped so the researchers can evaluate the content of your reports.

Are there any risks?:
Some people may find that talking about their accident is upsetting, especially those who are feeling depressed or anxious. However, all researchers in this project are trained mental health clinicians who will help you to decrease any distress that is experienced.

Confidentiality
Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will only be disclosed with your permission or except as required by law. If you give us your permission by signing this document, we plan to publish the results in professional journals. In any publication, information will be provided in such a way that you cannot be identified.

Do you have a choice?:
Your decision whether or not to participate is fully voluntary, will not influence your eligibility for treatment, and will not prejudice your future relations with Westmead Hospital. If you decide to participate, you are free to withdraw your consent at any time and discontinue participation without prejudice.

Complaints

If you have any concerns about the conduct of the study, or your rights as a study participant, you may contact the Westmead Hospital Patient Representative, Ms Jillian Gwynne Lewis, Telephone No 9845 7014 or email jillian_lewis@wsahs.nsw.gov.au

Contact details

If you have any problems while on the study, please contact **Professor Richard Bryant-**
Working hours Telephone No –9385 3640

CONSENT TO PARTICIPATE IN RESEARCH

Title of Research Project:
Screening for Psychopathology following injury

Name of Researcher: Professor Richard Bryant and Leah Campbell

1. I understand that the researcher will conduct this study in a manner conforming with ethical and scientific principles set out by the National Health and Medical Research Council of Australia and the Good Clinical Research Practice Guidelines of the Therapeutic Goods Administration.

2. I acknowledge that I have read, or have had read to me the Participant Information Sheet relating to this study. I acknowledge that I understand the Participant Information Sheet. I acknowledge that the general purposes, methods, demands and possible risks and inconveniences which may occur to me during the study have been explained to me by _____ ("the researcher") and I, being over the age of 16 years or over the age of 14 years but under the age of 16 years (delete as applicable), acknowledge that I understand the general purposes, methods, demands and possible risks and inconveniences which may occur during the study.

3. I acknowledge that I have been given time to consider the information and to seek other advice.

4. I acknowledge that refusal to take part in this study will not affect the usual treatment of my condition.

5. I acknowledge that I am volunteering to take part in this study and I may withdraw at any time.

6. **I acknowledge that this research has been approved by the Sydney West Area Health Service Human Research Ethics Committee.**

7. I acknowledge that I have received a copy of this form and the Participant Information Sheet, which I have signed.

Name of participant _____Date of Birth _____

Address of participant _____

Name of parent or guardian (where applicable) _____

Address of parent or guardian (where applicable) _____

Signature of participant _____Date: _____

Signature of parent or guardian (where applicable) _____Date: _____

Signature of researcher _____Date: _____

Signature of witness _____Date: _____

Statistical Summaries – Study 2

Table A 1.3

Summary Table for Differences Between Groups for Participant Characteristics in Terms of Time Distortion Experience

Dependent Variable	(I)	(J)	t	df	Sig.	Mean diff. (2-tailed)	SE	95% CI (I-J)
Months Since Trauma	NTD	TD	1.31	24	.203	24.20	18.51	-14.00, 62.41
IES (I)	NTD	TD	-1.17	24	.255	-4.00	3.43	11.08, 3.08
IES (A)	NTD	TD	-0.92	24	.367	-3.37	3.67	-10.94, 4.20
BDI-II	NTD	TD	-1.50	24	.147	-8.70	5.81	-20.69, 3.29
BAI	NTD	TD	-3.63	24	.003*	-19.27	5.73	-31.10, -7.45
CAPS-2	NTD	TD	-1.98	24	.060	-24.76	12.54	-50.64, 1.12
Age	NTD	TD	-0.99	24	.334	-4.46	4.53	-13.82, 4.89

Note. NTD= No Time Distortion, TD= Time Distortion. BAI = Beck Anxiety Inventory, BDI-II = Beck Depression Inventory-II, CAPS-2 = Clinician Administered PTSD Scale-2, IES-A = Impact of Events – Avoidance, IES-I = Impact of Event Scale – Intrusions. *p < .01

Table A 1.4

Chi-square Summary Table for Differences in Anticipation on Time Distortion Experience

	Value	df	Asymp. Sig. (2 sided)	Exact Sig. (2 sided)	Exact Sig. (1 sided)
Pearson Chi-Square	4.473	1	.034		
Continuity Correction	2.926	1	.087		
Likelihood Ratio	4.712	1	.030		
Fisher's Exact Test				.050	.042
Linear-by-linear Association	4.301	1	.038		
Number of Valid Cases	26				

Table A 1.5

Chi-square Summary Table for Differences in Pain on Time Distortion Experience

	Value	df	Asymp. Sig. (2 sided)	Exact Sig. (2 sided)	Exact Sig (1 sided)
Pearson Chi-Square	1.924	1	.165		
Continuity Correction	0.968	1	.325		
Likelihood Ratio	1.948	1	.163		
Fisher's Exact Test				.238	.163
Linear-by-linear Association	1.874	1	.174		
Number of Valid Cases	25				

Appendix 2

TIME DISTORTION AND AROUSAL

STUDIES 3, 4 & 5

Consent Forms - Study 3

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

Psychological and Physiological Factors Affecting Time Perception

You are invited to participate in a study of peoples' perception of time. We hope to learn how various psychological and physiological factors affect peoples' experience of time.

If you decide to participate in this study, the experimenter will ask you to complete a questionnaire. You will then be played a number of sounds and asked to estimate their duration. Following that you will engage in some non-related tasks requiring you to sort cards into categories. You will then be asked to spend 3 minutes, either sitting normally, or listening to a tape instructing you to speed up your breathing rate before being played more sounds and again asked to estimate their duration. Finally, you will complete two more questionnaires relating to your experiences during the experiment.

It is expected that it will take you about 40-50 minutes to complete this study. It is possible that you may experience some mild physical discomfort during the increased breathing phase of the experiment. This is expected to be minimal and should not last longer than 5 minutes. Please note that if you do feel any discomfort or suffer any inconvenience, you are free to withdraw from the study at any time.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to publish the results of this study in psychological journals, and present results at psychological conferences. Results of this study will be disclosed in order to inform the relevant disciplines about the effect of different psychological and physiological variables on time perception, in a way that may inform clinical research and practice. In any publication or presentation, information will be provided in such a way that you cannot be identified.

Your decision whether or not to participate will not prejudice your future relations with The University of New South Wales. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice.

If you have any questions, please feel free to ask us. If you have any additional questions later, Ms Leah Campbell, 9385 8758 or Professor Richard Bryant, 9385 3640 will be happy to answer them.

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).

You will be given a copy of this form to keep.

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM (continued)
Psychological and Physiological Factors Affecting Time Perception

You are making a decision whether or not to participate. Your signature indicates that, having read the information provided above, you have decided to participate.

……	…….
Signature of Research Participant	Signature of Parent or Guardian (when relevant)
……	…….
(Please PRINT name)	(Please PRINT name)
……	…….
Date	Nature of Witness

……
Signature(s) of Investigator(s)

…….
(Please PRINT Name)

REVOCATION OF CONSENT

Psychological and Physiological Factors Affecting Time Perception

I hereby **WITHDRAW** my consent to participate in the research proposal described above and direct that any data collected from me be destroyed.

I understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales.

…… …….

Signature Date

……

Please PRINT Name

The section for Revocation of Consent should be forwarded to Leah Campbell, School of Psychology, University of New South Wales, Sydney, 2052, Australia.

Statistical Summaries – Study 3

Table A 2.1

One-Way Analysis of Variance (ANOVA) Summary Table for Differences Across Groups for Pre and Post Dissociative Experiences and Physical Reactions

Participant Characteristic	Source	SS	df	MS	F	Sig.
PDEQ	Between Groups	1305.51	1	1305.51	63.94	.000*
	Within Groups	2123.56	104	20.42		
	Total	3429.09	105			
PRS	Between Groups	2660.01	1	2660.01	76.12	.000*
	Within Groups	3634.26	104	34.95		
	Total	6294.27	105			

Note. PDEQ = Peritraumatic Dissociative Experiences Questionnaire, PRS = Physical Reactions Scale. *p<.001

Table A 2.2

T-Test Summary Table for Differences Between Low and High Arousal Groups in Terms of Duration Estimates

Dependent Variable	(I)	(J)	t	df	Sig. (2-tailed)	Mean diff. (I-J)	SE	95% CI
Duration Estimate	Low	High	2.26	104	.026*	.306	.135	.038, .578

Note. *p<.05

Table A 2.3

Pearson Correlation Summary Table of Duration Estimates, Dissociative Experiences, and Physical Reactions for Low and High Arousal Groups

	Duration Estimate	PDEQ	PRS
		Low Arousal	
Duration Estimate	1.00	-.016	-.073
(significance)		(.910)	(.603)
PDEQ	-	1.00	-.013
(significance)			(.926)
PRS	-	-	1.00
(significance)			
		High Arousal	
Duration Estimate	1.00	-.341*	-.415*
(significance)		(.013)	(.002)
PDEQ	-	1.00	.622*
(significance)			(.000)
PRS	-	-	1.00
(significance)			

Note. PDEQ = Peritraumatic Dissociative Experiences Questionnaire, PRS = Physical Reactions Scale. *p < .05

Consent Form - Study 4

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

A study of memory and skydiving

You are invited to participate in a study of memory. We hope to learn about the way in which different features of the skydiving experience influence people's memory.

If you decide to participate, before you complete your skydive the experimenter will ask you to complete some information about yourself and your skydive. It should take you approximately 5 minutes to do this. After you have completed your skydive you will be asked to answer a few short questions relating to your experience. This should take approximately 10 minutes.

It is expected that it will take you about 15 minutes to complete this study. The experimenter does not expect that you will suffer any inconvenience or discomfort as a result of this study. Please note that if you do feel any discomfort or suffer any inconvenience, you are free to withdraw from the study at any time.

The experimenter does not reasonably expect any risks involved with your participation in this study. The experimenter also cannot and does not guarantee or promise that you will receive any benefits from this study.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to publish the results of this study in psychological journals, and present results at psychological conferences. Results of this study will be disclosed in order to inform the relevant disciplines about the effect of different psychological variables on memory, in a way that may inform clinical research and practice. In any publication or presentation, information will be provided in such a way that you cannot be identified.

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).

Your decision whether or not to participate will not prejudice your future relations with The University of New South Wales or the Sydney Skydiving Centre. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice.

If you have any questions, please feel free to ask us. If you have any additional questions later, Ms Leah Campbell (9385 8758) or Professor Richard Bryant (9385 3640) will be happy to answer them.

You will be given a copy of this form to keep.

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM (continued)

A study of memory and skydiving

You are making a decision whether or not to participate. Your signature indicates that, having read the information provided above, you have decided to participate.

……	…….
Signature of Research Participant	Signature of Witness
……	…….
(Please PRINT name)	(Please PRINT name)
……	…….
Date	Nature of Witness

……

Signature(s) of Investigator(s)

…….

Please PRINT Name

REVOCATION OF CONSENT

A study of memory and skydiving

I hereby wish to **WITHDRAW** my consent to participate in the research proposal described above and understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales.

…… **…….**

Signature

Date

……

Please PRINT Name

The section for Revocation of Consent should be forwarded to Leah Campbell, School of Psychology, University of New South Wales, Sydney, 2052, Australia.

Statistical Summaries – Study 4

Table A 2.4

Pearson Correlation Summary Table for Skydive Duration Estimates and Fear and Excitement Ratings Pre and During the Dive

	Duration Estimate	Fear	Excitement
		Pre Dive	
Duration Estimate	1.00	.478*	-.3.22*
(significance)		(.000)	(.009)
Fear	-	1.00	-.046
(significance)			(.696)
Excitement	-	-	1.00
(significance)			
		During Dive	
Duration Estimate	1.00	-.536*	-.292
(significance)		(.000)	(.019)
Fear	-	1.00	-.213
(significance)			(.083)
Excitement	-	-	1.00
(significance)			

Note. *p<.01

Consent Forms – Study 5

(HYPNOSIS CONDITION)

THE UNIVERSITY OF NEW SOUTH WALES
PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

Indexing the Subjective Experiences of Hypnosis

You are invited to participate in a study of individual differences in a range of hypnotic experiences, including memory and emotional states. This experiment is concerned with understanding the nature of hypnosis and hypnotic phenomena. You were selected as a possible participant in this study because we are interested in comparing the responses of people who vary in their hypnotic susceptibility. In addition to this, you participated in a screening session in a tutorial at the beginning of 2005 and agreed to return to the lab to take part in this study.

If you decide to participate, Dr Amanda Barnier and her associates will administer an hypnotic induction procedure, which will include a number of suggestions for different experiences. During the hypnosis session you will also complete a number of tasks. For instance, you will also be asked to describe some autobiographical memories and complete a short computer task. At the conclusion of the hypnosis, you will be given a debriefing about the aims of this experiment.

The whole experiment is expected to take approximately 2 hours. It is not expected that you will experience any discomfort or inconvenience. However, some of the descriptions that you may generate may lead you to experience different moods (including positive and negative moods). The effects of these moods are usually temporary.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to publish the findings of the research in academic journals and/or present the findings at professional conferences and/or report the findings to the Australian Research Council. In any publication, information will be provided in such a way that you cannot be identified.

In exchange for your participation in this experiment, you will be learning about the process of psychological research and you will receive 2 hours of experimental research credit.

Complaints may be directed to the Ethics Secretariat, University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).

Your decision whether or not to participate will not prejudice your future relations with the University of New South Wales. If you decide to participate, **you are free to withdraw your consent and to discontinue**

participation at any time without prejudice. Note, you will receive your research credit prior to the commencement of the experiment.

If you have any questions, please feel free to ask us. If you have any additional questions later, Dr Amanda Barnier (02 9385 3830) will be happy to answer them.

THE UNIVERSITY OF NEW SOUTH WALES

CONSENT FORM

Indexing the Subjective Experiences of Hypnosis

1. I, ... of .....
......, aged .....years,
agree to participate as a subject in the experiment described in the Participant Information Statement set out above.

2. I acknowledge that I have read the Participant Information Statement, which explains the aims of the experiment and the nature and the possible risks of the investigation, and the statement has been explained to me to my satisfaction.

3. Before signing this Consent Form, I have been given the opportunity to ask any questions relating to any possible physical and mental harm I might suffer as a result of my participation. I have received satisfactory answers to any questions that I have asked.

4. I understand that I can withdraw from the experiment at any time without prejudice to my relationship to the University of New South Wales.

5. I agree that research data gathered from the results of the study may be published, provided that I cannot be identified.

6. I understand that if I have any questions relating to my participation in this research, I may contact Dr Amanda Barnier on telephone (02) 9385 3830, who will be happy to answer them.

   Complaints may be directed to the Ethics Secretariat, University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).

_____	_____
Signature of participant	Signature of witness
_____	_____
Please PRINT name	Please PRINT name
_____	_____
Date	Nature of witness

REVOCATION OF CONSENT

Indexing the Subjective Experiences of Hypnosis

I hereby wish to **WITHDRAW** my consent to participate in the research proposal described above and understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales.

_____
Signature

_____
Please PRINT Name

_____
Date

The section for Revocation of Consent should be forwarded to Leah Campbell, School of Psychology, University of New South Wales, Sydney 2052, AUSTRALIA.

(WAKE CONDITION)

THE UNIVERSITY OF NEW SOUTH WALES
PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

Individual Differences in Memory and Information Processing

You are invited to participate in a study of individual differences in a range of experiences, including memory and emotional states. This experiment is concerned with understanding the nature of how people remember and forget personal events and our experiences and awareness of the world.

If you decide to participate, Dr Amanda Barnier and her associates will ask you to complete a number of different tasks, which will include instructions for different experiences. During the session you will also be asked to describe some autobiographical memories and complete a short computer task. At the conclusion of the session, you will be given a debriefing about the aims of this experiment.

The whole experiment is expected to take approximately 2 hours. It is not expected that you will experience any discomfort or inconvenience. However, some of the descriptions that you may generate may lead you to experience different moods (including positive and negative moods). The effects of these moods are usually temporary.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to publish the findings of the research in academic journals and/or present the findings at professional conferences and/or report the findings to the Australian Research Council. In any publication, information will be provided in such a way that you cannot be identified.

In exchange for your participation in this experiment, you will be learning about the process of psychological research and you will receive 2 hours of experimental research credit.

Complaints may be directed to the Ethics Secretariat, University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).

Your decision whether or not to participate will not prejudice your future relations with the University of New South Wales. If you decide to participate, **you are free to withdraw your consent and to discontinue participation at any time without prejudice**. Note, you will receive your research credit prior to the commencement of the experiment.

If you have any questions, please feel free to ask us. If you have any additional questions later, Dr Amanda Barnier (02 9385 3830) will be happy to answer them.

THE UNIVERSITY OF NEW SOUTH WALES

CONSENT FORM

Individual Differences in Memory and Information Processing

1. I, ... of .....
......, aged .....years,
agree to participate as a subject in the experiment described in the Participant Information Statement set out above.

2. I acknowledge that I have read the Participant Information Statement, which explains the aims of the experiment and the nature and the possible risks of the investigation, and the statement has been explained to me to my satisfaction.

3. Before signing this Consent Form, I have been given the opportunity to ask any questions relating to any possible physical and mental harm I might suffer as a result of my participation. I have received satisfactory answers to any questions that I have asked.

4. I understand that I can withdraw from the experiment at any time without prejudice to my relationship to the University of New South Wales.

5. I agree that research data gathered from the results of the study may be published, provided that I cannot be identified.

6. I understand that if I have any questions relating to my participation in this research, I may contact Dr Amanda Barnier on telephone (02) 9385 3830, who will be happy to answer them.

Complaints may be directed to the Ethics Secretariat, University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).

_____	_____
Signature of participant	Signature of witness
_____	_____
Please PRINT name	Please PRINT name
_____	_____
Date	Nature of witness

REVOCATION OF CONSENT

Individual Differences in Memory and Information Processing

I hereby wish to **WITHDRAW** my consent to participate in the research proposal described above and understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales.

_____
Signature

_____
Please PRINT Name

_____
Date

The section for Revocation of Consent should be forwarded to Leah Campbell, School of Psychology, University of New South Wales, Sydney 2052, AUSTRALIA.

Statistical Summaries – Study 5

Table A 2.5

Pearson Correlation Summary Table of Subjective Temperature Ratings and Participant Characteristics in Terms of Hypmotisability

	Cold	Hot	HGSHS:A	SHSS:C
Cold (significance)	1.00	-.003 (.980)	.425* (.000)	.506* (.000)
Hot (significance)	-	1.00	.476* (.000)	.522* (.000)
HGSHS:A (significance)	-	-	1.00	.965* (.000)
SHSS:C (significance)	-	-	-	1.00

Note. HGSHS:A = Harvard Group Scale of Hypnotic Susceptibility, Form A; SHSS:C = Stanford Hypnotic Susceptibility Scale, Form C. *p<.001

Table A 2.6

T-Test Summary Table for Effect of Order of Temperature Induction on Total Duration Estimates Following Each Induction and Subjective Temperature Ratings

Dependent Variable	(I)	(J)	t	df	Sig. (2-tailed)	Mean diff. (I-J)	SE	95% CI
				Duration Estimates				
Hot Total	Cold	Hot	-1.41	56.21	.159	-3.45	2.42	-8.30, 1.39
Cold Total	Hot	Cold	0.16	72	.877	0.25	1.60	-2.94, 3.44
				Subjective Temperature Rating				
Hot Rating	Cold	Hot	-.015	72	.885	-0.04	0.29	-0.63, 0.54
Cold Rating	Hot	Cold	0.22	72	.828	0.07	0.34	-0.60, 0.75

Table A 2.7

Repeated Measures ANOVA Summary Table for Hypnotisability, Hypnotic Condition, and Temperature Induction on Total Duration Estimates

	Value	F	Hypothesis df	Error df	Sig,
		Main Effects			
Induction	.950	3.66	1	69	.060
Hypnotisability		7.51	1	69	.008*
Condition		9.57	1	69	.003*
		Two-way Interactions			
Induction X Hypnotisability	.971	2.09	1	69	.153
Induction X Condition	.918	6.17	1	69	.015*
Hypnotisability X Condition		0.53	1	69	.469
		Three-way Interactions			
Induction X Hypnotisability X Condition	.937	4.63	1	69	.035*

Note. *p<.05. Values based on Wilks' Lambda

Table A 2.8

Repeated Measures ANOVA Summary Table for Post-hoc Comparisons on Hypnotic Condition for High and Low Hypnotisable Participants

	Value	F	Hypothesis df	Error df	Sig,
	Low Hypnotisable				
Induction X Condition	.989	0.37	1	35	.546
	High Hypnotisable				
Induction X Condition	.857	5.65	1	34	.023*

Note. *p<.05. Values based on Wilks' Lambda

Table A 2.9

Paired Samples T-Test Summary Table for Post-hoc Comparison of Time Estimates for Highly Hypnotisable Hypnotised Participants as a Function of Temperature Induction

Dependent Variable	(I)	(J)	t	df	Sig. (2-tailed)	SE	95% CI
Duration Estimate	Hot	Cold	2.09	16	.05*	3.14	-.06, 13.24

Note. *p<.05

Appendix 3

TIME DISTORTION AND EMOTIONAL VALENCE

STUDIES 6a, 6b, 7 & 8

Consent Form - Study 6a

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

Psychological and Physiological Factors Affecting Time Perception

You are invited to participate in a study of peoples' perception of time. We hope to learn how various psychological and physiological factors affect peoples' experience of time.

If you decide to participate in this study, the experimenter will ask you to complete a number of questionnaires. You will then be asked to watch a brief slide show, and answer a short question relating to that.

It is expected that it will take you about 40-50 minutes to complete this study. It is possible that you may experience some mild anxiety while watching the slideshow. If this occurs it is expected to be minimal and should not last more than a few minutes. Please note that if you do feel any discomfort or suffer any inconvenience, you are free to withdraw from the study at any time.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to publish the results of this study in psychological journals, and present results at psychological conferences. Results of this study will be disclosed in order to inform the relevant disciplines about the effect of different psychological and physiological variables on time perception, in a way that may inform clinical research and practice. In any publication or presentation, information will be provided in such a way that you cannot be identified.

Your decision whether or not to participate will not prejudice your future relations with The University of New South Wales. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice.

If you have any questions, please feel free to ask us. If you have any additional questions later, Ms Leah Campbell, 9385 8758 or Professor Richard Bryant, 9385 3640 will be happy to answer them.

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).

You will be given a copy of this form to keep.

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM (continued)
Psychological and Physiological Factors Affecting Time Perception

You are making a decision whether or not to participate. Your signature indicates that, having read the information provided above, you have decided to participate.

……	…….
Signature of Research Participant	Signature of Parent or Guardian (when relevant)
……	…….
(Please PRINT name)	(Please PRINT name)
……	…….
Date	Nature of Witness

……
Signature(s) of Investigator(s)

…….
Please PRINT Name

REVOCATION OF CONSENT

Psychological and Physiological Factors Affecting Time Perception

I hereby **WITHDRAW** my consent to participate in the research proposal described above and direct that any data collected from me be destroyed.

I understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales.

…… **…….**

Signature

Date

……

Please PRINT Name

The section for Revocation of Consent should be forwarded to Leah Campbell, School of Psychology, University of New South Wales, Sydney, 2052, Australia.

Statistical Summaries – Study 6a

Table A 3.1

T-Test Summary Table for Participant Characteristics as a Function of Slideshow Condition

Dependent Variable	(I)	(J)	t	df	Sig. (2-tailed)	Mean diff. (I-J)	SE	95% CI
Age	N	E	-0.12	56	.910	-0.14	1.22	-2.57, 2.30
BDI	N	E	1.77	56	.082	3.41	1.93	-0.45, 7.28
BAI	N	E	0.94	56	.352	1.69	1.80	-1.92, 5.30

Note. *p<.05, N=Neutral, E=Emotional

Table A 3.2

One-Way Analysis of Variance (ANOVA) Summary Table for Differences Across Valence Conditions for Slideshow Duration Estimates

Dependent Variable	Source	SS	df	MS	F	Sig.
Duration Estimate	Between Groups	4224.57	1	4224.57	4.33	.042*
	Within Groups	54589.66	56	974.82		
	Total	58814.22	57			

Note. *p<.05

Table A 3.3

Pearson Correlation Summary Table of Duration Estimate and Emotionality Rating of Slideshow

	Duration Estimate	Rating
Duration Estimate	1.00	-.031*
(significance)		(.017)

Note. *p<.05

Study 6b – Consent Form

SYDNEY WEST
Area Health Service

PARTICIPANT INFORMATION

Title of Project:
Memory for Trauma

Names of Investigators:
Professor Richard Bryant and Leah Campbell

What is the purpose of the study?:
This study aims to examine memory in people who have been through traumatic experiences, particularly how people remember emotional experiences compared to other experiences. We are also interested in looking at your perception of time. By improving our understanding of how people remember traumatic experiences we will be better able to identify those people who will need help coping with their distress after a traumatic event. We will also be able to develop better treatments for helping these individuals.

Who will be invited to enter the study?:
You are invited to participate in a study of memory for trauma. You are being asked to take part in the study because you have experienced a trauma.

What will happen on the study?:
If you decide to participate, an experimenter will administer a number of questionnaires and interview you to assess how you are coping following your traumatic experience. The experimenter will ask you to watch a short slideshow and answer a simple question about it, before answering some questionnaires relating to your experiences during the experiment. Together these tasks should take approximately 1 hour.

Are there any risks?:
Often participants become distressed when recalling their trauma or talking about trauma-related symptoms, but this distress is usually temporary. If you become distressed when recalling your trauma, you can be referred to a counsellor, should you wish. It is also possible you may experience some mild anxiety while watching the slideshow. If this occurs it is expected to be minimal and should not last more than a few minutes. Every assistance will be given to you to manage your distress. You are free to withdraw at any time.

Confidentiality
Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will only be disclosed with your permission or except as required by law. If you give us your permission by signing this document, we plan to publish the results in professional journals. In any publication, information will be provided in such a way that you cannot be identified. Part of the interview will be taped so that your description of your experience can later be analysed in more detail. Audiotapes will be available to the Chief Investigator alone.

Do you have a choice?:
Your decision whether or not to participate is fully voluntary and will not prejudice your future relations with Westmead Hospital. If you decide to participate, you are free to withdraw consent at any time and discontinue participation without prejudice.

Complaints

If you have any concerns about the conduct of the study, or your rights as a study participant, you may contact the Westmead Hospital Patient Representative, Ms Jillian Gwynne Lewis, Telephone No 9845 7014 or email jillian_lewis@wsahs.nsw.gov.au

Contact details

If you have any problems while on the study, please contact **Professor Richard Bryant**

Working hours Telephone No –9385 3640
After hours Telephone No –0423987042

CONSENT TO PARTICIPATE IN RESEARCH

Title of Research Project:
Memory for Trauma

Name of Researcher:

1. I understand that the researcher will conduct this study in a manner conforming with ethical and scientific principles set out by the National Health and Medical Research Council of Australia and the Good Clinical Research Practice Guidelines of the Therapeutic Goods Administration.

2. I acknowledge that I have read, or have had read to me the Participant Information Sheet relating to this study. I acknowledge that I understand the Participant Information Sheet. I acknowledge that the general purposes, methods, demands and possible risks and inconveniences which may occur to me during

the study have been explained to me by _____ ("the researcher") and I, being over the age of 16 years or over the age of 14 years but under the age of 16 years (delete as applicable), acknowledge that I understand the general purposes, methods, demands and possible risks and inconveniences which may occur during the study.

3. I acknowledge that I have been given time to consider the information and to seek other advice.

4. I acknowledge that refusal to take part in this study will not affect the usual treatment of my condition.

5. I acknowledge that I am volunteering to take part in this study and I may withdraw at any time.

6. I acknowledge that this research has been approved by the Western Sydney Area Health Service Human Research Ethics Committee.

7. I acknowledge that I have received a copy of this form and the Participant Information Sheet, which I have signed.

Name of participant _____Date of Birth _____

Address of participant _____

Name of parent or guardian (where applicable) _____

Address of parent or guardian (where applicable) _____

Signature of participant _____Date: _____

Signature of parent or guardian (where applicable) _____Date: _____

Signature of researcher _____Date: _____

Signature of witness _____ Date:_____

Statistical Summaries – Study 6b

Table A 3.4

Summary Table for Differences Between PTSD and Trauma-Exposed Non-PTSD Groups for Participant Characteristics

Dependent Variable	(I)	(J)	t	df	Sig. (2-tailed)	Mean diff. (I-J)	SE	95% CI
Age	Non	PTSD	-1.30	57	.199	-3.89	2.99	-9.88, 2.10
Months Since Trauma	Non	PTSD	0.91	56	.365	15.83	17.31	-18.85, 50.51
CAPS-2	Non	PTSD	-11.44	46.54	.000*	-52.23	4.57	-61.42, -43.05
IES (I)	Non	PTSD	-6.32	55	.000*	-14.56	2.30	-19.19, -9.93
IES (A)	Non	PTSD	-9.11	55	.000*	-17.81	1.96	-21.73, -13.89
BDI	Non	PTSD	-6.57	57	.000*	-19.39	2.95	-25.30, -13.48
BAI	Non	PTSD	-4.82	48.19	.000*	-15.24	3.16	-21.59, -8.88

Note. BAI = Beck Anxiety Inventory, BDI-II = Beck Depression Inventory-II, CAPS-2 = Clinician Administered PTSD Scale-2, IES-A = Impact of Events – Avoidance, IES-I = Impact of Event Scale – Intrusions. *p<.0001

Table A 3.5

Analysis of Variance (ANOVA) Summary Table for Slideshow Duration Estimates by Diagnostic Group as a Function of Valence

Source	MSE	df	F	Sig.
		Main Effects		
Group	9375.00	1	8.38	.005*
Slide Version	5415.00	1	4.84	.032*
		Two-Way Interaction		
Group X Slide Version	2535.00	1	2.27	.138
Error	1118.57	56		

Note. *p<.05

Table A 3.6

Pearson Correlation Summary Table of Emotionality Rating of Slideshow Valence

	Slideshow Valence	Rating
Slideshow Valence	1.00	-.45*
(significance)		(.001)

Note. *p<.05

Study 7 – Consent Form

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

Psychological and Physiological Factors Affecting Time Perception

You are invited to participate in a study of peoples' perception of time. We hope to learn how various psychological and physiological factors affect peoples' experience of time.

If you decide to participate in this study, the experimenter will ask you to complete a number of questionnaires. You will be asked to listen to a tape instructing you to either increase or decrease your rate of breathing, which will last about 3 minutes. Following that you will watch a slideshow, and answer a short question relating to that. Finally, you will be asked to answer a number of questionnaires relating to your experience during the experiment. Your heart rate and skin conductance responses will be measured throughout the experiment.

It is expected that it will take you about 1 hour to complete this study. It is possible that you may experience some mild physical discomfort during the phase of the experiment where you are asked to change your breathing rate. This is expected to be minimal and should not last longer than 5 minutes. Please note that if you do feel any discomfort or suffer any inconvenience, you are free to withdraw from the study at any time.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to publish the results of this study in psychological journals, and present results at psychological conferences. Results of this study will be disclosed in order to inform the relevant disciplines about the effect of different psychological and physiological variables on time perception, in a way that may inform clinical research and practice. In any publication or presentation, information will be provided in such a way that you cannot be identified.

Your decision whether or not to participate will not prejudice your future relations with The University of New South Wales. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice.

If you have any questions, please feel free to ask us. If you have any additional questions later, Ms Leah Campbell, 9385 8758 or Professor Richard Bryant, 9385 3640 will be happy to answer them.

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).

You will be given a copy of this form to keep.

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM (continued)
Psychological and Physiological Factors Affecting Time Perception

You are making a decision whether or not to participate. Your signature indicates that, having read the information provided above, you have decided to participate.

……	…….
Signature of Research Participant	Signature of Parent or Guardian (when relevant)
……	…….
(Please PRINT name)	(Please PRINT name)
……	…….
Date	Nature of Witness

……
Signature(s) of Investigator(s)

……
Please PRINT Name

REVOCATION OF CONSENT

Psychological and Physiological Factors Affecting Time Perception

I hereby **WITHDRAW** my consent to participate in the research proposal described above and direct that any data collected from me be destroyed.

I understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales.

…… **…….**

Signature Date

……

Please PRINT Name

The section for Revocation of Consent should be forwarded to Leah Campbell, School of Psychology, University of New South Wales, Sydney, 2052, Australia.

Statistical Summaries – Study 7

Table A 3.7

Repeated Measures ANOVA Summary Table for Skin Conductance Responses as a Function of Experimental Phase and Arousal Condition

	Value	F	Hypothesis df	Error df	Sig,
Main Effects					
Phase	.690	12.83	2	57	.000
Breathing Condition		0.34	1	58	.562
Two-Way Interaction					
Phase X Breathing Condition	.820	6.24	2	57	.004

Note. *p<.05. Values based on Wilks' Lambda

Table A 3.8

Paired Samples T-Test Summary Table for Post-hoc Comparison of Skin Conductance Responses Over Experimental Phases According to Breathing Induction

Dependent Variable	(I)	(J)	t	df	Sig. (2-tailed)	Mean Diff (I-J)	SE	95% CI	
					Relaxation				
SCR	BL	Induct	-1.25	29	.221	.373	-0.47	-1.23,	0.30
	BL	Exp	-1.09	29	.286	.461	-0.50	-1.44,	0.44
	Induct	Exp	-0.12	29	.906	.291	-0.04	-0.64,	0.57
					Hyperventilation				
SCR	BL	Induct	-6.34	29	.000*	.299	-1.90	-2.51,	-1.29
	BL	Exp	-4.49	29	.000*	.243	-1.09	-1.59,	-0.59
	Induct	Exp	5.11	29	.000*	.158	0.81	0.49,	1.13

Note. SCR = Skin Conductance Response, BL = Baseline Phase, Induct = Induction Phase, Exp = Experimental Period. *p<.05

Table A 3.9

Repeated Measures ANOVA Summary Table for Heart Rate as a Function of Experimental Phase and Arousal Condition

	Value	F	Hypothesis df	Error df	sig.
Main Effects					
Phase	.546	23.67	2	57	.000*
Breathing Condition		0.83	1	58	.351
Two-Way Interaction					
Phase X Breathing Condition	.636	16.30	2	57	.000*

Note. *p<.05. Values based on Wilks' Lambda

Table A 3.10

Paired Samples T-Test Summary Table for Post-hoc Comparison of Heart Rate Over Experimental Phases According to Breathing Induction

Dependent Variable	(I)	(J)	t	df	Sig. (2-tailed)	Mean Diff (I-J)	SE	95% CI	
					Relaxation				
HR	BL	Induct	-1.51	29	.141	-1.63	1.08	-3.83,	-1.51
	BL	Exp	-1.98	29	.057	-1.92	0.98	-3.90,	-1.98
	Induct	Exp	-0.34	29	.736	-0.29	0.85	-2.03,	-0.34
					Hyperventilation				
HR	BL	Induct	-7.20	29	.000*	-12.67	1.76	-16.27,	-9.08
	BL	Exp	-1.16	29	.256	-1.18	1.02	-3.27,	0.91
	Induct	Exp	5.84	29	.000*	11.49	1.97	7.47,	5.84

Note. HR = Heart Rate, BL = Baseline Phase, Induct = Induction Phase, Exp = Experimental Period. *p<.0001

Table A 3.11

Analysis of Variance (ANOVA) Summary Table for Slideshow Duration Estimates as a Function of Valence and Breathing Induction

Source	MSE	df	F	Sig.
	Main Effects			
Valence	735.00	1	0.79	.379
Induction	1815.00	1	1.94	.169
	Two-Way Interaction			
Valence X Induction	4860.00	1	5.19	.027*
Error	52440.00	56		

Note. *p<.05

Table A 3.12

T-Test Summary Table for Follow-up Comparisons of Breathing Induction on Duration Estimates According to Slideshow Valence

Dependent Variable	(I)	(J)	t	df	Sig. (2-tailed)	Mean diff. (I-J)	SE	95% CI
				Neutral Slideshow				
Duration Estimate	Relax	Hyper	.748	28	.461	7.00	9.34	-12.17, 26.17
				Emotional Slideshow				
Duration Estimate	Relax	Hyper	-2.28	28	.031*	-29.00	12.73	-55.08, -2.92

Note. Relax = Relaxation Condition, Hyper – Hyperventilation Condition. *p<.05

Table A 3.13

Pearson Correlation Summary Table of Slideshow Duration Estimates, Emotionality, and Breathing Induction Ratings

	Duration Estimate	Emotionality	Breathing Induction
Duration Estimate	1.00	-0.45*	-.0.32*
(significance)		(.000)	(.013)
Emotionality	-	1.00	.012
(significance)			(.929)
Induction Rating	-	-	1.00
(significance)			

Note. *p<.05

Study 8 – Consent Form

SYDNEY WEST
Area Health Service

PARTICIPANT INFORMATION

Title of Project:
Memory for Trauma

Names of Investigators:
Professor Richard Bryant and Leah Campbell

What is the purpose of the study?:
This study aims to examine memory in people who have been through traumatic experiences, particularly how people remember traumatic experiences compared to other experiences. We are also interested in looking at your perception of time. By improving our understanding of how people remember traumatic experiences we will be better able to identify those people who will need help coping with their distress after a traumatic event. We will also be able to develop better treatments for helping these individuals.

Who will be invited to enter the study?:
You are invited to participate in a study of memory for trauma. You are being asked to take part in the study because you have experienced a trauma.

What will happen on the study?:
If you decide to participate, an experimenter will administer a number of questionnaires and interview you to assess how you are coping following your traumatic experience. The experimenter will ask you to recall the trauma, and describe your memory for it in as much detail as possible. You will also be asked to try and remember a positive and a non-emotional experience from around the same time as your trauma, while at the same time doing a short computer task. You will be asked some questions about your memories for all three of these events. Together, these tasks should take approximately 1- 1 ½ hours.

Are there any risks?:
Often participants become distressed when recalling their trauma, but this distress is usually temporary. If you become distressed when recalling your trauma, you can be referred to a counsellor, should you wish. Every assistance will be given to you to manage your distress. You are free to withdraw at any time.

Confidentiality
Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will only be disclosed with your permission or except as required by law. If you give us your permission by signing this document, we plan to publish the results in professional journals. In any publication, information will be provided in such a way that you cannot be identified. Part of the interview will be taped so that your description of your experience can later be analysed in more detail. Audiotapes will be available to the Chief Investigator alone.

Do you have a choice?:
Your decision whether or not to participate is fully voluntary and will not prejudice your future relations with Westmead Hospital. If you decide to participate, you are free to withdraw consent at any time and discontinue participation without prejudice.

Complaints

If you have any concerns about the conduct of the study, or your rights as a study participant, you may contact the Westmead Hospital Patient Representative, Ms Jillian Gwynne Lewis, Telephone No 9845 7014 or email jillian_lewis@wsahs.nsw.gov.au

Contact details

If you have any problems while on the study, please contact **Professor Richard Bryant**

Working hours Telephone No –9385 3640
After hours Telephone No –0423987042

CONSENT TO PARTICIPATE IN RESEARCH

Title of Research Project:
Memory for Trauma

Name of Researcher:

1. I understand that the researcher will conduct this study in a manner conforming with ethical and scientific principles set out by the National Health and Medical Research Council of Australia and the Good Clinical Research Practice Guidelines of the Therapeutic Goods Administration.

2. I acknowledge that I have read, or have had read to me the Participant Information Sheet relating to this study. I acknowledge that I understand the Participant Information Sheet. I acknowledge that the general purposes, methods, demands and possible risks and inconveniences which may occur to me during the study have been explained to me by _____ ("the researcher") and I, being over the age of 16 years or over the age of 14 years but under the age of 16 years (delete as applicable), acknowledge that I understand the general purposes, methods, demands and possible risks and inconveniences which may occur during the study.

3. I acknowledge that I have been given time to consider the information and to seek other advice.

4. I acknowledge that refusal to take part in this study will not affect the usual treatment of my condition.

5. I acknowledge that I am volunteering to take part in this study and I may withdraw at any time.

6. **I acknowledge that this research has been approved by the Western Sydney Area Health Service Human Research Ethics Committee.**

7. **I acknowledge that I have received a copy of this form and the Participant Information Sheet, which I have signed.**

Before signing, please read 'IMPORTANT NOTE' following.

Name of participant _____Date of Birth _____

Address of participant _____

Name of parent or guardian (where applicable) _____

Address of parent or guardian (where applicable) _____

Signature of participant _____Date: _____

Signature of parent or guardian (where applicable) _____Date: _____

Signature of researcher _____Date: _____

Signature of witness _____ Date:_____

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

Psychological and Physiological Factors Affecting Time Perception

This study aims to examine memory in people who have been through traumatic experiences, particularly how people remember traumatic experiences compared to other experiences. We are also interested in looking at your perception of time. By improving our understanding of how people remember traumatic experiences we will be better able to identify those people who will need help coping with their distress after a traumatic event. We will also be able to develop better treatments for helping these individuals.

If you decide to participate, an experimenter will administer a number of questionnaires and interview you to assess how you are coping following your traumatic experience. The experimenter will ask you to recall the trauma, and describe your memory for it in as much detail as possible. You will also be asked to try and remember a positive and a non-emotional experience from around the same time as your trauma, while at the same time doing a short computer task. You will be asked some questions about your memories for all three of these events.

Often participants become distressed when recalling their trauma, but this distress is usually temporary. If you become distressed when recalling your trauma, you can be referred to a counsellor, should you wish. Every assistance will be given to you to manage your distress. You are free to withdraw at any time.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to publish the results of this study in psychological journals, and present results at psychological conferences. Results of this study will be disclosed in order to inform the relevant disciplines about the effect of different psychological and physiological variables on time perception, in a way that may inform clinical research and practice. In any publication or presentation, information will be provided in such a way that you cannot be identified.

Your decision whether or not to participate will not prejudice your future relations with The University of New South Wales. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice.

If you have any questions, please feel free to ask us. If you have any additional questions later, Ms Leah Campbell, 9385 8758 or Professor Richard Bryant, 9385 3640 will be happy to answer them.

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).

You will be given a copy of this form to keep.

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM (continued)
Psychological and Physiological Factors Affecting Time Perception

You are making a decision whether or not to participate. Your signature indicates that, having read the information provided above, you have decided to participate.

……	…….
Signature of Research Participant	Signature of Parent or Guardian (when relevant)
……	…….
(Please PRINT name)	(Please PRINT name)
……	…….
Date	Nature of Witness

……
Signature(s) of Investigator(s)

……
Please PRINT Name

REVOCATION OF CONSENT

Psychological and Physiological Factors Affecting Time Perception

I hereby **WITHDRAW** my consent to participate in the research proposal described above and direct that any data collected from me be destroyed.

I understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales.

…… **…….**

Signature Date

……

Please PRINT Name

The section for Revocation of Consent should be forwarded to Leah Campbell, School of Psychology, University of New South Wales, Sydney, 2052, Australia.

Statistical Summaries – Study 8

Table A 3.14

One-Way Analysis of Variance (ANOVA) Summary Table for Differences Across Groups for Participant Characteristics

Participant Characteristic	Source	SS	DF	MS	F	Sig.
Months Since Trauma	Between Groups	5515.92	2	2757.96	0.48	.618
	Within Groups	215223.20	38	5663.77		
	Total	220739.12	40			
Months Since Positive	Between Groups	3653.24	2	1826.62	0.36	.699
	Within Groups	191708.86	38	5044.97		
	Total	195362.10	40			
Months Since Neutral	Between Groups	5445.54	2	2722.77	0.47	.629
	Within Groups	220333.34	38	5798.25		
	Total	225778.88	40			
Age	Between Groups	1070.98	2	535.49	4.97	.012*
	Within Groups	4536.80	42	108.02		
	Total	5607.78	44			
CAPS-2	Between Groups	16175.51	2	8087.76	47.92	.000*
	Within Groups	7088.13	42	168.77		
	Total	23263.64	44			
BDI-II	Between Groups	1987.51	2	993.75	9.16	.001*
	Within Groups	4447.29	41	108.47		
	Total	6434.80	43			
BAI	Between Groups	1095.11	2	547.56	5.87	.006*

	Within Groups	3728.56	40	93.21		
	Total	4823.67	42			
IES (I)	Between Groups	1545.41	2	772.71	9.48	.000*
	Within Groups	3728.56	41	81.51		
	Total	4887.16	43			
IES (A)	Between Groups	2452.05	2	1226.03	23.09	.000*
	Within Groups	2176.86	41	53.09		
	Total	4628.91	43			

Note. BAI = Beck Anxiety Inventory, BDI-II = Beck Depression Inventory-II, CAPS-2 = Clinician Administered PTSD Scale-2, IES-A = Impact of Events – Avoidance, IES-I = Impact of Event Scale – Intrusions. *p<.05

Table A 3.15

Summary Table for Follow-up Comparisons of Differences Between Groups for Participant Characteristics

Dependent Variable	(I)	(J)	Sig. (2-tailed)	Mean diff. (I-J)	SE	95% CI	
Age	Non	Rec	.010	-11.80	3.81	-21.09,	-2.51
	Non	PTSD	.354	-5.52	3.96	-15.15,	4.12
	PTSD	Rec	.263	-6.28	3.96	-15.92,	3.35
CAPS	Non	Rec	.144	-9.13	4.74	-20.66,	2.39
	Non	PTSD	.000*	-45.72	4.91	-57.68,	-33.76
	PTSD	Rec	.000*	36.59	4.91	24.63,	48.55
BDI	Non	Rec	.894	-1.73	3.84	-11.08,	7.62
	Non	PTSD	.001*	-15.54	3.99	-25.24,	-5.83
	PTSD	Rec	.004*	13.81	3.99	4.10,	23.51
BAI	Non	Rec	.254	-5.67	3.53	-14.25,	2.91
	Non	PTSD	.004*	-12.54	3.66	-21.44,	-3.63
	PTSD	Rec	.158	6.87	3.66	-2.03,	15.78
IES (I)	Non	Rec	.544	3.33	3.15	-4.32,	10.99
	Non	PTSD	.002*	-12.14	3.26	-20.09,	-4.20
	PTSD	Rec	.000*	15.48	3.26	7.53,	23.42
IES (A)	Non	Rec	.645	-2.40	2.68	-8.91,	4.11
	Non	PTSD	.000*	-17.49	2.78	-24.25,	-10.74
	PTSD	Rec	.000*	15.09	2.78	8.34,	21.85

Note**.** NTD= No Time Distortion, TD= Time Distortion. Non = Trauma-Exposes Non-Treated Non-PTSD, Rec = Recovered PTSD, PTSD = Current PTSD. BAI = Beck Anxiety Inventory, BDI-II = Beck Depression Inventory-II, CAPS-2 = Clinician Administered PTSD Scale-2, IES-A = Impact of Events – Avoidance, IES-I = Impact of Event Scale – Intrusions. *$p < .05$, Tukey HSD applied for post-hoc comparisons.

Table A 3.16

Multiple Analysis of Variance (MANOVA) Summary Table for Differences Between Valence Order Groups on Perceived Narrative Durations and Total Spacebar Presses According to Valence

Source	MSE	df	F	Sig.
	Narrative Duration			
Positive	1786.62	2	1.349	.272
Trauma	2310.34	2	0.906	.413
Neutral	1128.74	2	1.310	.282
	Spacebar Presses			
Positive	57.00	2	2.996	.062
Trauma	24.69	2	2.200	.125
Neutral	2.00	2	0.401	.673

Table 3.17
Repeated Measures ANOVA Summary Table for Participant Group and Memory Valence on Narrative Duration Estimates

	Value	F	Hypothesis df	Error df	Sig,
		Main Effects			
Valence	.939	1.34	2	41	.273
Treatment Group		1.87	2	42	.167
		Two-way Interaction			
Valence X Group	.736	3.40	4	82	.013

Note. *p<.05. Values based on Wilks' Lambda

Table 3.18
Summary Table for Follow-up Comparisons of Differences Across Groups for Perceived Narrative Durations for as a Function of Memory Valence

Source	SS	df	MS	F	Sig.
		Positive			
Between Groups	911.51	2	455.76	.357	.702
Within Groups	53646.40	42	1277.26		
Total	54557.91	44			
		Neutral			
Between Groups	959.51	2	479.76	.575	.567
Within Groups	35059.73	42	834.76		
Total	36019.24	44			
		Trauma			
Between Groups	18120.84	2	9060.42	4.51	.017*
Within Groups	84311.07	42	2007.41		
Total	102431.91	44			

Note. *p<.05

Table A 3.19

Summary Table for Follow-up Comparisons of Differences Between Groups for Perceived Duration of Trauma Narrative

Dependent Variable	(I)	(J)	t	df	Sig. (2-tailed)	Mean diff. (I-J)	SE	95% CI	
Duration	Non	Rec	0.11	28	.915	0.47	4.36	-8.46,	9.39
	Non	PTSD	-2.15	28	.040	-42.33	19.69	-82.67,	-2.00
	Rec	PTSD	-2.15	28	.040*	-42.80	19.91	83.58,	-2.02

Note. Non = Trauma-Exposes Non-Treated Non-PTSD, Rec = Recovered PTSD, PTSD = Current PTSD Distortion *p<.05

Table A 3.20

Summary Table for Follow-up Within Groups Comparisons of Differences Between Narrative Durations as a Function of Valence

Dependent Variable	(I)	(J)	t	df	Sig. (2-tailed)	Mean diff. (I-J)	SE	95% CI	
					Non PTSD				
Duration	P	T	1.41	14	.182	5.33	3.79	-2.80,	13.47
	P	N	-0.09	14	.933	-0.33	3.92	-8.74,	8.07
	T	N	-2.38	14	.032*	-5.67	2.38	-10.78,	-0.55
					Recovered PTSD				
Duration	P	T	1.16	14	.266	11.93	10.30	-10.17,	34.03
	P	N	0.96	14	.356	6.67	6.98	-8.30,	21.64
	T	N	-0.98	14	.343	-5.27	5.37	-16.78,	6.24
					PTSD				
Duration	P	T	-2.10	14	.054	-26.00	12.37	-52.52,	0.50
	P	N	0.28	14	.785	1.33	4.79	-8.95,	11.61
	T	N	2.49	14	.026*	27.33	10.99	3.77,	50.90

Note. P = Positive Memory, T = Trauma Memory, N = Neutral Memory. *p<.05

Table A 3.21

Pearson Correlation Summary Table of Perceived Narrative Duration, Narrative Valence, and Emotional Intensity

	Positive Duration	Trauma Duration	Neutral Duration
Pos Intensity	-.076	.140	-.052
(significance)	(.619)	(.359)	(.735)
Trauma Intensity	.046	.228	-.092
(significance)	(.764)	(.131)	(.547)
Neutral Intensity	.143	.128	.091
	(.355)	(.407)	(.556)

Note. *p<.01

Table A 3.22

Repeated Measures ANOVA Summary Table for Participant Group and Memory Valence on Spacebar Presses

	Value	F	Hypothesis df	Error df	Sig,
		Main Effects			
Valence	.994	0.13	2	41	.876
Treatment Group		1.58	2	42	.218
		Two-way Interaction			
Valence X Group	.849	1.75	4	82	.148

Note. *p<.05. Values based on Wilks' Lambda

Appendix 4

TIME DISTORTION AND PERCEIVED CONTROL

STUDY 9

Page

Consent Form – Study 9

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

Psychological Factors Affecting Time Perception

You are invited to participate in a study of peoples' perception of time. We hope to learn how various cognitive and psychological factors affect peoples' experience of time.

If you decide to participate in this study, the experimenter will ask you to watch a number of slides and estimate how long you think they were projected for. **The types of slides you can expect to see depict violence, mutilated bodies, burns victims, erotic scenes, nature, and household items.** Finally, you will be asked to answer a few short questionnaires.

It is expected that it will take you about 45-50 minutes to complete this study. PLEASE NOTE: Some of the slides are quite graphic and it is possible that you may find some of the slides distressing, however, if you do feel any discomfort or suffer any inconvenience, you are free to withdraw from the study at any time without penalty.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to publish the results of this study in psychological journals, and present results at psychological conferences. Results of this study will be disclosed in order to inform the relevant disciplines about the effect of different psychological and physiological variables on time perception, in a way that may inform clinical research and practice. In any publication or presentation, information will be provided in such a way that you cannot be identified.

Your decision whether or not to participate will not prejudice your future relations with The University of New South Wales. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice.

If you have any questions, please feel free to ask us. If you have any additional questions later, Ms Leah Campbell, 9385 8758 or Professor Richard Bryant, 9385 3640 will be happy to answer them.

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).

You will be given a copy of this form to keep.

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM (continued)
Psychological Factors Affecting Time Perception

You are making a decision whether or not to participate. Your signature indicates that, having read the information provided above, you have decided to participate.

…… ……
Signature of Research Participant Signature of Parent or Guardian (when relevant)

…… ……
(Please PRINT name) (Please PRINT name)

…… ……
Date Nature of Witness

……
Signature(s) of Investigator(s)

……
Please PRINT Name

REVOCATION OF CONSENT

Psychological Factors Affecting Time Perception

I hereby **WITHDRAW** my consent to participate in the research proposal described above and direct that any data collected from me be destroyed.

I understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales.

…… **…….**

Signature Date

……

Please PRINT Name

The section for Revocation of Consent should be forwarded to Leah Campbell, School of Psychology, UNSW, SYDNEY NSW, 2052.

International Affective Picture System Stimuli

Picture Number	Picture Description	Valence Rating	Arousal Rating	Affective Description
7006	Bowl	4.88	2.33	Neutral
7009	Mug	4.93	3.01	Neutral
7010	Basket	4.94	1.76	Neutral
7020	Fan	4.97	2.17	Neutral
7025	Stool	4.63	2.71	Neutral
7030	Iron	4.69	2.99	Neutral
7031	Shoes	4.52	2.03	Neutral
7035	Mug	4.98	2.66	Neutral
7040	Dust Pan	4.69	2.69	Neutral
7050	Hair Dryer	4.93	2.75	Neutral
7060	Trash Can	4.43	2.55	Neutral
7080	Fork	5.27	2.32	Neutral
2304	Girl	7.22	3.63	Low Arousal Positive
2360	Family	7.70	3.66	Low Arousal Positive
5001	Sunflower	7.16	3.79	Low Arousal Positive
5200	Flowers	7.36	3.20	Low Arousal Positive
6010	Jail	3.73	3.95	Low Arousal Negative
9090	Exhaust	3.56	3.97	Low Arousal Negative
9110	Puddle	3.76	3.98	Low Arousal Negative
9190	Woman	3.90	3.91	Low Arousal Negative
4652	Erotic Couple	6.79	6.62	High Arousal Positive
4659	Erotic Couple	6.87	6.93	High Arousal Positive
4681	Erotic Couple	6.69	6.68	High Arousal Positive
4800	Erotic Couple	6.54	7.07	High Arousal Positive
8080	Sailing	7.73	6.65	High Arousal Positive
8185	Skydivers	7.57	7.27	High Arousal Positive
3000	Mutilation	1.45	7.26	High Arousal Negative
3030	Mutilation	1.91	6.76	High Arousal Negative
3053	Burn Victim	1.31	6.91	High Arousal Negative
3120	Dead Body	1.56	6.84	High Arousal Negative
3266	Injury	1.56	6.79	High Arousal Negative
9410	Soldier	1.51	7.07	High Arousal Negative

Statistical Summaries – Study 9

Table A 4.1

Paired Samples T-Test Summary Table for Dissociative Experiences Prior To and During Experiment

Dependent Variable	(I)	(J)	t	df	Sig . (2-tailed)	Mean Diff (I-J)	SE	95% CI
PDEQ	Prior	During	-2.37	52	.02*	-1.53	.646	-2.83, -0.23

Note. *p<.05

Table A 4.2

Repeated Measures ANOVA Summary Table for Perceived Control Order, Perceived Control, and Valence Slide Duration Estimates

	Value	F	Hypothesis df	Error df	Sig,
		Main Effects			
Valence	.968	0.80	2	49	.455
Perceived Control	.963	1.95	1	50	.169
Order		0.31	1	50	.580
		Two-way Interactions			
Valence X Order	.911	2.39	2	49	.102
Perceived Control X Order	.994	0.30	1	50	.586
Valence X Perceived Control	.806	5.91	2	49	.005*
		Three-way Interactions			
Valence X Perceived Control X Order	.952	1.24	2	49	.298

Note. *p<.05. Values based on Wilks' Lambda

Table A 4.3

T-Test Summary Table for Follow-up Comparisons of Perceived Control on Duration Estimates as a Function of Valence

Dependent Variable	(I)	(J)	t	df	Sig. (2-tailed)	Mean diff. (I-J)	SE	95% CI
				Negative Slides				
Duration Estimate	C	NC	-2.55	51	.014*	-.36	.142	-0.65, -0.08
				Neutral Slides				
Duration Estimate	C	NC	-1.15	52	.257	-.08	.070	-0.22, 0.06
				Positive Slides				
Duration Estimate	C	NC	1.40	52	.168	.16	.115	-0.07, 0.39

Note. C = Controllable, NC = No Control. *p<.05

Table A 4.4

Pearson Correlation Summary Table of Slide Duration According to Valence and Actual and Perceived Controllability

	Controllable	No Control
	Negative Duration	
Control Rating	-.185	-.370*
(significance)	(.188)	(.006)
	Neutral Duration	
Control Rating	-.230	-.258
(significance)	(.097)	(.064)
	Positive Duration	
Control Rating	-.092	-.333
(significance)	(.511)	(.015)

Note. *p<.01

Table A 4.5

Pearson Correlation Summary Table of Dissociative Experiences During Experiment and Duration of Negative Uncontrollable Slides

	PDEQ During	Duration (Neg/Uncontrollable)
PDEQ During	1.00	-.390*
(significance)		(.004)

Note. *p<.01