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Emotional Suppression When Processing Trauma: Consequences for Mood and Memory

Thesis (Volume 1) submitted for Doctorate of Clinical Psychology Qualification

University College London, 2004
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List of Acronyms Used in Thesis
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<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>ASD</td>
<td>Acute Stress Disorder</td>
</tr>
<tr>
<td>ANOVA</td>
<td>Analysis of Variance</td>
</tr>
<tr>
<td>APA</td>
<td>American Psychiatric Association</td>
</tr>
<tr>
<td>BAS</td>
<td>Behavioural Activation System</td>
</tr>
<tr>
<td>BIS</td>
<td>Behavioural Inhibition System</td>
</tr>
<tr>
<td>BDI</td>
<td>Beck Depression Inventory</td>
</tr>
<tr>
<td>CBT</td>
<td>Cognitive Behavioural Therapy</td>
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<td>DSM-III</td>
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<tr>
<td>DSM-IV</td>
<td>Diagnostic and Statistical Manual of Mental Disorder Version 4</td>
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<tr>
<td>ECG</td>
<td>Electrocardiogram</td>
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<td>EDA</td>
<td>Electrodermal Activity</td>
</tr>
<tr>
<td>EMG</td>
<td>Electromyocardography</td>
</tr>
<tr>
<td>GSR</td>
<td>Galvanic Skin Response</td>
</tr>
<tr>
<td>HR</td>
<td>Heart Rate</td>
</tr>
<tr>
<td>IAPS</td>
<td>International Affective Picture Set</td>
</tr>
<tr>
<td>MANOVA</td>
<td>Multivariate Analysis of Variance</td>
</tr>
<tr>
<td>MRC</td>
<td>Medical Research Council</td>
</tr>
<tr>
<td>NART</td>
<td>National Adult Reading Test</td>
</tr>
<tr>
<td>PC</td>
<td>Personal Computer</td>
</tr>
<tr>
<td>PAS</td>
<td>Physiological Analysis System Software</td>
</tr>
<tr>
<td>PTSD</td>
<td>Post Traumatic Stress Disorder</td>
</tr>
<tr>
<td>IAPS</td>
<td>International Affective Picture Set</td>
</tr>
<tr>
<td>ICS</td>
<td>Interactive Cognitive Subsystems</td>
</tr>
<tr>
<td>PANAS</td>
<td>Positive Affect Negative Affect Scale</td>
</tr>
<tr>
<td>RMSSD</td>
<td>Square Root of Mean Squared Differences of Successive Heart Rate Intervals</td>
</tr>
<tr>
<td>RTA</td>
<td>Road Traffic Accident</td>
</tr>
<tr>
<td>SAM</td>
<td>Situationally Accessible Memory</td>
</tr>
<tr>
<td>SDNN</td>
<td>Standard Deviation of Heart Rate Interval</td>
</tr>
<tr>
<td>SPAARS</td>
<td>Schematic Propositional Associative Analogue Representation System</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences</td>
</tr>
<tr>
<td>STAI</td>
<td>Spielberger State-Trait Anxiety Inventory</td>
</tr>
<tr>
<td>VAM</td>
<td>Verbally Accessible Memory</td>
</tr>
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</table>
Acknowledgements

The research reported in this thesis was made possible by funding from the MRC Cognition and Brain Sciences Unit in Cambridge. I would like to thank all of the volunteers who participated in the study for their time and effort. I would also like to thank the following colleagues for help during this thesis: Tim Dalgleish and Chris Brewin for expert support and advice during the project, Vicky Murphy for assistance collecting the follow up data, Emily Holmes for helpful comments on the initial protocol, staff at the CBU (particularly Pauline, Jackie, and Anthea for coping with my erratic organisation skills), and the research and administration support staff at UCL. Thanks should also go to Sophie, friends and fellow trainees at UCL for regular support, distraction, and beer.
Abstract

The thought suppression literature (Wegner et al. 1987; Wegner & Erber, 1992) illustrates that there are secondary costs of suppressing the cognitive content of conscious experience. A ‘thought rebound’ effect has been demonstrated in both healthy populations and psychopathology (Purdon, 1999), whereby the harder a thought is pushed out of mind the more likely it is to subsequently return. It is increasingly realised that people try to control affect as well as cognitions (Gross, 1998; 2001), but as yet the secondary consequences of different forms of emotion regulation have not been studied in detail. In particular, whether an ‘emotional rebound’ effect occurs following suppression of emotions rather than thoughts during processing of distressing material has not been investigated. ‘Emotional rebound’ could potentially help explain some of the secondary symptoms seen in PTSD and related conditions.

This thesis examines the concurrent and subsequent impact of attempting to suppress (both internally experienced and externally expressed) emotion while processing traumatic information, and is intended as a preliminary investigation of whether emotion suppression contributes to PTSD. Healthy participants were asked to watch a video trauma induction, either under emotional suppression (n = 21) or control (n = 23) conditions. The consequences of emotional suppression on mood, emotional response to novel material, episodic memory, and occurrence of intrusive memories were then measured, using both self-report and psychophysiological methods.

Results found that emotional suppression did not alter self-reported emotional experience, lead to a more variable heart response, and did not change electrodermal
response while watching the trauma induction. This suggests that emotional suppression is a largely ineffective way of regulating emotional experience and that it alters psychophysiological activity, although exactly what the change in heart rate means at a psychological level is unclear.

Subsequently, emotional suppression impaired free recall but not recognition memory of the trauma material, suggesting there is a slight mnemonic impact of this form of affect regulation. There was also a trend for suppression to lead to a reduction in the experience of intrusive memories about the trauma content, although this did not reach statistical significance.

There was no change in self-reported experience of emotion following suppression, either in terms of background mood or when processing novel emotional material. There was, however, an increased heart rate deceleration when viewing subsequent emotional material and a slight increase in depression scores at one week follow-up, perhaps indicative of ongoing emotional costs of suppression.

These findings, replicating and extending work from the normative emotion regulation literature (Gross, 1998; 2001), suggest that emotional suppression is not an effective form of emotion regulation at the time of encoding and that it leads to some subsequent emotional and mnemonic changes. A provisional clinical implication is that clients should perhaps be discouraged from using emotional suppression as form of mood control. In terms of understanding PTSD, it seems plausible to tentatively suggest that emotional suppression could contribute to the hyper-arousal and impaired recall of trauma seen in PTSD. It is important, however, to replicate and extend these findings to clinical populations to support these conclusions.

While emotional suppression has been found not to lead to a 'rebound' effect directly analogous to that seen following thought suppression, it does appear to have
some unexpected secondary costs that could perhaps contribute to symptoms of PTSD.
Chapter 1: Introduction

The paradoxical effects of attempting to regulate the contents of conscious experience have been powerfully illustrated in the thought suppression literature. In the seminal thought suppression experiment, Wegner, Schneider, Carter and White (1987) found that by asking participants in the suppression condition to avoid thinking about a white polar bear, while they were initially able to successfully suppress the thought, they later had more thoughts about the bear than the control group. The harder the thought was pushed out of conscious experience, the more frequently the thought returned to the mind later (the so called 'rebound' effect). Suppression of intrusive thoughts has now been implicated in a variety of forms of psychopathology (see Purdon, 1999 for a review).

Thought suppression clearly demonstrates the way in which initial attempts to control thoughts and feelings can have subsequent impact on cognitive and emotional experience and how this can potentially contribute to psychopathology. Post-Traumatic Stress Disorder (PTSD), which can develop as a reaction to exposure to extreme traumatic events, perhaps best encapsulates this phenomenon. PTSD is characterised by the subsequent emergence of three cardinal sets of symptoms, including re-experiencing of the trauma, avoidance of internal and external cues associated with the trauma, and increased arousal. While up to 93% of the population report exposure to traumatic events, only a proportion of these go on to develop PTSD (Lee & Young, 2001).1

It is possible that one of a number of factors mediating whether or not someone will develop PTSD is how they control their thoughts and feelings when they initially process the traumatic event. Further, the way in which people regulate

1 The conditional risk of PTSD following exposure to the trauma appears to depend on the nature of the stressor. For example, Breslau, Kessler, Chilcoat et al. (1998) found that 54% of people tortured, held captive or kidnapped developed PTSD, whereas only 2% of people in a car crash developed PTSD.
emotions and cognitions when encountering re-experiencing symptoms may also potentially contribute to the maintenance of PTSD.

Diagnostic criteria for PTSD require that the individual feels afraid, horrified or helpless in response to the trauma (Diagnostic and Statistical Manual of Mental Disorder Version 4 [DSM-IV]; APA, 1994), reflecting both the emotional and cognitive content of their experience. Reaction to the trauma can be mediated by modifying the meaning attached to the traumatic event (cognitive regulation) or altering the emotions people are experiencing or expressing (emotional regulation).

An emerging literature has developed a sound understanding of the consequences of cognitive regulation in maintaining PTSD symptoms (for example, see the cognitive theory of PTSD put forward by Ehlers & Clark, 2000). While cognitive regulation and its impact on memory and appraisal of the trauma have been well investigated, the use of different emotion regulation strategies and their consequences are largely unknown. Further, relatively little is understood about the extent to which either cognitive or emotional regulation during the initial coding of trauma are involved in the development of PTSD.

A clearer understanding of how emotional, as well as cognitive, regulation at the time of initial encoding shapes subsequent emotional and cognitive experience may aid understanding and treatment of PTSD and other related disorders. In particular, it may be useful to explore whether an 'emotional rebound' effect can be demonstrated, where suppression of emotion in response to stimuli at time one leads to alteration in information processing at time two. If this hypothesis is supported, it may be of interest in both clinical and theoretical terms.

In particular, emotional suppression could be a significant maintaining factor in negative emotional experience in psychopathology. A vicious cycle may be
formed, whereby short-term emotional suppression could reduce negative affect
(therefore reinforcing its use), but longer-term, unknown to the user, lead to a rebound
of negative affect (therefore encouraging the user to apply emotional suppression
again).

1.1 Thesis Overview

This thesis presents a study investigating the effects of emotion suppression at
the time of traumatic encoding on concurrent self-reported affect and
psychophysiological response and on subsequent emotional and cognitive processing.
An experiment is reported in which healthy participants were asked to watch a
distressing video about real road traffic accidents, either under emotion suppression or
control conditions. The impact these conditions had on participants' emotional
response to the video, their processing of subsequent emotional material, their
episodic memory of the video, and the number of intrusions they experienced about
the video was then measured over a one week follow-up period.

Before presenting the results of the experiment, this introduction will discuss
the evolution of the notion in psychological theory that initial processing strategy can
shape subsequent cognitive and emotional experience. The way in which the longer
term consequences of emotion regulation on subsequent experience have been
relatively ignored to date will be highlighted. The relevance of an emotion regulation
perspective for understanding PTSD will then be put forward. A brief overview of the
presentation of PTSD, main theoretical models of the disorder, and empirical
investigation of the mechanisms contributing to the condition will be presented. It will
be shown that, paralleling the normative literature, there has been a focus on cognitive
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rather than emotion regulation to date. It will then be considered how adoption of an emotion regulation perspective, particularly focusing on emotional suppression, could inform understanding and treatment of PTSD. Results of the experiment investigating the impact of emotion suppression on analogue trauma encoding will then be detailed.

1.2 Evolution of Understanding of Cognitive and Affective Regulation

The evolution of the idea that cognitive and emotional regulation can shape subsequent experience evolved will now be reviewed, in particular focusing on the thought suppression literature.

1.2.1 Psychoanalytic Accounts

The idea that how we manage thoughts and feelings can positively or negatively impact on subsequent functioning was first put forward in a variety of psychoanalytic accounts. Janet (1889; 1925) proposed that a breakdown in the regulation of conscious experience can lead to the development of a traumatic response. It was argued that the processing of extreme emotions in traumatic situations can sometimes unintentionally fragment, leading to the development of multiple separate, dissociated streams of consciousness, each with its own memories, sensations, and affects. This results in the memory for the trauma event being split off (or ‘dissociated’) from ordinary consciousness. Occasionally this dissociation breaks down and the trauma memory intrudes in the form of perceptions, obsessional preoccupations, and somatic complaints. This was used to explain the re-experiencing of symptoms following trauma.
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The Freudian concept of defence also suggests that there are consequences of how we control the contents of consciousness. Freud (1937) defined defence mechanisms as 'the ego making use of various procedures for fulfilling its tasks, which, to put in general terms, is to avoid danger, anxiety and displeasure'. Defences minimise conflict between different parts of the mind and external reality, thus reducing tension, maintaining intra-psychic equilibrium, and allowing the development of a sense of self in the face of a defective relational environment (Winnicot, 1965; Kohut, 1984). When defences are working, the individual remains in a calm state of equilibrium. When defences cease to work, perhaps because the external environment has changed or there is some secondary cost of the defence that is problematic, the individual becomes symptomatic.

A number of defences refer to emotion regulation strategies. Repression is where the content of a thought is pushed back outside consciousness but the affect remains. Isolation is where the memory of an event remains but is denuded of any feeling. Dissociation is where both affect and memory remain but are no longer reliably connected (see Bateman & Holmes, 1995 for an overview). While theoretically interesting and clinically useful, psychoanalytic concepts initially received relatively little empirical validation.

1.2.2 Investigation of the Stress Response

Empirical examination of the consequences of the regulation of conscious experience was first conducted in studies looking at how people react to stressful material (see Lazarus & Opton, 1966 for a review). Lazarus argued that stress occurs

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2 The Freudian concept of defence is therefore a more 'intentional' form of regulation than the accidental dissociation that occurs in Janet's (1925) model of trauma.
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when a situation is perceived as thwarting or potentially thwarting to a motivational state, thus producing affective arousal and subsequent processes to regulate this arousal (Lazarus & Baker, 1956). These regulation processes were akin to the defences described in the psychoanalytic literature.

In a series of experiments, participants were asked to watch a film of ‘subincision rites’ while listening either to a trauma soundtrack that maximised the threatening aspect of the film to two defensive soundtracks that reduced threatening aspects of the film. The defences used were denial and reaction formation or intellectualisation. The trauma condition produced a greater galvanic skin response than the defensive conditions and less pleasant mood ratings. Intellectualisation was more effective at reducing a stress response than denial and reaction formation.

In follow-up work mixed results have been obtained. In one study a sample of 115 undergraduate students watched a film portraying accidental physical injuries under natural conditions (Koriat, Melkmann, Averill et al., 1972) and were instructed to either ‘involve’ or ‘detach’ themselves from the experience. The conditions differed in terms of the psychophysiological and self-report responses they produced, with detachment leading to reduced experience of emotion and an altered heart rate response but no difference in galvanic skin response. Steptoe and Vogele (1986) attempted to replicate the original Lazarus experiment while controlling for different delays between conditions and did not find that reappraisal could short-circuit the emotional response.

Lazarus’s conceptualisation of the mediation of the stress response gradually moved from an ego-defence framework to a cognitive reappraisal framework (see Lazarus, 1993 for a review). Building on the coping literature, a distinction was drawn between problem-focused coping (changing the relationship with the environment so
the stressor is ameliorated) and emotion-focused coping (changing attention to or interpretation of the stressor). Which of these was most adaptive was found to depend on the nature of the stressor and the individual involved (Lazarus & Folkman, 1984; Folkman & Lazarus, 1988).

This body of work is a compelling early demonstration that the way in which we make sense of an event changes our initial emotional reaction to it. What it did not explore was the consequences of different forms of regulation on subsequent processing, for example, altered emotional experience or experience of intrusive memories. Further, it could not inform understanding of PTSD, since this was not officially recognised as a diagnostic concept in its present form at the time.

1.2.3 Thought Suppression and the Rebound Effect

In cognitive psychology, the notion that there are secondary costs of information processing strategies has been clearly encapsulated in the thought suppression literature. When participants were asked to deliberately not think of a particular concept for a short period of time (for example, a white polar bear), the concept was then more likely to enter their mind subsequently (Wegner et al., 1987), described as the ‘rebound’ effect.

Ironic process theory (Wegner & Erber, 1992; Wegner, 1994) proposes that this rebound is the result of the normal operation of mental control when system resources are limited. It suggests that mental control is usually regulated by a conscious intentional operating process that searches for mental contents that will yield the desired mental state (for example, material pertinent to happiness), while an automatic ironic monitoring process searches for mental contents that signal the
failure to achieve the desired state (for example, material indicating that happiness has not been achieved). The ironic operating process serves the important function of noticing lapses in the intentional operating process when the system is distracted and thereby reinstating mental control in these instances.

It is this vigilance that can be the source of paradoxical rebound effects. By monitoring for signs of failure of mental control, it increases the accessibility of such material to consciousness (Higgins & King, 1981). In usual operation the intentional process is more effective than the ironic process in introducing material into conscious awareness, so this is not problematic. In situation of high cognitive load, however, the contents of conscious awareness may be increasingly determined by ironic processes. In the case of mood control, it is predicted that trying to induce a mood during cognitive load should paradoxically increase the accessibility of cognitive contents representing the absence of that mood.

1.2.3.1 Empirical Status of the Thought Suppression Effect

Early studies showed a reliable increase in subsequent frequency of the target thought in suppression conditions relative to expression conditions using a variety of different experimental designs (Wegner et al., 1987; Wegner, Schneider, Knutson & McMahon, 1991; Wenzlaff, Wegner & Klein, 1991). Since these seminal findings, a mixed literature has emerged about the paradoxical effect of thought suppression (see Purdon, 1999 for a review). A variety of studies have replicated the rebound effect for neutral material (Lavy & van den Hout, 1990; Clark, Ball & Pape, 1991; Clark, Winton & Thynn, 1993; Bowers & Woody, 1996), while others did not find an increase in target thought frequency following suppression (for example,
1.2.3.2 Critique of Thought Suppression Literature

A number of factors may partially explain these inconsistent results. First, the nature of the target thought may mediate the tendency to utilise suppression and the effects of suppression on subsequent experience. There is some evidence to suggest that a reliable rebound effect is only found for neutral thoughts and is not found for personal intrusive thoughts (Kelly & Kahn, 1994), meaning that caution is warranted before applying the suppression model to psychological disorders.

Second, individuals may differ in their willingness to report thought occurrences. It may be the case that thought frequency reports may be open to self-report biases and researchers should instead look for other evidence of hyper-accessibility, including frequency of thought relevant words on later word association tasks and/or emotional reactivity to previously suppressed thoughts (Purdon, 1999).

A number of conceptual limitations of the thought suppression literature should also be held in mind. It is important to note that the empirical demonstration of a reliable rebound effect would not directly support the ironic process theory put forward by Wegner (1994) in any case. These data speak to the consequences of thought suppression, rather than elaborating the underlying mechanism by which these consequences come about. There is currently little empirical validation of the distinction drawn between intentional and ironic operations in the theory. Moreover, the literature to date has adopted a very narrow definition of what counts as 'mental
control’, focusing on thoughts rather than images and not looking at broader activation at a schematic level.

1.2.3.3 Application of Thought Suppression to Clinical Conditions

Despite these mixed findings, thought suppression has provided a useful heuristic framework for understanding psychological disorders characterised by persistent recurrence of intrusive, unwanted thoughts (Purdon, 1999). For example, in a variety of anxiety disorders it has been argued that anxious intrusive thoughts are difficult to dismiss because positive thoughts are not available as distracters and because suppression terminates exposure to unwanted thoughts, therefore blocking habituation and disconfirmation of anxious beliefs (Rachman, 1981; Foa & Kozak, 1986; Foa & McNally, 1996). More recently, it has been suggested that the attentional bias found in anxiety may actually be caused by attempts at cognitive avoidance, where as soon as suppression is activated there is immediate hypervigilance of threat cues (Wegner, 1994; Wegner & Erber, 1992).

Empirical support for the association between thought suppression and affective disorders in general is currently mixed, however. Purdon (1999) concludes that studies investigating suppression of depressive and worry-related thoughts have not consistently observed a paradoxical rebound effect. This may be because they have focused on analogue rather than clinical populations and have not looked at suppression during congruent mood states, so further research on material with clear personal salience in clinical populations is necessary.
1.2.4 Overview of Research into Regulation Processes

The psychoanalytic, stress response, and thought suppression literatures clearly illustrate the fact that the way in which information is processed can have a strong impact on subsequent thoughts and feelings. What have not yet been systematically explored are the longer term cognitive and emotional consequences of suppressing emotional, as well as cognitive, responses to stimuli.

For example, what might be the consequences of trying to minimise the amount of fear that is felt and shown when experiencing a traumatic event? It seems plausible that the adoption of emotional suppression as a form of affect regulation could lead to an effect analogous to thought rebound, where that emotion is experienced more strongly at a later time. Alternatively, it may be the case that emotional suppression could contribute to the development of subsequent ‘emotional numbing’ or anhedonic symptoms. Similarly, emotional suppression could change the accuracy with which people recall the details of the traumatic event or alter the number of intrusions they have in response to a traumatic event.

Demonstration of an ‘emotional rebound’ effect following emotional suppression could potentially inform understanding and treatment of a range of emotional symptoms seen across different psychopathologies. Work to date looking at emotional rather than cognitive regulation will now be presented.
1.3 The Emotion Regulation Perspective

1.3.1 Definition and Overview

Central to our well-being is our ability to regulate our emotions. While emotions predispose us towards time-tested responses to recurrent adaptive problems (Lazarus, 1991), we still have the capacity to decide to respond in a different way. For example, when we are afraid we may usually tend to run, but may instead decide to laugh or express anger. Instead of being ‘passions that come and go of their own accord’ (Solomon, 1976), it is increasingly acknowledged that individuals can exert considerable control over their emotions using a wide range of strategies (Gross, 1998).

Emotion regulation is the means by which people influence the emotions they have, when they are experienced, and how they are experienced and expressed (Gross, 1989, 2001). This is believed to occur at an intentional, as well as automatic, level. The psychoanalytic literature emphasises that defences are usually not wilfully activated and are instead unconsciously adopted, thus focusing on automatic emotion regulation. The affective science literature has concentrated on the intentional regulation of mood, showing that people can also be trained to adopt a particular emotion regulation style. For example, Jackson, Malmstadt, Larson et al. (2000) looked at voluntary regulation of short-term emotional responses to unpleasant visual images. Instruction to suppress negative emotions produced a reduction in startle eye blink and activity of the corrugator facial muscle, whereas instructions to enhance negative emotions increased both these measures.
1.3.2 Investigating the Consequences of Emotion Regulation

Mixed findings have emerged about the consequences of emotion regulation. On the one hand, clinical tradition dating back to Freud argues that psychological health hinges on how emotions are regulated (Freud, 1923/1961). A central component of therapy interventions across all orientations is helping people better manage their mood. For example, cognitive behavioural therapy (CBT) involves training people to manage their mood using cognitive strategies (for example, Beck, Rush, Shaw & Emery, 1979). The pioneering work of Lazarus on the stress response (see Lazarus, 1993 and Section 1.3.2 for a review) empirically demonstrates the positive benefits of some forms of emotion regulation.

On the other hand, the early psychosomatic literature demonstrated the potentially adverse consequences of emotion regulation on physical health. The idea that the regulation (particularly suppression) of negative emotions could have deleterious health consequences became central to psychosomatic accounts of physical health (Alexander, 1939). For example, the chronic inhibition of sadness was believed to lead to respiratory disorders (Alexander, 1950; Halliday, 1937), chronic inhibition of affiliative tendencies was linked to gastrointestinal disorders such as ulcers (Alexander, 1950), and chronic inhibition of anger was linked to cardiovascular problems (Alexander, 1939).

While some of these ideas are no longer widely accepted, emotion regulation is still linked to poor health in the current literature. The claim that hostility and anger may be linked to hyper-tension and coronary heart disease has been reiterated in a number of studies (for example, Friedman & Booth-Kewley, 1987; Manuck & Krantz, 1986; Smith, 1992; Steptoe, 1993) and inexpressiveness has been linked to the
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Acceleration of the progression of cancer (Fawzy, Fawzy, Hyun et al., 1993; Gross, 1989; Spiegel, Bloom, Kraemer & Gottheil, 1989). In addition, a large body of work by Pennebaker and colleagues has found that not talking about traumatic experiences is associated with a variety of health problems (Pennebaker & Susman, 1988; Pennebaker & O’Heeron, 1994). These adverse health consequences are believed to be partly a direct consequence of emotional inhibition but also a secondary consequence of social isolation and not having the opportunity to ‘work through’ the traumatic event via talking (see Pennebaker, 1989; 1997).

The underlying premise of these accounts is that inhibiting emotions leads to marked increases in physiological response parameters that may, if maintained long term, damage health (Krantz & Manuck, 1984). A mixed literature has emerged to support this claim (see Gross & Levenson, 1993 for a review). Some studies show no differences on physiological activation between suppression and spontaneous responding (Bush, Barr, McHugo & Lanzetta, 1989) and some find decreases in physiological activation associated with suppression (Zuckerman, Klorman, Larrance & Spiegel, 1981). The more typical finding, however, is that suppression leads to acute increases in sympathetic activation consistent with these models (Gross, 1998a; Gross & Levenson, 1993; 1997; Harris 2001; Richards & Gross, 1999, 2000). Further, different theoretical accounts would suggest that emotional inhibition should lead to a subsequent reduction rather than a rebound in emotional response in other emotional response systems. For example, it has been suggested by some researchers that expressive behaviour is the most significant part of emotional response, such that other aspects of emotion are greatly diminished if behavioural expression is stifled (for example, Darwin, 1872; James, 1884; Izard, 1971; Tomkins, 1981).
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Gross (1998) reconciles this literature by suggesting that style of emotion regulation utilised will influence the positive and negative consequences produced. For example, the physical health literature attends to response-focused strategies (including suppression), which may have adverse consequences on health. In contrast, the cognitive literature emphasises antecedent-focused strategies (for example, reappraisal), which may be more beneficial (see section 1.3.3 for description of Gross's process model and explanation of these terms). In other words, emotion regulation per se is not helpful or unhelpful. Instead, different emotion regulation strategies are likely to have different consequences, moderated by the nature of the situation and the individual involved.

1.3.3 The Process Model of Emotion Regulation

To map the different consequences of controlling affect, the Process Model of Emotion Regulation (Gross, 1998; 2001) has been put forward. This identifies two key stages at which emotion regulation can take place. Antecedent emotion regulation strategies are used before emotion response tendencies are fully activated. A situation that elicits emotion can be avoided or modified, attention can be deployed to aspects of a situation that are more or less emotionally arousing, or the meaning attributed to a situation can be reappraised. Response-focused emotion regulation involves enhancing or suppressing the experiential, behavioural, or physiological responses that constitute an emotion.

A series of studies have started to compare the different cognitive and social consequences of two forms of emotion regulation: cognitive reappraisal (construing a potentially emotion-eliciting situation in a way that reduces its emotional impact) and
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expressive suppression (inhibiting ongoing emotion-expressive behaviour). To investigate the impact on affect, participants’ emotional responses while watching film material under different emotion regulation conditions has been recorded. Gross & Levenson (1993) found that instructions to suppress emotional expression led to a reduction in expressive behaviour, an increase in sympathetic and cardiovascular responding, and no change in emotional experience, compared to a control condition.

In a later study participants watched a negative film and were instructed to either suppress any emotional expression, to change the meaning of the film, or simply to watch the film as normal (Gross, 1998). Participants in the suppression condition showed much less expressive behaviour, but experienced as much negative emotion as participants in the control condition. In contrast, reappraisal both decreased the expressive behaviour and reduced the experience of negative emotion. Interestingly, a different pattern appears to emerge for the suppression of positive emotional material, where both expressive behaviour and reported experience are reduced (Gross & Levenson, 1997; Stepper & Strack, 1993; Strack, Martin & Stepper, 1988).

Different emotion regulation strategies have also been found to have different consequences for memory. In a series of studies participants have been asked to remember social facts about people presented on slides while either reappraising or suppressing. Suppression led to memory impairment for social information, whereas reappraisal did not appear to be cognitively taxing (Richards & Gross, 1999; 2000). Social consequences of emotion regulation have also been demonstrated. Butler, Egloff, Wilhelm et al. (2003) asked unacquainted pairs of participants to watch an upsetting film together and then discuss their reactions. One half of each dyad had been asked to either suppress, reappraise, or interact naturally with the other person,
unbeknown to them. Interacting with a partner was more stressful in the suppression condition than the reappraisal condition, as indexed by increases in blood pressure. Further, suppression alone disrupted communication.

A parallel line of research has started to look at trait disposition to use different emotion regulation styles, as opposed to experimental inductions where people are given a particular set of instructions. Gross & John (2003) show that habitual tendency to reappraise is associated with positive adjustment, whereas tendency to suppress is linked with negative adjustment. Reappraisers were found to experience and express greater positive emotion and less negative emotion, whereas habitual suppressors experienced and expressed less positive emotion and yet experienced greater negative emotion. Further, using reappraisal was found to be associated with better interpersonal functioning, whereas using suppression was linked to worse interpersonal functioning. Finally, suppression was related negatively to wellbeing and reappraisal was related positively to wellbeing. Similarly, data suggest that those who habitually suppress tend to be less well liked and have poorer social support (Gross & John, 2002).

1.3.4 Critique of the Process Model of Emotion Regulation

A number of limitations of the normative literature on emotion regulation need to be considered. As with the PTSD literature on cognitive regulation, while these studies have looked at the longer term social and cognitive consequences of emotion regulation, they have not looked at the longer term affective consequences. This means the possibility of 'affective rebound' has yet to be systematically explored. In particular, studies look at whether emotional reaction to the stimuli being processed is
changed, but do not look at emotion after the event. Further, a distinction can be drawn between mood (background affect, largely unrelated to any stimuli) and emotion (foreground affect, generated in response to particular stimuli). It is possible that suppression will have different consequences for mood and emotion.

Further, there are some conceptual ambiguities with the process model of emotion regulation (Gross, 2001), which mean that the distinction drawn between suppression and reappraisal may not be as clear cut as claimed. First, Gross argues that appraisal is an antecedent strategy and suppression is a response-focused strategy, whereas it seems plausible that both strategies can take place at either time. Appraisal is an iterative process that takes place both before emotions are induced and when emotions are being experienced. Similarly, emotion can be experienced both during and in anticipation of a scenario, so suppression may take place at either time.

Second, Gross adopts a narrow definition of emotional suppression, focusing on the consequences of inhibiting expressive behaviour rather than internally experienced affect. It is possible that suppression of feeling in addition to expression may have more marked (or even quite different) consequences. It seems plausible to suggest that feeling suppression may be equally implicated in the development and maintenance of psychopathology.

Third, the instructions used by Gross for the appraisal condition ask people to view the material clinically and focus on technical detail. In a sense this is just asking them to down-regulate their emotional response, which could be achieved by a variety of emotion regulation strategies rather than appraisal alone. Fourth, no controls are made for cross-over contamination effects between conditions, so it is possible that people are using reappraisal to aid suppression and vice versa.
Nevertheless, these findings clearly illustrate the potential utility of an emotion regulation framework for understanding the persistence of emotional and cognitive symptoms across a variety of forms of mental illness. Attempts to date to apply an emotion regulation model to psychological disorders will now be briefly reviewed.

1.3.5 Emotion Regulation in Psychopathology

Emotion dysregulation is a central feature of multiple forms of both Axis 1 and Axis 2 psychopathology (Gross & Levenson, 1997). Current understanding of how emotions are affected and regulated in different forms of psychopathology is, however, limited.

Berenbaum, Raghavan, Le, Vernon & Gomez (2003) have recently proposed a taxonomy of emotional disturbances to help improve understanding of the affective symptoms seen across different forms of psychopathology. Consistent with earlier component models of emotion, in this framework mood is defined as subjective feeling state (for example, feeling sad) and affect as briefly outwardly observable behaviours linked to the emotion system (for example, frowning when angry). These are component parts of a larger emotion system that serves to pursue and attain individual goals and needs (including autonomic nervous system, facial expression, and approach versus withdrawal behaviour). Pleasant emotional states serve to motivate the individual to move towards rewards (‘appetitive’ emotions), whereas unpleasant emotional states motivate the individual to avoid punishment (‘aversive’ emotions). The emotion system becomes dysfunctional when it impedes rather than
promotes individual adaptation, resulting in negative consequences for that person or those around them.

Three forms of emotional disturbance are identified. Emotion valence disturbances are when the balance between experience of pleasant and unpleasant emotions is disrupted. For example, in depression people experience elevated negative emotions and diminished positive emotions. Emotion intensity/dysregulation disturbances occur when the intensity of both positive and negative emotions is either increased or diminished. For example, in mixed manic states people experience both heightened symptoms of mania and anxiety. In other words, emotion intensity/dysregulation difficulties relate to disruption in the modulation of intensity, persistence, onset, range, lability and recovery from emotional responses (Thompson, 1994). Emotion disconnections are when different component parts of the emotion system become dissociated. Affect disconnections are when outward manifestations of emotion no longer relate to internal experience and physiological responses. Awareness disconnections are when the individual lacks conscious awareness of his or her emotional response.

The value of this taxonomy is that it clearly describes ways in which emotions may be disturbed in psychopathology. A number of limitations with this model need to be held in mind, however. First, the way in which the term ‘emotion dysregulation’ is used differs from the wider emotion regulation literature. In the taxonomy, dysregulation describes the outcome of the disruptions in the emotion system, rather than the mechanism by which this disruption came about. Conventional use of emotion regulation refers to the mechanisms by which emotions are generated and controlled rather than simply describing the end product, so hold greater explanatory power (Rottenberg & Gross, 2003). Second, the taxonomy adopts a dimensional view
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of emotion (where all emotional responses can be placed on two dimensions of arousal and valence). There is considerable debate in the literature about whether categorical or dimensional frameworks best map affective experience. Third, Watson (2003) argues that the taxonomy does not place due emphasis on behavioural aspects of emotion, for example behavioural avoidance maintaining anxiety disorders.

Despite its limitations, this taxonomy points out the significance of adopting an emotion regulation perspective to understand psychopathology. A number of researchers have begun to focus on the nature of emotional disturbance in mental illness, but as yet emotion regulation has not been systematically investigated.

Depression will be considered as a representative case to illustrate this point. A variety of empirical studies have delineated the nature of the emotional profile in depression, but without suggesting how this comes about. For example, depression has been linked to decreased emotional reactivity to positive material (Rottenberg, Kasch, Gross et al, 2002; Dunn, 2002; Dunn, Dalgleish, Lawrence et al., 2004), but whether this is a product of blunted emotional response per se or the adoption of different emotion regulation strategies is unknown. It may be the case that different emotion regulation strategies confer vulnerability to particular disorders or are involved in their development or relapse. For example, use of a ruminative response style may predispose an individual to depression if they encounter a negative life event (for a review see Nolen-Hoeksema, 1991).

In addition, some theoretical models of depression begin to explore the nature of emotional disturbance in the disorder, but do not explicitly link this to the intentional use of emotion regulation strategies. For example, Davidson and Irwin (1999) characterise depression as resulting from under-active approach behaviour (linked to left-hemisphere decreased activity) and over-active withdrawal behaviour.
(linked to right-hemisphere increased activity). Approach and withdrawal behaviours are related to the BIS/BAS distinction made by Gray (1982, 1987) and positive affect/negative affect distinction drawn by Clark and Watson (1991). Evidence for hemispheric asymmetries is derived from EEG and neuroimaging studies of depressed and anxious patients (for example, see Henriques & Davidson, 1989; Bench, Friston, Brown et al., 1993). It is unclear in this framework exactly how this deficit in approach and excess in withdrawal arises and the extent to which this is related to the intentional or unintentional application of emotion regulation strategies.

An emotion regulation perspective has perhaps been most helpfully utilised to understand borderline personality disorder (BPD). The biosocial model underpinning dialectical behaviour therapy (DBT; Linehan, 1993) argues that borderline pathology is primarily a result of dysfunction of an underlying emotion regulation system, which develops from a biological deficit in inhibitory control and exposure to an invalidating environment in childhood (Linehan, 1993). An invalidating environment is characterised by incompatibility between the needs of the child and environmental provisions, including abuse of different types (Thomas & Chess, 1985). The child learns to think that they are wrong in the sense they make of their feelings, specifically their relationship to the external world. As a result, they learn to rely on external agencies for understanding rather than developing a sense of personal and judgement agency.

According to Linehan, an invalidating environment also prevents the child learning to label and modulate internal emotional experience (Linehan, 1993). Often the only means by which the child may provoke a helpful environmental response to his/her internal distress is to produce an extreme reaction, thus reinforcing dramatic or exaggerated modes of self-presentation. For example, a child may learn that crying
will not elicit sympathy from the family but a threat to self-harm may do so. The patterns of behaviour that are learned from early exposure to an invalidating environment tend to be repeated in later life, often drawing out an invalidating response from subsequent situations and leading to the establishment of a vicious cycle between person and environment. Again, while the DBT model offers a useful heuristic to understand BPD, the claims of the model have not yet been supported by extensive empirical investigation.

In summary, it is increasingly apparent that emotion regulation may contribute to onset, maintenance and recovery from mental illness, but currently this area has received little empirical attention. Further investigation of which emotion regulation strategies are used in different forms of psychopathology, and the consequences these have, seems a fruitful avenue for future research. The literature on emotion in PTSD will now be reviewed, illustrating how the focus to date has been on the nature of emotional experience per se, rather than on how this is regulated.

1.4 Overview of PTSD

1.4.1 History

A lasting, adverse reaction following exposure to stress was first widely recognised as a clinically significant condition following the First World War. The debilitating effects of war related traumas on soldiers was variously described as either ‘shell shock’ (Mott, 1919) or ‘war neurosis’ (Grinker & Spiegel, 1943) and The American Psychiatric Association [APA] eventually included ‘Gross Stress Reaction’ in their diagnostic taxonomy (APA, 1952). Understanding of reaction to trauma
developed greatly during the Vietnam War, where it was observed that veterans often reported similar patterns of psychological symptoms following combat trauma. PTSD was introduced as a diagnostic construct in the Diagnostic and Statistical Manual of Mental Disorder Version 3 (DSM-III: APA, 1980), with intrusive re-experiencing, avoidant, and physiological reactivity symptom clusters developing following exposure to an ‘event outside the range of usual human experience’. Recent diagnostic criteria additionally emphasise that the person experiencing the traumatic event must respond to it with intense fear, helplessness and/or horror (DSM-IV; APA, 1994).

1.4.2 Diagnosis

PTSD in DSM-IV is currently defined as the following:

- Exposure to an event in which the individual experienced, witnessed, or was confronted by actual or threatened death or serious injury or a threat to physical integrity of self or others. Further, the person’s response must involve intense fear, helplessness, and/or horror.
- At least one symptom of re-experiencing of the event, via dreams, visual flashbacks, intrusive thoughts, or triggered internal or external cues to reminders of the event.
- At least three symptoms of avoidance of related stimuli and/or numbing of responsiveness. These include avoidance of thoughts and behaviour related to the event, avoidance of activities, places or people, psychogenic amnesia,
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diminished interest in significant activities, emotional numbing, and
detachment from others.

- At least two symptoms of increased physiological arousal, including
  irritability and anger outbursts, difficulty sleeping, concentration problems,
  hyper-vigilance, and potentiated startle responses.

These symptoms must be present for at least one month post-trauma and cause
clinically significant distress and interfere with function. A distinction is drawn
between acute PTSD (symptoms lasting less than three months) and chronic PTSD
(symptoms lasting more than three months). A similar set of criteria is outlined in the
International Classification of Diseases framework (ICD-10; World Health
Organisation, 1993), although emotional numbing is not seen as a necessary symptom
requirement (Yule, Williams & Joseph, 1999).

Lee & Young (2001) outline how differential diagnosis often needs to be made
between PTSD and adjustment disorder, acute stress disorder (where response to
trauma is seen in first four weeks; if this reaction persists beyond four weeks a
diagnosis of PTSD is made), obsessive compulsive disorder (where intrusive
phenomena are not always related to trauma), malingering (where the person is faking
illness for financial gain or for mitigating legal purposes), and psychosis (where
hallucinations and delusions are experienced about a trauma that did not occur).

The diagnosis of PTSD has been criticised on the grounds that it does not
capture people who are very symptomatic but do not show features of all three
symptom clusters, that what counts as a traumatic event continues to change
frequently, that severity distinctions are largely arbitrary, and the high co-morbidity
with other conditions suggests it may not be a distinct construct (for a review, see Lee & Young, 2001).

1.4.3 Presentation and Prevalence

PTSD frequently presents co-morbid with other conditions (Kulka, Schlanger, Fairbank et al., 1990; Kessler, Sonnega, Bromet et al., 1995). Further, it more often occurs subsequent to at least one previous episode of another disorder, particularly those with an anxiety component (Kessler et al., 1995; Prekonigg, Kessler, Stortz et al., 2000). In contrast, co-morbid conditions that develop after PTSD diagnosis may reflect maladaptive coping with the trauma, including agoraphobia and drug dependence (Buckley, Blanchard & Hickling, 1998).

Research does not reliably support the presence of the three distinct symptom clusters outlined in DSM-IV in the disorders presentation. For example, Taylor, Kuch, Koch et al. (1998) subjected the reported PTSD symptoms of 103 road traffic accident survivors and 419 United Nation Peace Keepers to factor analysis, producing a two factor model of intution/avoidance and hyper-arousal/numbing. Alternatively, Asmundson et al. (2000) produced a four factor model of re-experiencing, avoidance, numbing, and hyperarousal symptoms. These studies suggest that diagnostic criteria for PTSD may need to be revised in the future.

The prevalence estimates of exposure to traumatic events vary depending on which criteria of what counts as a traumatic event are adopted and the different questioning methods used (Lee & Young, 2001). For example, estimates of male lifetime exposure rates to traumatic events vary from 43% (Breslau et al., 1992) to 93% (Breslau & Davis, 1998). Prevalence estimates of PTSD suggest that between 5–
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6% of men and 10–12% of women in the general population have experienced the disorder at some point over their life course (Resick, 2001). Estimates of the conditional probability of developing PTSD following exposure to a stressful event again vary, ranging from 9% (Breslau et al., 1998) to 24% (Breslau et al., 1991). What this illustrates is that PTSD is only present in a significant minority of people exposed to traumatic events and thus some mediating variables must explain who goes on to develop the disorder (for example, nature of the stressor, nature of the coping response, and individual differences variables). Risk factors identified to date include trauma severity, lack of social support post-trauma, life stress post-trauma, previous psychiatric history, childhood abuse, family psychiatric history, low socio-economic status, lack of education, low intelligence, previous trauma, other adverse childhood factors, female gender, younger age at trauma, and minority race status (Brewin, Andrews & Valentine, 2000; Lee & Young, 2001).

1.4.4 Theoretical Models of PTSD

A brief review of theoretical models of PTSD that inform understanding of how thoughts and feelings are regulated in the disorder will now be presented, based on the reviews of Brewin & Holmes (2003) and Dalgleish (2004). How an emotion regulation perspective could contribute to these models will be highlighted where appropriate.

3 Importantly, from an emotion regulation perspective, there is preliminary evidence to suggest that the nature of the traumatic event may determine the extent to which emotion regulation difficulties are implicated in the disorder. Cloitre, Koenen, Cohen et al. (2002) observe that people who were victims of childhood sexual abuse are much more likely to show inter-personal and emotion regulation difficulties alongside a more typical PTSD profile. These symptoms have been linked to poorer prognosis and treatment outcome in typical exposure-based treatments.
Horowitz (1976, 1986) pioneered the earliest theoretical frameworks to understand the regulation of processing in PTSD when it was first included in DSM-III (APA, 1980) as a diagnostic concept. The stress response model described how people typically react to trauma with an initial outcry followed by attempts to assimilate the traumatic information with prior knowledge. A consequence of assimilation can be 'information overload', where the person is unable to connect their earlier model of the world with the traumatic event, leading to considerable tension. Various psychological defence mechanisms are utilised to reduce this tension, helping to avoid the trauma memory and/or control how speedily it is remembered. These include denial, emotional numbing, and avoiding cues that remind people of it. Thus, two competing processes can be operating: suppression of trauma information to reduce stress and bringing the trauma memory to mind to promote its assimilation into autobiographical memory. The individual can swing between intrusions of the trauma and marked avoidance.

In many ways, the stress response model parallels the earlier account of Lazarus describing how regulation strategies are brought into play to control reaction to stressful events (Lazarus & Opton, 1966). What it elaborates is how there can be marked conflict between different psychological processes operating, which can lead to the individual being stuck in a PTSD-like state. The stress response model first considered the consequences of trauma regulation in PTSD and served as a foundation for subsequent accounts of the disorder, which have begun to delineate more fully the way in which encoding at the time of trauma shapes development of subsequent psychopathology.
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It is possible to reconceptualise the defence mechanism identified in this model as the activation of different forms of emotion regulation strategies during initial encoding and re-experiencing. As yet there has been limited empirical validation to support the defences postulated by this model.

1.4.4.2 Conditioning Theory

Mowrer’s (1960) two factor learning theory has also been used to explain the development and maintenance of PTSD (for example, Keane, Zimering & Caddell, 1985). When exposed to a traumatic event, classical conditioning results in neutral stimuli in the traumatic situation becoming fear eliciting cues through their association with the trauma. These neutral stimuli can then subsequently act as triggers for re-experiencing symptoms. Habituation is prevented as the person actively attempts to avoid or distract themselves from the memories or images, making any exposure incomplete. This avoidance is instrumentally reinforced by the short-term reduction in fear it brings about. A limitation of this account is that it does not distinguish PTSD from the development of other anxiety disorders and cannot account for the full range of phenomena observed in PTSD (for example, experience of other negative emotions). Further, it views PTSD as the result of simple conditioning processes, neglecting the impact of the way in which the event is processed on the development of subsequent symptoms.
A class of models have focused on the processing of the traumatic event itself rather than on wider personal and social context. The central claim of these 'information-processing theories' is that the way in which the traumatic event is processed and represented in memory contributes to the development of psychopathology (for example, Chemtob, Roitblat, Hamada, Carlson & Twentyman, 1988; Foa, Steketee & Rothbaum, 1989; Litz & Keane, 1989).

Building on the work of Lang (1979) they claim that, following exposure to trauma, people develop unusually coherent and stable fear networks, linking stimulus information, physiological information, and meaning information about the event tightly. These memory traces can thus be unusually easily activated by usually ambiguous stimulus elements that bear some small resemblance to the trauma. The person then re-experiences the physiological reactions and makes sense of the world in the same way that they did during the trauma. Foa et al. (1989) further claim that the memory of trauma holds particular significance and violates assumptions of basic safety that the person previously held, similar to the theory of shattered assumptions (Janoff-Bulmann, 1992). The degree of distress brought about by the reactivation of trauma structures means that people actively try to avoid or suppress them, which prevents full exposure. These accounts cannot fully explain the impoverishment of detail of memory for some aspects of trauma.

Again, an emotion regulation perspective seems a potentially helpful framework to better delineate the processes by which people prevent reactivation of trauma structures, but has so far been little researched.
A substantial body of work from a cognitive regulation perspective has looked at how the meaning attached to a traumatic event determines whether PTSD develops. Cognitive accounts of PTSD postulate that processing the trauma in a way that leads to a sense of serious, current threat is what makes symptoms persistent (Ehlers & Clark, 2000). This sense of threat arises as a consequence of excessively negative appraisals of the trauma and its sequelae and the disturbance of a clear autobiographical memory trace. These appraisals are not allowed to change because the individual adopts a series of problematic behavioural and cognitive strategies, including thought suppression, distraction, avoidance, selective attention to threat, dissociation, and symptom control behaviours. Successful treatment is believed to involve elaborating the trauma memory, modifying appraisals, and preventing use of dysfunctional coping strategies.

The strength of the cognitive model is that it identifies a number of psychological processes that are likely to contribute to PTSD. First, if the person appraises the traumatic event in a negative way PTSD may be more likely (Dunmore, Clark & Ehlers, 1997; Murray, Ehlers & Mayou, 2002). The content of appraisals relate to personal responsibility, control, safety in the world, reliability of others, and implications for the future. Second, appraising early symptoms of PTSD in a negative way can maintain them (Clohessy & Ehlers, 1999). Third, PTSD is more likely if a person suffers ‘mental defeat’ at the time of trauma, where the person experiences an extreme form of helplessness and feels unable to protect themselves (Ehlers, Maercker & Boos, 2000). Fourth, the use of data driven (focusing on sensory impressions) rather than conceptual encoding (focusing on the meaning of the
situation and organising information) increases the likelihood of developing PTSD, since the person develops a memory trace less related to their autobiographical database, that is subject to strong perceptual priming, and that is hard to retrieve intentionally (Ehlers & Clark, 2000; Halligan et al, in press; Murray et al, 2002).

Fifth, use of problematic coping strategies after experiencing the trauma can increase the likelihood of developing PTSD.

Interestingly, a number of the risk factors for trauma identified in the cognitive model may potentially be related to emotion regulation processes. For example, use of suppression may lead to data-driven coding (making trauma more likely) whereas use of reappraisal may lead to conceptually-driven coding (making trauma less likely).

1.4.4.5 Dual Representation Theory

Dual representation theory (Brewin, Dalgleish & Joseph, 1996) links the development of PTSD to disturbance in the integration of different aspects of memory following trauma. It proposes that memories are of two distinct types, stored in different representational formats. Verbally accessible memory (VAM) supports ordinary autobiographical memory that can be retrieved either automatically or using deliberate, strategic processes. Situationally accessible memory (SAM) contains information obtained from the more extensive, lower level perceptual processing of the scenes, including visuospatial information and bodily response. When processing traumatic events, extreme stress can lead to these memory systems failing to be integrated such that an impoverished VAM and strengthened SAM trace is established. These results in flashbacks and re-experiencing of the trauma when SAM is activated, which cannot be controlled and contextualised by the VAM trace.
Successful resolution of PTSD symptoms involves integrating the two memory systems.

It seems plausible to suggest that emotion regulation processes may also influence the extent to which these two memory traces are elaborated. For example, emotional suppression pushing material out of conscious experience may lead to an impoverished VAM trace (therefore impairing episodic memory) and a strengthened SAM trace (therefore leading to intrusive symptoms). While there has been investigation of how dissociation may contribute to this memory impairment (Holmes, Brewin & Hennessy 2004; see section 1.5.2), the consequences of more intentional emotion regulation strategies such as suppression have not yet been systematically explored.

1.5 Regulation of Processing in PTSD

Empirical work unpacking how information processing may lead to the development of symptoms in PTSD will now be reviewed, focusing on the role of thought suppression and the consequences of dissociation on intrusive memory. It will be highlighted how this work has largely focused on cognitive rather than emotional regulation. Investigations of emotional processing in the disorder will then be described, illustrating how emotion regulation has not been systematically explored.

1.5.1 Thought Suppression in PTSD

A number of theorists have proposed a link between control of thoughts and PTSD. It is believed that trauma related thoughts are avoided as much as possible, and
when they come to mind they are then actively suppressed. Avoidance of trauma thoughts may powerfully maintain trauma by preventing full activation of the fear structures maintaining the phobic response to stimuli linked with the trauma, and thus blocking the natural habituation processes (Foa, Steketee & Rothbaum, 1989; Foa & McNally, 1996). Suppression of thoughts may lead to an ironic rebound effect as suggested by Wegner (1987).

The connection between PTSD and thought suppression has been empirically demonstrated in both longitudinal, regression based studies and in studies using modified versions of the thought suppression paradigm (Wegner, 1987). Longitudinal studies have shown that catastrophic negative appraisal of trauma-related intrusions predicts the behavioural and cognitive avoidance of the intrusions, which in turn predicts PTSD severity (Ehlers & Steil, 1995; Steil & Ehlers, 2000). Further, the tendency to suppress intrusions at three months after a traumatic event has also been found to predict persistence of PTSD symptoms at a one year follow-up (Mayou & Bryant, 1998) and three-year follow-up (Mayou, Ehlers & Bryant, 2002).

As with the control data on the thought suppression paradigm, a complex pattern of data has emerged with experimental studies. Preliminary studies found that non-clinical participants who suppressed while watching a traumatic film showed impaired episodic memory for the film but did not report more film-related thoughts (Wegner, Quillian and Houston, 1996). This supports the opposite claim that suppression of trauma thoughts, rather than making memory of the trauma hyper-accessible, may impede memory for the trauma and result in psychogenic amnesia.

In contrast, data consistent with the broader thought suppression literature were later uncovered. Rassin, Merckelbach and Muris (1997) asked a non-clinical sample to watch a distressing film, half of whom were instructed to suppress thoughts
about the film and the other half were given no instructions. At five-hour follow-up, the suppression group reported a higher number of film-related thoughts, consistent with ironic processing theory (Wegner & Erber, 1992). Suppression had no effect on the accuracy of episodic recall about the content of the film. This study relied on retrospective self-report of intrusion frequency, however, which may have been biased by the instructions participants were given to suppress.

Similar results using a counting methodology were produced by Davies & Clark (1998), who found that a non-clinical sample asked to suppress their thoughts in response to a distressing film reported fewer thoughts in the suppression condition but more thoughts in the subsequent free viewing condition, relative to a control group.

Davies and Clark (1999) investigated whether individual differences in tendency to suppress would mediate response to traumatic material. Healthy participants watched a stressful film about a real fire and then monitored and recorded their intrusions about the film immediately afterwards and for a seven day period. Pre-existing tendency to suppress unwanted thoughts in combination with a more negative mood state after watching the film predicted more frequent intrusions immediately after watching the film (but not over the seven-day follow-up).

More recent studies have looked at the consequences of thought suppression in clinical samples. For example, Shipherd and Beck (1999) investigated the effects of suppressing rape-related thoughts in a thought suppression paradigm on female sexual assault survivors. The PTSD participants experienced an increase in frequency of rape-related thoughts following deliberate suppression, whereas the control participants did not show any rebound effect.

These findings are broadly consistent with accounts suggesting that suppression of thoughts about trauma may make those memories hyper-accessible, as
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suggested by the ironic processing theory (Wegner & Erber, 1992; Wegner, 1994),
and potentially contribute to the maintenance of PTSD. A limitation of most of the
above studies, however, is that they used analogue film inductions, which have
questionable ecological validity and, in particular, do not have the ideographic
relevance of a personally experienced traumatic event. Nevertheless, this work
generally supports the claim that thought rebound following thought suppression is an
important maintaining factor in PTSD. What this literature has not explored is the
short and long term consequences of thought suppression on emotional processing in
the disorder.

1.5.2 Dissociation and its impact on intrusive memories in PTSD

A parallel line of investigation has looked at the consequences of dissociation
on intrusive memory in PTSD. A central feature of PTSD is experiencing repeated
intrusive images of the traumatic event (Brewin, 1998), which may relate to a
dissociative response at the time of encoding (Holmes, Brewin & Hennessey, 2004).
Dissociation is defined by DSM-IV as ‘disruption in the usually integrated functions
of consciousness, memory, identity, or perception of the environment’ (APA, 1994, p
.477). It is seen as a response to extreme stress that limits conscious processing of the
traumatic material, thus reducing negative affect and the physiological stress response
(Brewin & Saunders, 2001). In PTSD, dissociation may lead to the disruption of the
encoding of stressful events, making the events more likely to be re-experienced as
intrusive flashbacks than be integrated into wider autobiographical memory.

If dissociation is viewed as an active rather than involuntary coping response
to stress, it should be possible to induce it experimentally by asking participants to
process stressful material in a dissociative way. Analogue studies that train participants to use dissociative encoding strategies while viewing distressing material have so far produced mixed results about the impact on long term memory of the event, however.

Murray (1997) asked participants to watch a distressing film and either emotionally engage with the film or to dissociate from it by trying to induce a state of emotional numbness. Contrary to prediction, the dissociation group showed no elevation in levels of distress after watching the film and no increase in intrusive memories. It is possible, however, that participants were unable to carry out the dissociation instructions fully.

An alternative way to understand intrusions in PTSD in terms of competing memory traces was first put forward by Holmes (2000). Dual representation theory of PTSD (Brewin, 2001; Brewin, Dalgleish & Joseph, 1996) proposes that in traumatic situations memory encoding is disrupted by heightened levels of arousal, such that events are encoded predominantly in a situationally accessible form (perceptual or image based memory) rather than in a verbally accessible form (language based memory). This makes memories less likely to be integrated into autobiographical memory and more likely to be experienced as sensory flashbacks and intrusions.

This account was used to make sense of what initially appeared to be paradoxical data. Brewin and Saunders (2000) asked participants to watch a stressful film either under standard conditions or while simultaneously performing a tapping task. Dual-task processing was hypothesised to limit the amount of attention and conceptual processing given to the film, thus leading to less well organised memory. Paradoxically, there were no differences in levels of distress or explicit memory between the two conditions, but the dual task condition produced significantly fewer
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Intrusive memories over the following two weeks. In the experiment the dual task condition (a spatial tapping task) may actually have occupied situationally accessible memory and left verbally accessible memory intact, thus reducing rather than increasing the number of intrusions experienced.

To back up this interpretation, Holmes, Brewin & Hennessy (2004) contrasted the effects of a verbal distraction task and a visual distraction task while encoding traumatic material in a series of studies. The rationale was that the verbal task should block verbally accessible memory, whereas the visual task should block situationally accessible memory acquisition. As predicted, the visual task decreased the frequency of later memory intrusions and the verbal task increased the frequency of later memory intrusions.

The strength of this approach is that it focuses on coding at the time of trauma exposure and looks at a regulation style that has both a cognitive and affective component. Further, the work measures longer term consequences of regulation in the form of intrusive memories experienced after coding. While the work looked at the cognitive consequences of a form of affective regulation, the emotional consequences were not systematically examined in depth. This means it is still an open empirical question as to whether the way in which emotion is regulated at the time of coding shapes subsequent emotional experience in PTSD.

1.5.3 Emotion Processing in PTSD

Work exploring emotion processing in PTSD will now be reviewed, highlighting how the focus has been on mapping out the emotional disturbance rather than understanding how it is regulated.
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Two common emotional symptoms reported by sufferers of PTSD are reports of intense negative emotional reactions (particularly fear and sadness) when reminded of the trauma they experienced and a general 'numbing' of interest in and emotional response to other situations that would previously have elicited an emotional reaction (APA, 1994).

Empirical validation of these reports has been largely based on studies looking at emotional response to trauma-related cues in PTSD. It has been found that people with PTSD react intensely to cues reminding them of their trauma, which can be characterised as an integrated negative emotional response involving central and peripheral nervous system activity and a variety of unpleasant feelings (Malloy, Fairbank & Keane, 1983; Pallmeyer, Blanchard & Kolb, 1986; Pitman et al., 1987; Rauch, van der Kolk, Fisler, & Alpert, 1996).

It is currently unclear, however, how emotional numbing symptoms are related to these heightened negative responses to trauma reminders. Behavioural theories suggest that emotional numbing is the consequence of chronic avoidance of trauma reminders and reactions (for example, Keane, Fairbank, Caddell, Zimering, & Bender, 1985). This is not consistent with data showing that emotional numbing is distinct from avoidance in factor analysis (Foa, Riggs & Gershuny, 1995) or that avoidance symptoms explain only a small proportion of variance in the report of numbing symptoms (Litz et al., 1997).

Other investigators suggest that the emotional blunting seen in PTSD is similar to 'conditioned analgesia' responses to uncontrollable and unpredictable aversive stimulation (Foa, Zinberg & Rothbaum, 1992). In other words, after repeated exposure to trauma reminders, people with PTSD show a numbing in their reactivity to subsequent emotional material. Evidence for this account is largely based on
animal stress studies, however, so its applicability to humans with PTSD is questionable.

Horowitz (1986) proposes that trauma creates two sets of internal processes to cope with and resolve responses to extreme stressors. The intrusion phase of adjustment leads to re-experiencing and hyper-emotionality, whereas the denial phase is activated to defend against these difficult feelings and memories linked to the trauma. In particular, emotional numbing allows patients with PTSD to reduce feelings associated with traumatic memories. It is believed that people with PTSD shift back and forth between denial and intrusion until resolution of the trauma occurs. Although of heuristic value to explain PTSD, the central claim that denial is a phasic response after a period predominated by intrusive symptoms has not been empirically demonstrated (for example, see Joseph, Yule & Williams, 1995).

Associative network models argue that re-experiencing comes about by activation of a fear network linked to the traumatic event (Foa, Steketee, & Rothbaum, 1989; Litz & Keane, 1989; Chemtob, Roitblat, Hamada, Carlson & Twentyman, 1988). PTSD is distinguished from other disorders by the unusually coherent and stable network of trauma memories, such that the network can be easily activated by environments that share only a few matching elements to the trauma trace. These models explain the re-experiencing and hyper-emotionality symptoms but cannot account for the emotional numbing found in the disorder.

Building on these frameworks, Litz (1992) argues that emotional numbing can be explained as a deficit in emotional processing in times of hyperemotionality, typically triggered by exposure to trauma cues. When reminded of trauma, patients with PTSD may experience less intense positive feelings and be more reactive to negative cues.
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There is also a dearth of studies testing out whether emotional numbing is reliably found in PTSD. Indeed, evidence to date suggests that PTSD is not characterised by a global reduction in response to non-trauma related material. Litz, Orsillo, Kaloupek, and Weathers (2000) looked at the impact viewing trauma cues had on subsequent emotional processing of positive, negative and neutral images selected from the International Affective Picture Set (IAPS; Lang, Greenwald, Bradley et al., 1993) in Vietnam veterans with PTSD, compared to a well adjusted Vietnam veteran control group.

A complex data set emerged, which was inconsistent with the hypothesis that emotional processing in PTSD is characterised by a global ‘numbing’ of emotional response. Following exposure to non-trauma related cues, both groups’ emotional response to a series of positive, neutral and negative images was modulated by stimulus valence. Following exposure to reminders of Vietnam, the PTSD group showed suppressed facial displays of emotion to positive but not negative or neutral images (measured by zygomatic facial muscle activation), relative to the control group. Unexpectedly, the PTSD group also showed a reduction in pleasantness ratings of neutral stimuli (but not negative or positive images). There were no statistically significant differences in electrodermal response to the images, but the PTSD group showed elevated heart rate to both the positive and negative images.

This pattern of findings is inconsistent with associative models of PTSD, which would predict that a trauma prime should lead to a cascading activation of fear networks, and thus intensification of experience of negative emotions. It should be noted, however, that the failure to find a global numbing of emotional response in this study may be because non self-referent emotional material was used. A different pattern may emerge if personally salient, idiographic material was presented.
As yet there has been limited empirical examination of the extent to which intentional adoption of emotion regulation strategies influences symptoms in PTSD. Wastell (2002) reports a cross-sectional study looking at the long term effects of suppressing emotional reactions following exposure to trauma in 437 Australian ambulance workers. The use of suppressing defences (including withdrawal or acting out) was positively correlated with the development of both physical and psychological stress symptoms. Unfortunately, correlational evidence is insufficient to demonstrate any causal link between the use of different emotion regulation strategies and the development of stress symptoms. For example, it is possible that other variables could lead to both increased stress and the use of suppression strategies. Further, reliance on subjective, retrospective measures of suppression strategies may have biased the result.

Further, Joseph, Dalgleish, Williams et al. (1997) investigated factors affecting traumatic response in survivors of the Herald of Free Enterprise ferry disaster. They found that negative attitudes towards the expression of emotion at three-year follow-up were associated with higher PTSD symptom scores at five-year follow-up. Additional work is needed, however, to support and extend these preliminary findings.

In summary, while the nature of emotion deficits in PTSD is now better understood, the contribution of intentional emotion regulation strategies to the disorder has not been sufficiently investigated.
1.5.4 Overview of Regulation of Processing in PTSD

Work to date on PTSD has illustrated how initial processing shapes memory of the traumatic event and has begun to explore emotional processing in the disorder. The secondary emotional consequences of different processing styles are currently unclear and the relative advantages and disadvantages of cognitive versus emotional regulation are uncertain, however. To clarify these issues it may be useful to incorporate normative models of emotional regulation into models of PTSD.

The central proposition of cognitive accounts of PTSD is that the sense one makes of a traumatic event while it is happening, and how this is subsequently reinforced and elaborated, determines whether or not PTSD will develop. Implicit in the model is that cognition precedes and shapes affect, so it focuses more on the consequences of ‘appraisal based’ regulation strategies rather than ‘emotional expression based’ regulation strategies. Moreover, the “down the line” consequences of trauma regulation that are focused on are changes in memory trace of the event and how it is appraised, rather than how emotional experience is altered.

Multi-representational theories of cognition increasingly realise the reciprocal relationship between cognition and affect (Interactive Cognitive Subsystems [ICS] Teasdale & Barnard, 1993; Schematic Propositional Associative Analogue Representational System [SPAARS]; Power & Dalgleish, 1997), however, suggesting emotional consequences of trauma regulation may have greater aetiological significance.

To illustrate multiple representation frameworks, ICS will be considered as a representative example. This argues that to understand how the mind works we have to recognise that there are different, interacting forms of information, or ‘mental
codes', which represent distinct aspects of experience. These include basic sensory input, feedback from the body, and a series of higher level codes that represent increasingly abstract meaning. Propositional meanings are logical, truth-like statements akin to thoughts that can be expressed in language. The implicational representation is a holistic, higher order framework that incorporates sensory and proprioceptive information within schematic models of the world. It generates non-verbal emotional beliefs or feelings as well as intellectual thoughts.

Information is passed from one code to another and patterns of activity across each code are stored in memory. To fully understand an individual’s experience, the dynamic activity across different levels of representation needs to be considered. For example, to comprehend a given emotional response, the interplay between its sensory and proprioceptive ‘feel’, its intellectual ‘cold’ propositional representation, and its emotive ‘hot’ implicational representation should be outlined. People’s predominant focus of attention can rest with different codes at different times, altering their experiential awareness.

Therefore, ICS predicts that both feedback from the emotions (largely via the implicational system) and cognition (largely via the propositional system) shape experience. For this reason it seems sensible to further investigate the cognitive and affective consequences of emotional, as well as cognitive, regulation strategies.

An emotion regulation perspective could potentially inform understanding of how coding at the time of trauma produces the cluster of symptoms seen in PTSD and how the disorder is maintained by subsequent adoption of affect control. It is possible that, when exposed to trauma, people voluntarily or involuntarily adopt differing emotional regulation styles that have variable short and long term consequences. Further, even if particular emotion regulation strategies are not adopted during trauma
encoding, their later use to manage re-experiencing symptoms may maintain the disorder.

1.6 Applying an Emotion Regulation Perspective to PTSD

Speculation now follows on the consequences of different forms of emotion regulation while encoding traumatic material, focusing particularly on emotional suppression.

Suppression is defined here as the intentional inhibition of any emotion that is felt or expressed to others. Suppression seems the most relevant form of emotion regulation to focus on, owing to the high number of avoidant symptoms that characterise sufferers of PTSD. A variety of different experimental literatures, briefly reviewed below, make somewhat different predictions about the consequences of using emotional suppression, which will be briefly reviewed below.

Research into the process model of emotion regulation (Gross, 1998; 2001: see section 1.3.3) would predict that suppression in trauma should not lead to marked experiential change but may produce impaired episodic memory and physiological hyper-arousal. The work makes no predictions about the longer term emotional consequences of suppression, in terms of either self-report or arousal. Further, it does not separate the consequences on mood (background affect) and emotion (foreground affect, triggered by particular stimuli). Perhaps most importantly, the definition of suppression adopted focuses on limiting overt expression of feelings rather than reducing the feeling state internally. It seems likely that the primary goal of emotion regulation in sufferers of PTSD is to escape internal experience of distress rather than limit its communication, so the strength with which the Gross findings can be
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generalised to this disorder may be limited. It may be the case that attempts to suppress internal feelings would change self-reported emotional experience.

In contrast, the thought suppression literature (Wegner et al., 1987; Wegner, 1994: see sections 1.2.3 and 1.5.1) might suggest that emotional suppression should lead to successful initial regulation of emotion but subsequent affective rebound (where emotion is increased). This prediction would only hold, however, if it can be assumed that the mechanisms by which thoughts and emotions are suppressed are the same, which we do not yet know to be the case. Further, the thought suppression literature generates no clear predictions about the differential consequences of thought suppression on self-report and psychophysiology, between mood and emotion, or on different types of memory.

Finally, the dissociation literature (for example, Holmes, Brewin & Hennessy, 2004: see section 1.5.2) might predict that emotional suppression would lead to an increase in the number of intrusions experienced about the trauma material but no deficit in episodic memory. Again, the validity of these predictions depends on the extent to which emotional suppression can be viewed as similar to dissociation.

In summary, different predictions about the consequences of emotional suppression can be generated depending on which literature is considered. Perhaps one way to integrate these somewhat different accounts is in terms of multiple representation theories of emotional processing. For example, in terms of the dual representation theory of PTSD (Brewin, Dalgleish & Jospehs, 1996: see section 1.4.4.4), it is possible that emotional suppression leads to a marginally strengthened SAM trace (causing increased intrusions as predicted by the thought rebound literature; increased physiological arousal as predicted by process model literature; and perhaps affective rebound as predicted by the thought suppression literature) and
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a slightly impoverished VAM trace (leading to poorer episodic recall as predicted by the process model literature). Similarly in terms of ICS (Teasdale & Barnard, 1993), emotional suppression may lead to a disturbance of the inter-relationship between implicational and propositional levels of representation, where the propositional representation of the trauma is weakened and the implicational level of representation is no longer inhibited.

To frame this prediction in the Bernebaum et al. taxonomy (2003) of emotional disturbance, it may be the case that emotional suppression leads to both an affect disconnection (where component parts of emotional response are no longer related to one another) and an awareness disconnection (where aspects of the situation are no longer consciously remembered in explicit memory but the memory trace in implicit memory systems is strengthened).

The consequences of emotional suppression can be contrasted with those of other forms of affect regulation. In severe trauma where emotional arousal is so extreme that other mechanisms to control it break down, dissociation may result. Dissociative symptoms include emotional numbing, derealisation, depersonalisation, and out-of-body experiences. Dissociation can be seen as a cluster of regulation strategies with the goal of avoiding as much as possible the cognitive, emotional, and bodily impact of a trauma, thus producing limited short term gain. The long term consequences of dissociation, however, may be to lead to a fragmented memory trace, increased rate of intrusions, and a blunted or potentiated emotional response to subsequent material. Again in terms of dual representation theory (Brewin, Dalgleish & Joseph, 1996), dissociation may lead to a very strong SAM trace and a very weak VAM trace. Dissociation can be contrasted with suppression, which is a more focal
attempt to reduce the internal experience and expression of an emotion without the wider attempts to avoid the cognitive and bodily aspects of the trauma.

In contrast to suppression and dissociation, the use of a reappraisal strategy could help control emotions during the trauma encoding and be of benefit long term. Research into the process model of emotion regulation (Gross, 1988) has shown that reappraisal reduces experience and expression of negative emotional states during encoding. It seems likely that use of reappraisal would also ensure that the event is integrated into autobiographical memory, therefore blocking re-experiencing symptoms. In dual representation theory terms (Brewin, Dalgleish & Joseph, 1996), reappraisal would lead to a strengthened VAM trace which can regulate the SAM trace, thereby reducing likelihood of a PTSD reaction.

In summary, different emotion regulation strategies, used either when actually going through the traumatic event or when re-experiencing it, may contribute to the development of maintenance and PTSD.

A study will now be outlined that investigates the concurrent and subsequent effects of emotional suppression when processing traumatic material. It will be examined whether attempts to minimise emotions experienced during an analogue trauma induction may paradoxically lead to an emotional 'rebound' effect, where there is increased likelihood of subsequently experiencing PTSD-like phenomena.

1.7 Project Overview and Rationale

The project presented in this thesis explores the consequences of emotional suppression at the time of trauma encoding, to see whether it is an effective way of
regulating response during initial encoding and whether an 'emotional rebound' effect emerges subsequently.

Emotion suppression was selected for investigation because it was felt to be the strategy most directly analogous to thought suppression, which has been clearly linked to onset and maintenance of PTSD. Further, suppression was felt to be the strategy most easily definable, best established in the literature, and most clearly a form of 'emotional' rather than 'cognitive' regulation.

Since the focus of the study was on initial trauma encoding, the decision was made to use an analogue trauma induction rather than recruiting a sample with PTSD (where the initial trauma encoding has necessarily already occurred). Suppression was operationalised as attempts to reduce any emotions experienced internally (for example, feeling angry subjectively) and displayed externally (for example, having an angry face, posture, or behaviour).

It is important to note that this is not the same definition of suppression used in the series of emotion regulation experiments by Gross (1998), which limited the construct to the suppression of external expression of emotion. The decision to adopt a broader definition of emotional suppression was made for a number of reasons. The key aim of the current project was to look at the consequences of altering subjective experience of emotion. The Gross data show that using emotional expression suppression influences observable signs of experienced affect but does not change subjective experience. Moreover, the focus of the Gross experiments was on contrasting different ways of down-regulating emotional experience, whereas the focus in the current study was on the consequences of down-regulating emotion, to some extent irrespective of how this is achieved. To maximise the likelihood of successful down-regulation, it was decided not to limit the strategies participants
could use to external expression alone. Finally, the distinction drawn between different forms of emotion regulation in the process model may not in any case be valid (see section 1.5.2).

To investigate the consequences of emotion suppression when encoding traumatic material, the following experiment was conducted (see Chapter 2 for full details of methodology). Healthy participants were asked to view a distressing video about real road traffic accidents (compiled by Steil, 1996), which was intended to act as an analogue trauma induction. A video stress induction was chosen as this has been widely used in the normative emotion regulation literature (Gross 1998, 2001), the Lazarus stress response literature (Lazarus, 1993), and the cognitive literature on PTSD (Davies & Clark, 1998).

Half of the participants were instructed to watch the video as normal (control condition), whereas the other half of participants were asked to minimise how much emotion they were expressing and experiencing (suppression condition). How successfully they followed these instructions was measured in terms of self-report of emotional experience and psychophysiological response (heart rate and galvanic skin response) during the video. Both self-report and psychophysiology measures were included as emotions are increasingly viewed as having a number of different component responses that can be measured by language, behaviour, or physiological change (for example, Lang, Greenwald, Bradley & Hamm, 1993).

Psychophysiological indices may be less susceptible to demand characteristics than self-report and less susceptible to display rules than facial expressions (Sloan et al., 2001) and may therefore reveal a different pattern of findings.

The consequences on subsequent emotional processing were indexed by asking participants to view a series of emotional images and record their emotional
response (again both self-report and psychophysiological response). This intends to extend the normative emotion regulation literature (Gross, 1998; 2001) by looking at the consequences of suppression on processing of subsequent emotional material and shorter and longer term background mood, rather than simply investigating mood at the time of encoding. Further, previous research into PTSD has looked at subsequent processing of emotional images (Litz et al., 2000), so it will be possible to test whether emotional suppression leads to a PTSD-like profile when viewing other emotional material.

The impact the suppression and control conditions had on concurrent and subsequent mood was measured by asking participants to rate their emotional state immediately before and after the induction and for the week before and after the induction. It was felt to be important to measure background mood as well as emotional response to new material, as the consequences of emotional suppression may not be uniform across these indices. A variety of different emotions and mood states will be indexed, to make it possible to test whether suppression has a generic effect on all affect or a specific impact on the predominant emotions that were being suppressed.

To assess how the conditions influenced episodic memory, participants completed memory tests about the content of the video at a one-week follow-up. Further, to explore the influence on intrusive memories about the video, participants completed an auditory stream of consciousness task immediately after watching the video and filled in a daily intrusion diary for the following week. These measures allow comparison to the series of studies by Brewin and colleagues looking at the consequences of dissociation as form of trauma regulation (see Holmes, Brewin &
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Hennessey, 2004) and also the general thought suppression literature (Wegner et al., 1993).

1.8 Hypotheses

Integrating findings from the thought suppression, process model of emotion regulation, and dissociation literatures in terms of dual representation theory (Brewin, Dalgleish & Joseph, 1996: see section 1.6), the general prediction of this thesis is that emotional suppression will lead to a strengthened situationally accessible memory trace (SAM; visual memory) and a weakened verbally accessible memory trace (VAM; verbal memory) of the trauma material. This is hypothesised to have the following concurrent and subsequent consequences.

First, replicating the findings from the process model of emotion regulation (Gross et al. 1998; Gross, 2001), it is hypothesised that participants in the emotional suppression group will show an increase in psychophysiological response while viewing the trauma film, compared to volunteers in the control condition. In contrast to the predictions arising from the process model of emotion regulation, it is hypothesised that extending suppression to internal feeling state as well as external expression will mean that self-reported negative affect will decrease rather than remain unaffected following suppression.

Second, consistent with the rebound hypothesis (Wegner et al., 1987; Wegner, 1994) it is predicted that participants in the emotional suppression group will show a subsequent increase in negative mood and a decrease in positive mood, compared to volunteers in the control condition.
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Third, also consistent with the rebound hypothesis (Wegner et al., 1987; Wegner, 1994), it is hypothesised participants in the emotional suppression group will show an elevated self-report and psychophysiological emotional response when viewing subsequent negative affective material and a decreased self-report and psychophysiological emotional response when viewing subsequent positive affective material, compared to volunteers in the control condition.

Fourth, replicating the dissociation literature (see Brewin, Hennessey & Holmes, 2004), it is predicted that participants in the emotional suppression group will report experiencing a higher number of intrusive thoughts and images about the trauma film. This will be indexed by verbalising a higher number of intrusions and talking about the film for longer during the stream of consciousness task and recording more intrusions in the week long intrusion diary, compared to volunteers in the control condition.

Fifth, replicating the Gross data (Gross, 1989, 2001), it is hypothesised that participants in the emotional suppression group will show impaired episodic memory for the trauma film, compared to volunteers in the control condition.
Chapter 2: Methodology

2.1 Ethical Approval

The study was approved by the Human Psychology Experiment Research Ethics Committee, University of Cambridge School of Biological Sciences. In accordance with ethical guidelines, all participants were sent a letter describing the study, read an information sheet and gave written, informed consent prior to taking part in the experiment. They were instructed that they could withdraw from the study at any time and for whatever reason. Volunteers were given an honorarium of five pounds an hour for their time and a contribution was made towards their travel expenses. A copy of the ethics approval letter, the consent form, the information sheet, and letter written to participants are shown in Appendix 1.

2.2 Participants

2.2.1 Power Calculation

To estimate required sample size for the experiment, a power calculation was conducted. Power is defined as the probability of correctly rejecting a false null hypothesis. A majority of analyses that will be reported in this thesis will be independent sample t-tests/univariate F-tests, so power calculations were derived for this statistic. Assuming a large effect size and an alpha value of .05, Cohen (1988) suggests recruiting a sample of 26 people to have a power (d) of .80. A value of d = .80 would produce a type II error rate (Beta) of .20. This equates to a 1 in 5 chance of

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1 For any consequences of emotional suppression found in the current study to have clinical or theoretical utility it was felt that the effect would need to be of a reasonably large magnitude. For this reason, the study was designed to detect large effect sizes. This introduces the risk that some smaller magnitude effects may be missed in the analysis, but these effects are unlikely to have high ecological validity.
accepting the null hypothesis when it is in fact false. For this reason, the target sample size aimed for in the current project was 26 participants in each group. This was felt to ensure adequate power in the study without placing undue logistical pressures on the project. Further, this intended sample size was comparable to that used in the original Gross and Levenson (1993) study that found significant effects of expression suppression (21 participants in the suppress condition; 22 participants in the control condition).

2.2.2 Recruitment Process

Participants were recruited into the study from the Medical Research Council (MRC) Cognition and Brain Sciences Unit (CBU) Volunteer Participant Panel. Volunteers were initially contacted by letter outlining the experiment and asked to opt into the study by returning a form. 250 letters were posted out, from which 56 people replied saying they were willing to take part (52 people said they did not wish to take part in the study, the other letters generated no response). Participants who provisionally agreed to take part in the study were then contacted by telephone to discuss the study and dates for testing arranged. A further 4 participants withdrew from the study at this stage. Of the remaining 52 people who agreed to participate, 48 people attended the testing session.

To ensure that participants were not vulnerable to the potentially distressing emotional material used in the study, the information sheet advised participants not to take part if they had any mental health history. Prior to the experiment participants were also screened for any psychopathology. People who reported being diagnosed by their GP or any other mental health practitioner with a past or current diagnosis of a
Diagnostic Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 1994) condition were advised not to take part in the study. Significant mental health history led to two participants being excluded from the study (one with a history of OCD; one with a history of depression).

In addition, participants were specifically screened for history of traumatic reaction to life events (c.f. Hennessey, 2002). Volunteers were asked if they had ever encountered any of 12 common traumatic situations (derived from the Posttraumatic Stress Diagnostic Scale; Foa, 1995). If answering yes, further details of the event were taken to see whether they had experienced a reaction consistent with a diagnosis of PTSD. Participants reporting a PTSD-like response to these life events would have been advised not to take part in the experiment. No participants described a PTSD-like reaction.

Further, to control for current symptoms of depression or anxiety, people scoring on the Beck Depression Inventory (BDI) above ten (symptomatic range on the BDI as defined by Shaw, Vallis & McCabe, 1985) and people scoring more than two standard deviations from the mean on either scale of the Spielberger State-Trait anxiety inventory (STAI; Spielberger, 1983) would also be excluded from the study. No participants were above clinical cut offs on these measures.

2.2.3 Final Sample Characteristics

Volunteers were all aged between 18 and 65 and were of either gender. They were screened for colour blindness and instructed to wear their glasses if they normally used them for reading or watching television. After screening, participants were randomly assigned to the control or suppress conditions of the experiment (n =
23 in each condition). To ensure that the comparability of groups could be examined, age, gender, intelligence, and medication status were recorded. Intelligence was estimated using the National Adult Reading Test (NART; Nelson, 1982) to predict full-scale IQ.

Two participants withdrew during the testing session (both from the suppression group), leaving a final sample size of 44 (23 in the control condition; 21 in the suppress condition). It is important to note that this final sample size is smaller than the intended sample size generated by the power calculation, making the analyses reported slightly under-powered. Owing to time constraints and running out of available participants on the CBU panel, it was not possible to recruit a larger sample prior to the data collection deadline. This means that any null results should be interpreted cautiously, as they may reflect a lack of statistical power rather than genuine comparability between the two experimental conditions.

2.3 Measures

2.3.1 Rest Task

To measure baseline psychophysiology activity independent of task demands, participants were asked to relax for three minutes while their galvanic skin response (GSR) and heart rate (HR) were recorded (see section 2.4 for details of psychophysiology methodology). These data were then used as a baseline to compare with the psychophysiological response to the trauma induction, affective picture task, and stream of consciousness task.
2.3.2 Emotion Regulation Training and Practice

Participants in each condition were then trained in how to control their emotions during the trauma induction. Participants were shown written instructions for either the control or suppression condition (see Appendix 2). These instructions were based on those used by Jackson (2000), elaborated to give a clearer definition of suppression in terms of down-regulating both internal feeling and external expression\(^2\). Following any questions about the instructions, participants then practised following them while viewing a two minute segment of an American war film in black and white called ‘A Tale of Two Cities’, which documented the nuclear bombing of Hiroshima and Nagasaki.

After watching the practice film, volunteers were asked to rate how they were feeling in various ways. Participants recorded how much happiness, sadness, anger, surprise, fear, and disgust they experienced and also to what extent they felt helpless, horrified, and distressed on computerised 100 point visual analogue scales (ranging from 0 not at all to 100 extremely). They also rated arousal and valence of each scene on 9 point sliding visual analogue scales (arousal: 1 not at all arousing to 9 very arousing; valence: 1 very unpleasant, 5 neutral, to 9 very pleasant). GSR and HR were recorded to measure emotional arousal.

\(^2\) Piloting using the original Jackson (2000) suppression instructions revealed that participants found it hard to understand what was meant by suppression, so struggled to achieve this. To elaborate the definition of suppression, the reappraisal and expression suppression instructions used by Gross (1998) were included. Further piloting revealed that participants felt more confident following the revised instructions.
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2.3.3 Trauma Induction: Road Traffic Accident Video

To induce an analogue of trauma, participants then watched a 12.5 minute digitised trauma video of real-life footage of road traffic accidents (compiled by Steil, 1996). The footage consisted of five traumatic scenes made up from the aftermath of vehicle crashes, including emergency service personnel working to extract trapped victims, injured victims screaming, dead bodies being moved, and body parts among car wreckage. Between scenes, a brief commentary provided context to each accident and the people involved (see Appendix 4). This film has previously been found to be an effective trauma induction without unduly disturbing participants (Murray, 1997; Brewin & Saunders, 2000; Holmes, Brewin & Hennessey, 2003). The film content is similar to that seen in news broadcasts of road traffic accidents or programmes about the work of emergency service personnel.

Participants were instructed to continue following the emotion regulation they had been given while they watched the film. After the film, they rated how it had made them feel on the same rating scales described above (see section 2.2.2). Volunteers were then told they could stop following the emotion regulation instructions. GSR and HR were recorded for the duration of each video.

To control for the potentially harmful effects of showing a film with traumatic content a number of steps were taken. Participants were screened prior to taking part and it was emphasised they could withdraw at any time during the study (see section 2.1). All participants were encouraged to contact the experimenter should they feel distressed about the film, either in the week between testing sessions or after the end of the experiment. Depending on the degree of distress, volunteers could then be offered either a debriefing or a referral made to local psychological services. In
practice, two participants withdrew from the experiment during the video. Both of these participants reported feeling better soon after the film and did not report any adverse effects at a one week telephone call follow-up, so no further action was taken.

2.3.4 Compliance With Emotion Regulation Instructions

To measure compliance with the emotion regulation instructions, participants completed a brief questionnaire asking them how they controlled their emotions while watching the film (see Appendix 3) at the end of the testing session. Participants were asked to rate the extent to which they attempted to suppress their emotions, tried to change the meaning of the material, looked away from the screen, did not pay attention, or deliberately thought of other things (all rated on 100 point sliding visual analogue scales from 0 not at all to 100 extremely).

2.3.5 Mood Monitoring: Self-Report Measures

To measure the impact of the trauma induction on emotion, participants were asked to rate their mood before and after watching the video. Mood ratings were taken both immediately pre- and post the induction and over the week before and the week after the induction. The following self-report measures were completed:

2.3.5.1 Week Long Mood Measures

- The Beck Depression Inventory (BDI; Beck et al 1961) was used as a self-report measure of depressive symptoms over a week long period. On each of 21 items, four statements describe increasingly severe presentation of a given
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symptom of depression. Participants circle the response (or sometimes responses) that describes their mood over the past week, on a scale of 0 (symptom absent) to 3 (symptom severe). The following cut-offs have been recommended for detecting depression: 0 – 9 = asymptomatic, 10 – 15 = mild depression, 16 – 23 = moderate depression, 24 – 63 = severe depression (Shaw et al., 1985). The BDI has been found to have high reliability and stability and has also been demonstrated to correlate highly with clinicians’ ratings of depression (Beck et al, 1988).

• A modified version of the trait scale from the Spielberger State-Trait Anxiety Inventory (STAI; Spielberger et al, 1983) was given to measure anxiety symptoms over a week long period. The STAI is one of the most frequently used and long standing measures of anxiety. It is made up of two forms that generate a trait (stable propensity to experience anxiety) and a state (current experience of anxiety) measure. Each form has 20 statements that require individuals to rate how they feel on a four-point scale. Reliability and validity of the scale is high (Bieling et al, 1998), with test-retest reliability ranging from .65 to .86 and internal consistency reported to range from .83 to .92. In the standard version of the trait scale, participants are asked to rate how they generally feel. In the version used in this thesis, participants were asked to rate how they had felt over the past week.

• A modified version of the Positive Affect Negative Affect Scale (PANAS; Watson, Clark & Tellegen, 1988) was administered to measure affective experience over a week long period. The PANAS measures the extent to which participants experience positive and negative emotions. It is made up of sixteen adjectives, eight of which are positive (for example, ‘excited’, ‘active’)
and eight of which are negative (for example, ‘distressed’, ‘irritable’). In the
standard version, participants are asked to rate to what extent they generally
feel that way on a five point scale (1 very slightly or not at all: 5 extremely).
Instructions were modified to ask participants to rate how they had felt over
the past week rather than how they generally feel.

- In addition to the above scales, participants also completed a series of pen and
paper 100 point visual analogue scales rating how much happiness, sadness,

fear, disgust, surprise, anger, guilt, shame, helplessness, horror, terror, and
distress they had experienced over the past week (from 1 not at all to 100
extremely). These rating were included to make it possible to measure change
in particular discrete emotional states that pilot work suggested the video
induced. Further, participants rated how aroused they had felt over the past
week (from 1 not at all to 9 extremely) and how pleasant they had felt (from 1
very unpleasant, 5 neutral, to 9 very pleasant) over the past week. High arousal
was defined to participants as “feeling stimulated, jittery, wide awake and/or
alert” and low arousal was defined to participants as “feeling relaxed, calm,
sluggish, dull and/or sleepy”. Arousal and valence measures were included to
make it possible to index emotion change in dimensional as well as categorical
terms. A copy of these measures is shown in Appendix 4.

2.3.5.2 State Mood Measures

- The state scale of the STAI was administered to measure anxiety symptoms

- A second modified version of the PANAS was administered to measure
positive and negative affect. The instructions asked participants to say how
much each adjective described their mood at that precise moment in time.
Chapter 2: Methodology

- Modified versions of the pen and paper visual analogue mood scales were given to measure experience of different emotional states and to gain arousal and valence ratings. Instructions were altered, asking participants how they felt at that precise point in time rather than over the past week (see Appendix 5).

2.3.6 Thought Monitoring: Stream of Consciousness Task

To measure the impact of emotion regulation on thought content immediately after the induction, participants were asked to complete a verbal stream of consciousness task as used in the thought suppression literatures. This task simply asks volunteers to speak out loud whatever is going through their mind, with their responses being recorded onto audio cassette using an external microphone (c.f. Wegner, Erber & Zanakos, 1993). To minimise participants feeling self-conscious verbalising their thought, the experimenter left the room while this practice was being performed.

To ensure participants were familiar with the demands of the task, prior to the trauma induction they were given written instructions (based on Wegner et al., 1993: see Appendix 6) and asked to complete a two minute practice. At the end of the practice, the experimenter checked that they had been able to complete the task and answered any further questions. Following the trauma induction, participants were reminded of the instructions and asked to repeat the stream of consciousness task over a five minute period. The number of intrusions about the content of the film and the length of time (in seconds) that people talked about the film during this time were
then calculated by the experimenter. GSR and HR were recorded and averaged for the duration of the stream of consciousness task.

2.3.7 Affective Picture Task

To measure the impact of the emotion regulation condition on subsequent processing of emotional material, participants were shown fifty images selected from the International Affective Picture Set (IAPS; Lang et al, 1993) in each of the following categories: positive, fearful, sad, disgusting and neutral (ten of each category). The IAPS is a series of emotional and neutral images that have detailed normative rating and psychophysiological response data (for a review, see Bradley, 2000). Use of the IAPS makes it possible to measure emotional processing relatively unconfounded by differences in the content of material being imagined or recalled by participants.

The positive images incorporated pictures of people smiling, beautiful scenes from nature, and sports. The fearful images were made up of scenes of frightening animals and human attack. The sad images consisted of scenes of people crying, loss, deprivation, and injury. The disgusting images included pictures of decaying food, waste, and litter. The neutral images had pictures of common household and road-side objects. Figure 2.3.7.1 shows an example of an image from each category and Appendix 7 reproduces all of the images used. Selection of pictures for each block was initially based on a pilot study of ten people which identified images that generated a particular emotion and were rarely confused with other emotions. The images chosen have subsequently been validated on over 60 control participants and
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shown to reliably induce the desired discrete emotions and to generate distinct valence and arousal ratings as intended (Dunn et al, 2002).

Participants viewed each image for six seconds, rated how the image made them feel, and there was then an eight second inter-trial interval before the next image was shown (based on timings used by Bradley et al, 2001). Participants rated how much happiness, sadness, fear, and disgust they had experienced on the same 100-point scales and rated how arousing and pleasant each images was on the same 9-

Figure 2.3.7.1: Example Images Used in the Affective Picture Task.

Typical Fear Image

Typical Disgust Image

Typical Sad Image

Typical Positive Image

Typical Neutral Image
point scales used in the trauma induction. GSR and HR response to each image were also recorded.

Participants were instructed to view the pictures normally, without following any particular emotion regulation instructions, and to then rate how they felt as honestly as possible (see Appendix 8 for a copy of the instructions used). To control for order effects, the images were presented in a pseudo-random sequence. On each block of five trials, one of each image type would be randomly selected, presented, and then excluded from selection on subsequent trials. The task took around 30 minutes to complete on average.

2.3.8 Intrusion Diary

To monitor the number of intrusions participants experienced about the road traffic accident video, they were asked to complete a daily intrusion diary for one week after the first testing session (c.f. Holmes, Brewin & Hennessey, 2004; Brewin & Saunders, 2001). Intrusions were defined as spontaneously occurring (not deliberate) memories or images of the film. One diary page was provided for each day of the following week, divided into spaces for morning, afternoon, evening, and night. For each intrusion experienced, participants were asked to record: a) the number of times it occurred; b) whether it was primarily a thought, image, or both; c) a brief description of the content; and d) a rating of how much distress it caused them (ranging from 0 not at all distressed to 100 extremely distressed). For all times where participants did not experience any intrusions they were asked to enter a zero. The total number of intrusions was counted from the diary entries by the experimenter.
Chapter 2: Methodology

To ensure compliance with the diary, participants were instructed how to use it at the end of the first testing session and they were given a cover sheet with full instructions and a completed example of the diary for one day (see Appendix 9). At follow-up, participants were asked how often they had been unable or forgotten to complete the diary on an 11 point scale (0: not at all true; 10: extremely true; Davies & Clark, 1998).

2.3.9 Memory for Trauma Induction

To measure recall of the road traffic accident video at session two, participants completed a recognition memory questionnaire and a cued recall explicit memory questionnaire about the film (c.f. Hennessy, 2002). The recognition memory questionnaire was made up of 20 descriptions of traumatic scenes and participants had to judge whether that item had or had not occurred in the film. Half of the items were genuine and half did not occur in the video. The cued recall questionnaire was made up of 15 questions about specific details in the film (three from each scene). A copy of both measures is shown in Appendix 10.

2.4 Psychophysiological Recording and Analysis

The rationale for including psychophysiological measures of GSR and HR as well as the behavioural measures is that emotions are increasingly viewed as having a number of different component responses that can be measured by language, behaviour, or physiological change (e.g., Lang, Greenwald, Bradley & Hamm, 1993). Psychophysiological indices may be less susceptible to demand characteristics than
Chapter 2: Methodology

self-report and less susceptible to display rules than facial expressions (Sloan et al., 2001) and may therefore reveal a different pattern of findings. GSR and HR are two of the best studied psychophysiology measures, are relatively simple to record, and are relatively robust to artefact.

2.4.1 Galvanic Skin Response

GSR is assessed by passing a small current across two electrodes placed on the surface of the skin and measuring how much resistance there is. This technique was first used in the laboratory of Charcot over 100 years ago, both to explore differences in tonic skin resistance level as a diagnostic sign of illness (Vigouroux, 1879, 1888) and to measure changes in skin resistance in response to a variety of stimuli (Fere, 1888).

The GSR measures used today are simply the reciprocal of skin resistance, calculated by dividing voltage by current and in turn taking the reciprocal of this. GSR is used as an index of a wide range of psychological concepts, including arousal, emotion and attention. Care needs to be taken not to assume GSR is specific to any one of these processes.

The physiological basis of GSR is believed to reflect activity of the eccrine sweat glands, which increase the amount of sweat released when we are emotionally or physically aroused, which in turn boosts skin conductance (see Edelberg (1993) for a review of the single effector model). Activity of the eccrine sweat glands is based on sympathetic cholinergic and adrenergic innervation (Shields et al, 1987). Control of this system is complex. Excitatory hypothalamic, cortical, and brainstem projections
interacting with inhibitory projections from the hippocampus are believed to regulate these neurotransmitter pathways (see Dawson et al, 2000).

The advantages of GSR are that it is a relatively pure measure of sympathetic activity, where as heart rate is influenced by both sympathetic and parasympathetic activation. Further, it is easy to measure and discriminate if a response has occurred; cheap, easy to record, safe, and relatively insensitive to potential sources of artefact such as electrical noise. Its disadvantages are that it is a slow moving system so has limited temporal resolution, and that it is multiply determined by a range of stimuli so its specificity has been questioned.

A typical GSR profile is tonic response to specific stimuli being superimposed on a drifting phasic baseline. The current study was most interested in tonic response to stimuli, so activity during each trial had a pre-stimulus baseline subtracted from it to minimise the confounding effects of phasic activity on the signal. Further, a measure of GSR variability (standard deviation) during the tasks was included.

2.4.2 Cardiovascular System

Both stroke volume and heart rate influence the cardiac output of the heart. Stroke volume is the difference between the systolic, or relaxation, and diastolic, or contraction, phases of the heart. In other words, it is how much blood is pumped out of the heart on each contraction, which is a function of both blood pressure and resistance to flow in the body. Heart rate measures how frequently the heart contracts and is measured in beats per minute, or bpm (see Brownley et al, 2000 for a review).

Most psychophysiological studies of cardiovascular function focus on heart rate. Heart rate is indexed using electrocardiography, or ECG. This was first used in
the early twentieth century (see Einthoven et al., 1913). Electrodes are placed on appropriate points of the body and leads go to the electrocardiograph, thus forming an electrical circuit between the amplifier and heart. The ECG records electrical impulses that stimulate the heart to make it contract. The ECG of a single cardiac cycle is made up of three waveforms and three intervals, of which the R-wave is the most easily identifiable. Heart period is the interval between the R-waves of each cardiac cycle and heart rate is the reciprocal of this value.

Control of the heart is influenced by both neuronal and neuroendocrine factors. The intrinsic rate of the heart (i.e., how fast it would beat in the absence of any inhibitory control) is around 105 bpm but resting rate in most humans is between 60 – 80 bpm. In particular, the vagus nerve provides neuronal constraint and an interaction of sympathetic and parasympathetic divisions of the ANS provides neurochemical and hormonal control. Heart rate increase can be due either to an increase of activity in the sympathetic division or a decrease of activity in the parasympathetic division; these two systems tend to be mutually antagonistic (Bernston & Cacioppo, 2000).

Heart control is largely reflexive, influenced by reflex arcs in the brain stem and higher level input from the limbic system and cortex. For example, in a ‘defence’ response cardiac output increases and peripheral resistance decreases, thus readying the organism for action. This is controlled by activation of the hypothalamic-adrenal axis and the sympathetic adrenomedullary systems (see Schneiderman & McCabe, 1989). Interestingly, elevated activity of this system in response to stress is now believed to be predictive of subsequent elevated blood pressure and hypertension (for example see Menekes et al., 1989), both important risk factors for coronary heart disease (CHD).
Chapter 2: Methodology

The advantages of rate measures of cardiovascular function are that they are insensitive to artefact, easy and safe to record, and are known to be sensitive to manipulations of a range of psychological phenomena. The disadvantage of heart rate is that it is hard to interpret any changes found, since increases can either reflect increase of the sympathetic activation or parasympathetic deactivation division of the autonomic nervous system.

In the current study, a variety of ways of measuring HR were used. HR does not linearly increase or decrease following stimulus presentation. For example, following exposure to fearful pictures, a triphasic pattern of response is typically seen, where HR initially decreases, then increases, and finally decreases again. For this reason, simple measures of mean HR activity are not particularly informative.

For longer term measures (video task, stream of consciousness task, rest task) analysis will use HR variability measures. HR variability is defined as variations in instantaneous heart rate over time (Bernston, Bigger, Eckberg et al., 1997). Research guidelines (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996) recommend indexing HR variability both in terms of standard deviations between normal-normal intervals on the ECG (SDNN) and the square root of the mean of the sum of the square of differences between adjacent normal-normal intervals on the ECG (RMSSD). This thesis will report both of these measures.

For shorter term measures (the response to each emotional image in the affective picture task) component acceleration and deceleration responses will be used to best model the triphasic HR response (c.f. Bradley et al., 2002: see section 3.6.3 for more details).
2.4.3 Psychophysiological Equipment Setup

Psychophysiological recording used a BIOPAC™ MP100 unit, with one GSR 100B amplifier and one ECG 100B amplifier (BIOPAC, 1997). The GSR amplifier was set to direct current, had a sensitivity of 10 umho/V, with a 10Hz low-pass filter and 0.05 Hz high-pass filter. The ECG amplifier gain was set at x 2000, the R-wave detector was switched on, and the filter was switched off. The sampling rate was 200 samples per second for all acquisitions, providing a temporal resolution of 5ms. The MP100 was connected through the Comm port to a Pentium 300 computer, which recorded the amplifier output using the Acqknowledge™ 8.0 software. The experimental tasks were presented on a separate Pentium 300 computer with a 15" display. This communicated with the digital input ports of the MP100 through the parallel port of the computer, marking when and what kind of events occurred during the experimental task on the Acqknowledge record. Figure 2.4.3.1 displays a schematic representation of the equipment setup and Figure 2.4.3.2 shows an example of a typical Acqknowledge Record.
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Figure 2.4.3.1: Schematic Diagram Showing How Physiological Recordings Are Taken.

Each physiological system is recorded as a different analogue channel by the MP100.

Digital marker signals are sent through the parallel port of the task computer to the MP100, indicating when and what kind of event has just occurred in the task.

The MP100 sends the digital and analogue signals to the recording computer, where Acqknowledge saves the record.

Figure 2.4.3.2: A Typical Acqknowledge Record.

The top four channels record on-line activity of the physiological systems. The bottom four channels indicate when and what kind of event is occurring in the behavioural task.
Chapter 2: Methodology

2.4.4 Electrode Placement and Attachment

To monitor heart rate (in bpm) three disposable Ag-AgCl ECG electrodes with clip-on shielded leads were attached to the top sides of each wrist and the right shin of each participant. Prior to attachment, electrode sites were cleaned with an alcohol wipe. To measure skin conductance (in micro-Siemens; μS) two Ag-AgCl GSR electrodes were attached to the volar surfaces of the medial phalanges of the first and second finger of the non-dominant hand. Participants were asked to wash their hands gently with soap and water prior to electrode attachment and BIOPAC GSR paste was used as the electrolyte. Choice of electrode attachment and sampling was based on published research guidelines for GSR (Fowles et al, 1981; Dawson et al, 2000), and ECG (Jennings et al, 1981; Brownley et al, 2000).

2.4.5 Psychophysiology Data Analysis

Prior to analysis all data were visually inspected for recording artefact and that channel excluded if artefact was present. In borderline cases, artefact was defined as anything greater than three standard deviations from the channel mean. The ECG signal was transformed to a heart rate estimate, using the Acqknowledge interval function.

Analysis was conducted using the Physiological Analysis System software (PAS; Dunn & Cusack, in preparation). This is a package developed to automate the event-related analysis of psychophysiological data. PAS searches through each Acqknowledge subject file to find when events to be analysed occurred, using the digital markers traced on the record. Summary measures are then calculated to
characterise the physiological response for each event, typically mean response during
the stimulus and mean response during a pre-stimulus baseline period. The decision
was made to report magnitude rather than amplitude of response, owing to the
arbitrary nature of deciding what counts as a significant threshold for a response in
either the electrodermal or heart rate data.

The quantification of psychophysiological activity is complicated by a
distinction drawn between phasic and tonic activity. Tonic activity is the underlying
level of system activity when no phasic response is occurring. Superimposed on tonic
activity are phasic changes in response to external or internal stimuli.

Wilders law of initial values (1967) argues that these components of a signal
are not independent: if the baseline level of activity on a channel is near maximum it
is harder to produce an event-related change than if the baseline level of activity on a
channel is near minimum. To illustrate this point, consider measuring activity of
zygomatic facial muscle with electromyocardography (EMG) to indicate a positive
response to a stimulus. If the participant is already smiling widely prior to stimulus
presentation then when the stimulus is shown there will not be a large change in the
EMG signal because it is already close to ceiling. The interaction of phasic and tonic
components of a signal makes the analysis of group differences in psychophysiology
complex. Any group difference could reflect a different level of baseline activity, a
different response to stimulus presentation, or an interaction of baseline activity and
response to stimulus.

To ensure event related responses to stimuli were not confounded by
underlying baseline activity, change scores were used in this thesis. This subtracts
activity during the event from activity during a pre-event baseline period. For
example, response to the road traffic accident video had resting state activity during
the rest task subtracted from it, to minimise the impact of baseline differences. The specific psychophysiological measures taken for each experimental task will be outlined in more detail the results section (see chapter 3).

2.5 Procedure

Participants sat in a comfortable chair in a darkened room while completing the computerised tasks. They completed questionnaire measures in an adjacent testing cubicle. All computerised tasks were programmed in Microsoft Visual Basic 6.0 (Microsoft, 2000), run on a PC, and presented on a 17” TFT flat screen monitor. Tasks were piloted prior to testing to check for programming bugs and experimenter error.

Testing took place over two sessions, separated by one week. In session one (lasting around two hours), a number of baseline measures were taken, participants were instructed how to regulate their emotions and then viewed a trauma induction, and the impact this induction had on mood and memory immediately afterwards was measured. Participants’ psychophysiological responses were recorded during performance of the experimental tasks during the session. In the week between sessions one and two, volunteers were asked to keep a daily diary of any thoughts they had about the trauma induction (taking around five minutes per day). In session two (lasting around thirty minutes), participants’ diaries were reviewed, their memory for the trauma video assessed, and the impact of the trauma induction on their mood over the past week assessed. Participants completed the tasks in the following fixed order:
Chapter 2: Methodology

2.5.1 Session One

- Screening
- Baseline mood measures: past week and current time
- Rest psychophysiology task
- Practice stream of consciousness task
- Practice film (Nagasaki bombing)
- Trauma induction (RTA Video)
- Test stream of consciousness task
- Test mood measures: current time
- Affective Picture Task
- Compliance with emotion regulation instructions
- Instructions given for intrusion diary

2.5.2 Session Two

- Test mood measures: past week
- Cued-Recall Memory Questionnaire
- Recognition Memory Questionnaire
- Review intrusion diary
- Diary compliance rating
Chapter 2: Methodology

2.6 Statistical Issues

Statistical analysis was carried out using SPSS 8.0 For Windows (SPSS Inc, 1997). Prior to analysis all variables were explored to check they met the normality and homogeneity of variance and sphericity assumptions of parametric statistics (see Howell, 1992). If the data were positively skewed a natural log transform was applied and if the data were negatively skewed a reciprocal natural log transform was applied. Where transformed data have been used this is highlighted in the analysis; all other analyses are carried out on raw data.

In some cases transformation failed to normalise variables; in this instance both parametric and the closest non-parametric equivalent analyses are run and reported on raw data. Repeated Measures Analyses of Variance (ANOVA) output usually reports the within-participants rather than multivariate output. The exception to this is where sphericity was violated and multivariate output was then reported. Vasey and Thayer (1987) discuss how multivariate output is much less prone to elevation of a type I error when sphericity is violated. An alpha value of .05 was used to indicate significance and an alpha value of .1 to indicate a trend. The decision was made not to correct for multiple comparisons in the analysis section, as all of the contrasts were based on a priori hypotheses.
Chapter 3: Results

3.1 Examining Comparability of Conditions

To check that the participants in each group were comparable, a series of independent samples t-tests and chi squared tests were run on key demographic, mood, and resting state psychophysiology variables.

3.1.1 Demographic Variables

Table 3.1.1.1 summarises demographic variables of participants assigned to the suppression and control conditions. There was no difference between groups for age, gender ratio, or NART full scale IQ estimate, suggesting the groups were comparable on these variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Suppress Condition (n = 21)</th>
<th>Control Condition (n = 23)</th>
<th>Statistical Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>35.43 (16.38)</td>
<td>33.26 (16.48)</td>
<td>t (1, 42) = 0.44, p = 0.66 *</td>
</tr>
<tr>
<td>Gender Ratio</td>
<td>14 f : 9 m</td>
<td>16 f : 5 m</td>
<td>Chi (1, 42) = 1.19, p = 0.34</td>
</tr>
<tr>
<td>NART full scale IQ estimate</td>
<td>117.97 (4.79)</td>
<td>119.10 (3.47)</td>
<td>t (1, 38) = 0.87, p = 0.39 b</td>
</tr>
</tbody>
</table>

Data are mean (standard deviation) values: NART = National Adult Reading Test
a: Age was significantly positively skewed and could not be corrected by log transformation. Non-parametric analysis using the Mann-Whitney U-test found identical non-significant results.
b: Four participants reported having seen the NART word list before, so their error scores were excluded (1 in the control group; 3 in the suppress group).

3.1.2 Mood Variables

Table 3.1.2.1 measures the mean rating of state mood prior to the trauma induction for each group. Independent samples t-tests found that the suppress and
control conditions were comparable on all measures. Identical results were found using non-parametric Mann Whitney U-tests to control for non-normality.

Table 3.1.2.1: Mood Measures Immediately Prior to Trauma Induction in the Suppress and Control Conditions.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Suppress Condition (n = 21)</th>
<th>Control Condition (n = 23)</th>
<th>Statistical Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happiness</td>
<td>68.60 (19.39)</td>
<td>67.08 (17.22)</td>
<td>t (1, 42) = 0.28, p = 0.78</td>
</tr>
<tr>
<td>Sadness</td>
<td>12.14 (18.53)</td>
<td>8.93 (11.75)</td>
<td>t (1, 42) = 0.69, p = 0.49 *</td>
</tr>
<tr>
<td>Fear</td>
<td>8.06 (13.33)</td>
<td>6.78 (8.38)</td>
<td>t (1, 42) = 0.38, p = 0.70 *</td>
</tr>
<tr>
<td>Disgust</td>
<td>2.51 (4.21)</td>
<td>3.01 (3.08)</td>
<td>t (1, 42) = 0.45, p = 0.66 *</td>
</tr>
<tr>
<td>Surprise</td>
<td>6.44 (15.43)</td>
<td>4.35 (5.03)</td>
<td>t (1, 42) = 0.62, p = 0.54 *</td>
</tr>
<tr>
<td>Anger</td>
<td>3.51 (5.80)</td>
<td>2.72 (3.59)</td>
<td>t (1, 42) = 0.55, p = 0.59 *</td>
</tr>
<tr>
<td>Guilt</td>
<td>2.62 (3.96)</td>
<td>2.72 (3.60)</td>
<td>t (1, 42) = 0.09, p = 0.93 *</td>
</tr>
<tr>
<td>Shame</td>
<td>1.73 (2.10)</td>
<td>3.54 (5.47)</td>
<td>t (1, 42) = 1.42, p = 0.16 *</td>
</tr>
<tr>
<td>Helplessness</td>
<td>5.76 (11.89)</td>
<td>3.44 (4.01)</td>
<td>t (1, 42) = 0.88, p = 0.38 *</td>
</tr>
<tr>
<td>Horror</td>
<td>2.15 (2.66)</td>
<td>2.91 (3.27)</td>
<td>t (1, 42) = 0.85, p = 0.40 *</td>
</tr>
<tr>
<td>Distress</td>
<td>3.19 (4.17)</td>
<td>3.78 (4.73)</td>
<td>t (1, 42) = 0.43, p = 0.67 *</td>
</tr>
<tr>
<td>Arousal</td>
<td>5.81 (1.75)</td>
<td>5.74 (1.66)</td>
<td>t (1, 42) = 0.14, p = 0.89 *</td>
</tr>
<tr>
<td>Valence</td>
<td>6.24 (1.34)</td>
<td>6.26 (1.18)</td>
<td>t (1, 42) = 0.06, p = 0.95 *</td>
</tr>
<tr>
<td>PANAS - positive</td>
<td>30.52 (7.17)</td>
<td>29.87 (6.27)</td>
<td>t (1, 42) = 0.32, p = 0.75</td>
</tr>
<tr>
<td>PANAS - negative</td>
<td>12.19 (3.22)</td>
<td>12.39 (2.19)</td>
<td>t (1, 42) = 0.24, p = 0.81 *</td>
</tr>
<tr>
<td>STAI - state anxiety</td>
<td>32.09 (4.97)</td>
<td>31.83 (4.70)</td>
<td>t (1, 42) = 0.19, p = 0.85</td>
</tr>
</tbody>
</table>

Data are mean (standard deviation) values.
Emotional experience rated on 100 point scale, from 0 (not at all) to 100 (extremely).
Valence rated on 9 point scale, from 1 (unpleasant) to 5 (neutral) to 9 (pleasant).
Arousal rated on a 9 point scale, from 1 (low) to 9 (high).
PANAS = Positive Affect Negative Affect Scale; STAI = Spielberger State Trait Anxiety Inventory.
a: These variables were significantly positively skewed and could not be corrected by transformation.
Non-parametric analysis using the Mann-Whitney U-test found identical non-significant results.

Table 3.1.2.2 plots the mean rating of mood over the week prior to the trauma induction for each group. Again, independent samples t-tests found that the suppress
and control conditions were comparable on all measures, which was also supported by non-parametric Mann Whitney U-tests to control for non-normality.

Table 3.1.2.2: Mood Measures for Week Prior to the Trauma Induction in the Suppress and Control Conditions.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Suppress Condition (n = 21)</th>
<th>Control Condition (n = 23)</th>
<th>Statistical Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happiness</td>
<td>70.50 (18.24)</td>
<td>72.78 (15.84)</td>
<td>( t(1, 42) = 0.42, p = 0.55 )</td>
</tr>
<tr>
<td>Sadness</td>
<td>26.51 (27.33)</td>
<td>22.22 (16.95)</td>
<td>( t(1, 42) = 0.59, p = 0.56 )</td>
</tr>
<tr>
<td>Fear</td>
<td>10.85 (13.97)</td>
<td>15.06 (19.84)</td>
<td>( t(1, 42) = 0.76, p = 0.45 )</td>
</tr>
<tr>
<td>Disgust</td>
<td>10.46 (16.78)</td>
<td>7.65 (7.40)</td>
<td>( t(1, 42) = 0.68, p = 0.50 )</td>
</tr>
<tr>
<td>Surprise</td>
<td>32.16 (26.54)</td>
<td>30.86 (23.00)</td>
<td>( t(1, 42) = 0.16, p = 0.87 )</td>
</tr>
<tr>
<td>Anger</td>
<td>19.23 (20.44)</td>
<td>18.21 (14.49)</td>
<td>( t(1, 42) = 0.18, p = 0.86 )</td>
</tr>
<tr>
<td>Guilt</td>
<td>8.71 (14.93)</td>
<td>11.79 (12.96)</td>
<td>( t(1, 42) = 0.69, p = 0.50 )</td>
</tr>
<tr>
<td>Shame</td>
<td>5.72 (14.10)</td>
<td>7.78 (14.06)</td>
<td>( t(1, 42) = 0.46, p = 0.65 )</td>
</tr>
<tr>
<td>Helplessness</td>
<td>15.46 (21.94)</td>
<td>15.93 (25.56)</td>
<td>( t(1, 42) = 0.06, p = 0.95 )</td>
</tr>
<tr>
<td>Horror</td>
<td>9.10 (20.55)</td>
<td>6.30 (5.76)</td>
<td>( t(1, 42) = 0.58, p = 0.95 )</td>
</tr>
<tr>
<td>Distress</td>
<td>9.88 (12.33)</td>
<td>11.85 (18.12)</td>
<td>( t(1, 42) = 0.40, p = 0.69 )</td>
</tr>
<tr>
<td>Arousal</td>
<td>6.21 (1.81)</td>
<td>6.05 (1.40)</td>
<td>( t(1, 42) = 0.31, p = 0.76 )</td>
</tr>
<tr>
<td>Valence</td>
<td>6.11 (1.41)</td>
<td>6.80 (1.20)</td>
<td>( t(1, 42) = 1.66, p = 0.11 )</td>
</tr>
<tr>
<td>PANAS - positive</td>
<td>33.79 (7.05)</td>
<td>32.40 (7.00)</td>
<td>( t(1, 42) = 0.62, p = 0.54 )</td>
</tr>
<tr>
<td>PANAS - negative</td>
<td>15.84 (3.80)</td>
<td>16.60 (3.98)</td>
<td>( t(1, 42) = 0.61, p = 0.55 )</td>
</tr>
<tr>
<td>STAI - trait anxiety</td>
<td>10.67 (3.38)</td>
<td>11.50 (2.95)</td>
<td>( t(1, 42) = 0.39, p = 0.70 )</td>
</tr>
<tr>
<td>BDI</td>
<td>3.33 (2.95)</td>
<td>3.91 (2.95)</td>
<td>( t(1, 42) = 0.65, p = 0.52 )</td>
</tr>
</tbody>
</table>

Data are mean (standard deviation) values.
Emotional experience rated on 100 point scale, from 0 (not at all) to 100 (extremely).
Valence rated on 9 point scale, from 1 (unpleasant) to 5 (neutral) to 9 (pleasant).
Arousal rated on a 9 point scale, from 1 (low) to 9 (high).
PANAS = Positive Affect Negative Affect Scale; STAI = Spielberger State Trait Anxiety Inventory; BDI = Beck Depression Inventory.
a: These variables were significantly positively skewed and could not be corrected by transformation.
Non-parametric analysis using the Mann-Whitney U-test found identical non-significant results.
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3.1.3 Rest Psychophysiology Task

Table 3.1.3.1 shows the psychophysiological response of participants in each condition during the three-minute resting task. Both independent samples t-tests and non-parametric Mann Whitney U-tests found there were no significant differences between the suppress and control conditions on any of the measures of GSR or HR, suggesting they are comparable in terms of baseline psychophysiological activity.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Suppress Condition</th>
<th>Control Condition</th>
<th>Statistical Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 21)</td>
<td>(n = 23)</td>
<td></td>
</tr>
<tr>
<td>GSR</td>
<td>1.38 (0.74)</td>
<td>1.33 (0.57)</td>
<td>t (1, 42) = 0.25, p = 0.81</td>
</tr>
<tr>
<td>GSR Variability (SDNN)</td>
<td>0.11 (0.11)</td>
<td>0.07 (0.05)</td>
<td>t (1, 42) = 1.26, p = 0.22</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>70.17 (2.11)</td>
<td>70.47 (10.22)</td>
<td>t (1,42) = 0.10, p = 0.92</td>
</tr>
<tr>
<td>HR Variability 1 (SDNN)</td>
<td>0.07 (0.04)</td>
<td>0.08 (0.07)</td>
<td>t (1, 42) = 0.13, p = 0.90</td>
</tr>
<tr>
<td>HR Variability 2 (RMSSD)</td>
<td>0.01 (0.01)</td>
<td>0.01 (0.01)</td>
<td>t (1,42) = 0.80, p = 0.43</td>
</tr>
</tbody>
</table>

Data are mean (standard deviation) values.
GSR = galvanic skin response; HR = heart rate
SDNN = standard deviation of the normal-normal interval.
RMSSD = square root of the mean squared differences of successive NN intervals.
HR measured in beats per minute (bpm); GSR measured in micro-siemens.
a: These variables were significantly non-normal and could not be corrected by transformation. Non-parametric analysis using Mann-Whitney U-tests found identical non-significant results.

3.2 Trauma Induction

Hypothesis 2: Participants in the emotional suppression group will show a decrease in experienced negative affect but an increase in psychophysiological response while viewing the trauma film, compared to volunteers in the control condition.
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3.2.1 Compliance with Emotion Regulation Instructions

Table 3.2.1.1 records the mean ratings for the suppression and control conditions concerning the extent to which participants suppressed, reappraised, looked away, did not pay attention, or deliberately thought of other things while watching the films.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Suppress Condition (n = 21)</th>
<th>Control Condition (n = 23)</th>
<th>Statistical Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suppressed</td>
<td>60.15 (31.70)</td>
<td>35.81 (28.43)</td>
<td>t (1,42) = 2.69, P = 0.01* a</td>
</tr>
<tr>
<td>Reappraised</td>
<td>30.21 (30.88)</td>
<td>21.13 (20.65)</td>
<td>t (1,42) = 1.16, P = 0.25 a</td>
</tr>
<tr>
<td>Looked Away</td>
<td>3.36 (4.40)</td>
<td>4.54 (4.57)</td>
<td>t (1,42) = 0.87, P = 0.39 a</td>
</tr>
<tr>
<td>Did not pay Attention</td>
<td>14.87 (17.94)</td>
<td>12.29 (12.75)</td>
<td>t (1,42) = 0.56, P = 0.58 a</td>
</tr>
<tr>
<td>Thought of Other Things</td>
<td>13.82 (28.18)</td>
<td>6.30 (6.67)</td>
<td>t (1,42) = 1.24, P = 0.22 a</td>
</tr>
</tbody>
</table>

Data are mean (standard deviation) values. Use of strategies was rated on a scale from 0 (not at all) to 100 (extremely).

* = significant at P < .05.
a: These variables were significantly non-normal and could not be corrected by transformation. Non-parametric analysis using the Mann-Whitney U-test found an identical pattern of results.

Independent samples t-tests found that the suppress group, as planned, made significantly greater use of the suppression strategy but did not differ in use of the other emotion regulation strategies. Both groups made moderate use of reappraisal as a mood regulation strategy but reported little use of looking away, not paying attention, and deliberately thinking of other things. These results suggest that the participants were compliant with the instructions presented to them. Again, an identical pattern of results emerged in the non-parametric analysis.
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3.2.2 Response to Road Traffic Accident Video

The following section presents participants emotional responses while watching the road traffic accident video, measured in terms of both self-report and psychophysiology. This is intended to measure the emotion elicited directly by the video.

3.2.2.1 Self-Report Data

To control for differences in pre-induction state and trait emotional reactivity, it was decided to measure emotional response to the film relative to pre-experimental mood measures. Difference scores were computed, subtracting the pre-induction state measures of emotions from the comparable emotional ratings of the trauma induction video. Analyses reported below look at how experimental condition influenced these emotional change scores.

Figure 3.2.2.1 shows changes in basic emotion ratings following the trauma induction film by the suppression and control groups. Pilot work (Dalgleish & Schartau, 2004) showed that the predominant basic emotions induced by the road traffic accident video were an increase in sadness, fear and disgust and a decrease in happiness. These variables were therefore entered into a multivariate analysis of variance (MANOVA), with Emotion (sadness, fear, disgust, happiness [reverse scored]) as the within-subjects factor and Condition (suppress, control) as the between subjects-factor. This found no difference between conditions in overall emotional change, Wilks’ Lambda = 0.95, F (4, 39) = 0.05, p = 0.73.
Further, independent samples t-tests also demonstrated no significant effect of Condition on happiness, $t (1, 42) = 0.64$, $p = 0.52$, fear, $t (1, 42) = 1.20$, $p = 0.24$, sadness, $t (1, 42) = 0.47$, $p = 0.64$, disgust, $t (1, 42) = 0.93$, $p = 0.36$, anger, $t (1, 42) = 0.25$, $p = 0.80$, or surprise, $t (1, 42) = 0.32$, $p = 0.75$, ratings. Identical results emerged in non-parametric Mann Whitney U-tests.

Participants overall reported experiencing a high increase in levels of sadness, a medium increase in levels of disgust, fear, anger, and surprise, and a reduction in levels of happiness after watching the video, but this did not vary as a function of group.

Figure 3.2.2.1: Change in Self-Report Ratings of Basic Emotions After Watching the Trauma Induction Film in the Suppression and Control Groups.

Data are mean (standard error of the mean) values.

Figure 3.2.2.2 plots the change in arousal and valence ratings following the trauma induction film by each group. Independent samples t-tests found no difference between conditions for either valence ratings, $t (1, 42) = 0.93$, $p = 0.36$, or arousal.
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ratings, $t(1, 42) = 0.47, p = 0.64$. Identical non-significant results emerged in the non-parametric analysis. Both groups reported feeling significantly less pleasant following the video but described little change in arousal.

Figure 3.2.2.2: Change in Arousal and Valence Ratings Following the Trauma Induction Film in the Suppression and Control Groups.

Figure 3.2.2.3 plots the change in helplessness, horror and distress self-report ratings following the trauma induction film in each group. Independent samples t-tests found no difference between conditions for helplessness, $t(1, 42) = 0.11, p = 0.91$, horror, $t(1, 42) = 0.58, p = 0.56$, or distress, $t(1, 42) = 0.50, p = 0.62$. Identical results emerged using non-parametric Mann Whitney U-tests to control for non-normality. Both groups reported experiencing an increase in levels of helplessness, horror, and distress following the video.
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Figure 3.2.2.3: Change in Helplessness, Horror and Distress Self-Report Ratings Following the Trauma Induction Film in the Suppression and Control Groups.

Data are mean (standard error of the mean) values

3.2.2.2 Psychophysiology Data

To control for tonic differences in baseline physiological reactivity, a difference score was created by subtracting the response during the rest task from response during the video for each psychophysiological index. These differences scores were then compared for each group using independent samples t-tests (see Table 3.2.2.1). The only significant difference between conditions was for the RMSSD measure of HR variability, where the suppression group showed greater variability relative to rest whereas the control group showed lesser variability relative to rest while watching the video.
Table 3.2.2.2: Psychophysiology Response to the Trauma Induction Film, Relative to the Rest Task, in the Suppression and Control Groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Suppress Condition (n = 21)</th>
<th>Control Condition (n = 23)</th>
<th>Statistical Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSR</td>
<td>0.20 (0.51)</td>
<td>0.10 (0.16)</td>
<td>t (1, 42) = 0.85, p = 0.40</td>
</tr>
<tr>
<td>GSR Variability (SDNN)</td>
<td>0.04 (0.12)</td>
<td>0.03 (0.05)</td>
<td>t (1, 42) = 0.19, p = 0.85</td>
</tr>
<tr>
<td>HR</td>
<td>1.95 (5.60)</td>
<td>1.11 (3.20)</td>
<td>t (1, 42) = 0.61, p = 0.54</td>
</tr>
<tr>
<td>HR variability 1 (SDNN)</td>
<td>0.24 (1.03)</td>
<td>-0.10 (0.05)</td>
<td>t (1, 42) = 1.17, p = 0.25</td>
</tr>
<tr>
<td>HR variability 2 (RMSSD)</td>
<td>0.0030 (0.00509)</td>
<td>-0.0006 (0.00624)</td>
<td>t (1, 42) = 2.06, p = 0.05</td>
</tr>
</tbody>
</table>

Data are mean (standard deviation) values.
GSR = galvanic skin response; HR = heart rate.
SDNN = standard deviation of the normal-normal interval.
RMSSD = square root of the mean squared differences of successive NN intervals.
HR measured in beats per minute (bpm); GSR measured in micro-siemens.
Difference scores are reported, where activity during the rest task was subtracted from activity during the video.

3.3 Mood Change Following Trauma Induction

Hypothesis 2: Participants in the emotional suppression group will show a subsequent increase in negative mood and a decrease in positive mood, compared to volunteers in the control condition.

The following sections present data on participants' free floating mood in the five minute period after watching the video and in the week following watching the video. It is important to contrast this analysis of the subsequent impact on mood having watched the video with the results presented in section 3.2, which looked at the concurrent emotions induced while watching the video.
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3.3.1 Mood immediately pre- and post-induction

To measure impact of the trauma induction on mood, differences scores were computed by subtracting the pre-induction rating from the post-induction ratings for each variable. Figure 3.3.1.1 plots the difference in ratings of the basic emotions in each group. As with the video data, a MANOVA was run on the emotions that pilot work (Dalgleish & Schartau, 2004) found the video reliably induced. Emotion (sadness, fear, disgust, happiness [reverse scored]) was used as the within-subjects factor and Condition (suppress, control) was used as the between subjects-factor. This found no overall difference between conditions in immediate mood change, Wilks’ Lambda = 0.97, F (4, 39) = 0.35, p = 0.84. Similarly, independent samples t-tests found no difference between conditions for happiness, t (1, 42) = 1.07, p = 0.29, sadness, t (1, 42) = 0.73, p = 0.47, fear, t (1, 42) = 0.03, p = 0.98, disgust, t (1, 42) = 0.05, p = 0.96, surprise, t (1, 42) = 0.31, p = 0.76, or anger, t (1, 42) = 0.10, p = 0.92. Identical results emerged in non-parametric analysis using Mann Whitney U-test. Participants in both groups reported experiencing less happiness and more of the negative emotions five-minutes post-induction, relative to pre-induction.

Figure 3.3.1.2 shows the difference in arousal and valence ratings in each condition. Arousal and valence ratings were compared pre- and post- the induction using independent samples t-tests. There were no differences between the conditions in terms of valence, t (1, 42) = 0.87, p = 0.39, or arousal, t (1, 42) = 0.34, p = 0.73. An identical pattern of results emerged using non-parametric Mann-Whitney U-tests to control for non-normality. Both groups reported feeling much less pleasant and slightly less aroused five minutes post-induction, relative to pre-induction.
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Figure 3.3.1.1: Difference in Self-Report of Experience of Basic Emotions Immediately Pre- and Post-Trauma Induction in each Condition.

Data are mean (standard error of the mean) values. Emotional experience rated on a 100 point scale, from 0 (not at all) to 100 (extremely) pre- and post-induction. This graph shows the difference between these ratings.

Figure 3.3.1.2: Difference in Arousal and Valence Ratings Immediately Pre- and Post-Induction in each Condition.

Data are mean (standard error of the mean) values. Arousal rated on a 9 point scale, from 0 low to 9 high; valence rated on a 9 point scale, from 0 (very unpleasant) to 9 (very unpleasant). This graph shows difference in these ratings pre- and post-induction.
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Table 3.3.1.1 records difference in ratings of other emotional states in the two samples. There were no significant differences between participants in the suppress and control conditions. Participants in both groups reported reduced positive emotional experience and increased negative emotional experience five minutes post-induction, relative to pre-induction.

Table 3.3.1.1: Difference Between Ratings of Other Emotional States Immediately Pre- and Post-Trauma Induction For the Suppress and Control Conditions.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Suppress Condition</th>
<th>Control Condition</th>
<th>Statistical Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 21)</td>
<td>(n = 23)</td>
<td></td>
</tr>
<tr>
<td>Guilt</td>
<td>8.16 (18.73)</td>
<td>5.56 (8.89)</td>
<td>t (1, 42) = 0.60, p = 0.55 a</td>
</tr>
<tr>
<td>Shame</td>
<td>10.35 (17.80)</td>
<td>3.56 (8.71)</td>
<td>t (1, 42) = 1.63, p = 0.11 a</td>
</tr>
<tr>
<td>Helplessness</td>
<td>24.42 (28.62)</td>
<td>24.80 (28.6)</td>
<td>t (1, 42) = 0.04, p = 0.97 a</td>
</tr>
<tr>
<td>Horror</td>
<td>22.67 (31.08)</td>
<td>25.64 (27.27)</td>
<td>t (1, 42) = 0.34, p = 0.74 a</td>
</tr>
<tr>
<td>PANAS positive a</td>
<td>-8.23 (10.76)</td>
<td>-6.09 (9.58)</td>
<td>t (1, 42) = 0.70, p = 0.49 a</td>
</tr>
<tr>
<td>PANAS negative a</td>
<td>2.43 (8.19)</td>
<td>3.43 (6.94)</td>
<td>t (1, 42) = 0.44, p = 0.66 a</td>
</tr>
<tr>
<td>STAI state anxiety</td>
<td>10.52 (9.83)</td>
<td>10.78 (11.89)</td>
<td>t (1, 42) = 0.08, p = 0.94 a</td>
</tr>
</tbody>
</table>

Data are mean (standard deviation) values.
PANAS = Positive Affect Negative Affect Scale; STAI = Spielberger State Trait Anxiety Inventory. All emotions were originally rated on 100 point scale (from 0 emotion not experienced to 100 emotion experienced extremely). Scores reported here are the difference between immediately pre- and post trauma induction ratings.
a: These variables were significantly non-normal and could not be corrected by transformation. Non-parametric analysis using the Mann-Whitney U-test found an identical pattern of results.

3.3.2 Mood over week prior- and post- experiment

A number of participants’ data were missing in the analyses reported below, as they did not attend the follow-up session (three in the control group; three in the suppress group) or had not completed all of the measures given to them (two in the control group; one in the suppress group). This meant the samples consisted of 18 in
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the control group and 17 in the suppress group. As with the immediate mood data,
week-long mood differences scores were computed by subtracting the pre-induction
from the post-induction ratings for each variable.

Figure 3.3.2.1 plots the difference in ratings of the basic emotions in each
group. As with the immediate mood change data, MANOVA was conducted on the
emotions the video was known to induce. The between-subjects factor was Emotion
(fear, sadness, disgust, happiness [reverse scored]) and the within-subjects factor was
Condition (suppress, control). This found no overall difference in emotion change
between the two groups, Wilks’ Lambda = 0.98, F (4, 30) = 0.14, p = 0.97. Similarly,
independent samples t-tests found no difference in change in happiness, t (1, 33) =
0.05, p = 0.96, sadness, t (1, 33) = 0.65, p = 0.52, fear, t (1, 33) = 0.18, p = 0.86,
disgust, t (1, 33) = 0.57, p = 0.58, surprise, t (1, 33) = 0.46, p = 0.65, or anger, t (1,
33) = 1.33, p = 0.19, in the week after the induction. Identical non-significant results
emerged from the non-parametric analysis.

Figure 3.3.2.1: Difference in Self-Report of Experience of Basic Emotions in Week Pre- and Post-
Trauma Induction in each Condition.

Data are mean (standard error of the mean) values. Emotional experience rated on a 100 point scale,
from 0 (not at all) to 100 (extremely) pre- and post- induction. This graph shows the difference
between these ratings.
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Participants in both groups tended to report no change or a decrease in their experience of the basic emotions in the week after the experiment, compared to the week before. There was a larger reduction in reports of surprise than the other emotions.

Figure 3.3.2.2 plots the difference in arousal and valence ratings for each condition. These were contrasted using independent samples t-tests. These found no difference between conditions for arousal, \( t(1, 33) = 1.63, p = 0.11 \), or valence, \( t(1, 33) = 0.58, p = 0.57 \). Identical non-significant results were found using non-parametric Mann Whitney U-tests to control for non-normality.

Table 3.3.2.1 plots the difference in the other emotional ratings for suppress and control conditions, which were again compared using independent samples t-tests. The suppress group showed a slight increase in BDI ratings in the week after the
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induction, whereas the control group showed a slight reduction. This effect was still
present as a trend in the non-parametric analysis using a Mann Whitney U-test.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Suppress Condition (n = 17)</th>
<th>Control Condition (n = 18)</th>
<th>Statistical Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guilt</td>
<td>-1.87 (12.30)</td>
<td>-4.73 (9.88)</td>
<td>t(1, 33) = 0.76, p = 0.45*</td>
</tr>
<tr>
<td>Shame</td>
<td>1.84 (8.01)</td>
<td>-1.80 (5.61)</td>
<td>t(1, 33) = 1.56, p = 0.13*</td>
</tr>
<tr>
<td>Helplessness</td>
<td>7.48 (29.40)</td>
<td>-6.71 (24.43)</td>
<td>t(1, 33) = 1.56, p = 0.13*</td>
</tr>
<tr>
<td>Horror</td>
<td>-2.55 (7.91)</td>
<td>-1.62 (6.87)</td>
<td>t(1, 33) = 0.37, p = 0.71*</td>
</tr>
<tr>
<td>PANAS positive affect</td>
<td>-1.06 (9.01)</td>
<td>-1.87 (6.53)</td>
<td>t(1, 33) = 0.30, p = 0.77</td>
</tr>
<tr>
<td>PANAS negative affect</td>
<td>-1.31 (4.14)</td>
<td>-3.06 (4.68)</td>
<td>t(1, 33) = 1.14, p = 0.26</td>
</tr>
<tr>
<td>STAI trait anxiety</td>
<td>-2.00 (7.65)</td>
<td>-2.94 (4.62)</td>
<td>t(1, 33) = 0.44, p = 0.66*</td>
</tr>
<tr>
<td>BDI</td>
<td>0.74 (2.64)</td>
<td>-0.90 (2.53)</td>
<td>t(1, 33) = 2.01, p = 0.05**</td>
</tr>
</tbody>
</table>

Data are mean (standard deviation) values.
All emotions were originally rated on 100 point scale (from 0 emotion not experienced to 100 emotion experienced extremely).
Scores reported here are the difference between pre- and post trauma induction weekly ratings.
* = significant at p < .05
PANAS = Positive Affect Negative Affect Scale; STAI = Spielberger State Trait Anxiety Inventory;
BDI = Beck Depression Inventory
a: These variables were significantly non-normal and could not be corrected by transformation. Non-parametric analysis using the Mann-Whitney U-test found an identical pattern of results, except that the significant difference on BDI between groups had become a trend: z(1, 33) = 1.87, p = 0.06.
3.4 Verbal Stream of Consciousness Task

**Hypothesis 4:** Participants in the emotional suppression group will report experiencing a higher number of intrusive thoughts and images about the trauma film, compared to volunteers in the control condition.

3.4.1 Audio Tape Data

Due to equipment failure (a tape was damaged when it became stuck in the recorder), three participants' data from each condition were lost. In the analyses reported below there are therefore 20 participants in the control condition and 18 participants in the suppress condition. Figure 3.5.1.1 plots the mean number of intrusions related to the content of the trauma induction verbalised in the five-minute stream of consciousness task by participants in the suppress and control conditions. Intrusions were defined as any verbalisation of specific content of the video, either in thought or image form (for example, 'I am seeing the student in scene five being ventilated', 'I am thinking about the bodies being thrown into the temporary coffin'). Non-specific references to the video content were not scored as intrusion (for example, 'I am picturing the road traffic accidents', 'I am thinking about emergency service personnel'). These data were interpreted by the experimenter and were not double-scored.

Independent samples t-test analysis found a trend in the direction of the suppress group to report fewer intrusions than the control group, \( t(1, 36) = 1.94, p = 0.06 \). An identical trend emerged in the non-parametric analysis.
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Figure 3.4.1.1: Number of Content Related Intrusions about the Trauma Induction during the Stream of Consciousness Task Reported by the Suppress and Control Conditions.

Figure 3.4.1.2 plots the length of time (in seconds) spent talking about the content of the trauma induction in the five minute stream of consciousness task by participants in the suppress and control conditions. Induction related material was classified as any utterances about the content of the video (for example, ‘the dead body in the coffin was disgusting’), how participants felt while watching the video (for example, ‘it was not as bad as I was expecting’), how it related to their own experience of road traffic accidents (for example, ‘it reminded me of a similar accident I was in’), and the broader meaning of road traffic accidents (for example, ‘I will drive more carefully now’). Again, these data were not double-scored. Independent samples t-test analysis found no significant difference between conditions, $t (1, 36) = 1.09, p = 0.29$. A similar non-significant pattern emerged in non-parametric analysis.
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Figure 3.4.1.2: Length of Time Spent Talking About the Trauma Induction During the Stream of Consciousness Task by the Suppress and Control Conditions.

Data are mean (standard error of the mean) values

3.4.2 Psychophysiology Data

As with the video psychophysiology data, to control for the potentially contaminating effects of tonic activity on phasic response, the difference between psychophysiology response during the auditory stream of consciousness task and the rest task was computed (see Table 3.4.2.1). Again, one participants’ data from the suppress condition and four participants’ data from the control condition were missing due to either equipment failure or artefact in the psychophysiology data. This meant the sample consisted of 19 in the control group and 20 in the suppress group.

Independent samples t-tests found no difference in psychophysiology response across conditions and a similar pattern emerged for the non-parametric analysis.
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Table 3.4.2.1: Psychophysiology Response during the Auditory Stream of Consciousness Task, Relative to the Rest Task, in the Suppression and Control Groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Suppress Condition (n = 20)</th>
<th>Control Condition (n = 19)</th>
<th>Statistical Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>GSR</td>
<td>0.51 (0.64)</td>
<td>0.41 (0.40)</td>
<td>t (1, 37) = 0.58, p = 0.57</td>
</tr>
<tr>
<td>GSR Variability (SDNN)</td>
<td>0.02 (0.12)</td>
<td>0.02 (0.04)</td>
<td>t (1,37) = 0.01, p = 0.99a</td>
</tr>
<tr>
<td>HR</td>
<td>10.73 (16.28)</td>
<td>10.19 (11.76)</td>
<td>t (1, 37) = 0.12, p = 0.91</td>
</tr>
<tr>
<td>HR variability 1 (SDNN)</td>
<td>0.07 (0.09)</td>
<td>0.05 (0.05)</td>
<td>t (1, 37) = 0.91, p = 0.37</td>
</tr>
<tr>
<td>HR variability 2 (RMSSD)</td>
<td>0.01 (0.01)</td>
<td>0.01 (0.01)</td>
<td>t (1, 37) = 0.99, p = 0.33</td>
</tr>
</tbody>
</table>

Data are mean (standard deviation) values. Difference scores are reported, where activity during the rest task was subtracted from activity during the stream of consciousness task.

GSR = galvanic skin response; HR = heart rate.
SDNN = standard deviation of the normal-normal interval.
RMSSD = square root of the mean squared differences of successive NN intervals.
HR measured in beats per minute (bpm); GSR measured in micro-siemens.
a: GSR variability was significantly non-normal for the control group and could not be corrected by transformation. Non-parametric analysis using the Mann-Whitney U-test also found no significant effect of condition.

3.5 Subsequent Emotional Processing: Affective Picture Task

**Hypothesis 3:** Participants in the emotional suppression group will show an elevated self-report and psychophysiological emotional response when viewing subsequent negative affective material and a decreased self-report and psychophysiological emotional response when viewing subsequent positive affective material, compared to volunteers in the control condition.

3.5.1 Self-Report of Experience of Emotions

Emotional responses to the affective images were analysed using the neutral pictures as a baseline to control for differences in orienting response to images or how
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the ratings scales were used between conditions. Emotion ratings for each of the four emotional picture blocks each had the comparable rating for the neutral picture block subtracted from them. These differences scores were then analysed using 4 by 2 repeated measures ANOVAs for each emotional image class, with Emotion (happiness, sadness, fear, disgust [relative to neutral]) as the within-subjects factor and Condition (suppression, control) as the between-subjects factor. Analysis of the neutral pictures will first be reported to demonstrate that there were no effects of condition on these ratings.

Table 3.5.1.1 reports the emotional ratings of the neutral images by the suppress and control groups.

Table 3.5.1.1: Emotional Ratings of the Neutral Images by the Suppress and Control Conditions.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Suppress Condition (n = 23)</th>
<th>Control Condition (n = 21)</th>
<th>Statistical Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happiness</td>
<td>12.51 (12.32)</td>
<td>9.51 (12.15)</td>
<td>t (1, 42) = 0.81, p = 0.42 a</td>
</tr>
<tr>
<td>Sadness</td>
<td>3.95 (4.41)</td>
<td>3.07 (3.33)</td>
<td>t (1, 42) = 0.76, p = 0.46 a</td>
</tr>
<tr>
<td>Fear</td>
<td>3.39 (4.40)</td>
<td>2.85 (2.23)</td>
<td>t (1, 42) = 0.52, p = 0.61 a</td>
</tr>
<tr>
<td>Disgust</td>
<td>3.30 (4.58)</td>
<td>2.75 (3.68)</td>
<td>t (1, 42) = 0.44, p = 0.66 a</td>
</tr>
<tr>
<td>Arousal</td>
<td>2.60 (1.48)</td>
<td>1.97 (1.22)</td>
<td>t (1, 42) = 1.55, p = 0.13 a</td>
</tr>
<tr>
<td>Valence</td>
<td>4.85 (0.46)</td>
<td>4.97 (0.49)</td>
<td>t (1, 42) = 0.85, p = 0.40 a</td>
</tr>
</tbody>
</table>

Data are mean (standard deviation) values. Happiness, sadness, fear and disgust experience rated on 100 point scales, ranging from 0 (not at all) to 100 (extremely); valence rated on a point scale, from 1 (unpleasant) to 5 (neutral) to 9 (pleasant); arousal rated on a 9 point scale, from 1 (low) to 9 (high)
a: These variables were significantly non-normal and could not be corrected by transformation. Non-parametric analysis using the Mann-Whitney U-test also found no significant effect of condition.

A series of independent samples t-tests found there was no effect of condition on emotional response to the neutral images, a pattern which was replicated with non-parametric analyses. Repeated measures ANOVA with Emotion (happiness, sadness,
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fear, disgust) as the within-subjects factor and Condition (control, suppress) as the between-subjects factor was used to explore whether there was any interaction amongst the emotional ratings of the neutral images. A significant effect of Emotion, \( F(3,126) = 23.07, p < .01 \), no Emotion by Condition interaction, \( F(3, 126) = 0.53, p = 0.67 \), and no main effect of Condition, \( F(1, 42) = 0.64, p = 0.43 \), was found. Both groups rated the neutral images as inducing small amounts of happiness and very little negative affect. Further all participants tended to rate the images as inducing little arousal and of neutral valence.

Figure 3.5.1.1 shows the mean amount of each emotion reported for positive pictures by the suppress and control groups.

Analysis revealed a significant effect of Emotion, \( F(3, 126) = 166.39, P < 0.01 \), no Emotion by Condition interaction, \( F(3, 126) = 0.16, p = 0.93 \), and no main effect of Condition, \( F(1, 42) = 0.02, p = 0.89 \). Participants in both conditions tended to rate the positive images as inducing medium amounts of happiness but little
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sadness, fear or disgust (relative to ratings of neutral conditions), but this pattern was
not mediated by being in the suppress or control conditions.

Figure 3.5.1.2 shows the mean amount of each emotion reported for fearful
pictures by the suppress and control groups. Repeated measures ANOVA found a
significant effect of Emotion, $F(3, 126) = 59.27, p < .01$, no Emotion by Condition
interaction, $F(3, 126) = 0.66, p = .58$, and no main effect of Condition, $F(1, 42) =
0.05, p = .82$. The fearful images induced a medium amount of fear, small amounts
of disgust and sadness, and negative amounts of happiness (relative to the neutral
images), but there was no difference in these ratings between the suppress and control
conditions.

Figure 3.5.1.2: Emotion Ratings of the Fearful Images by the Suppress and Control Conditions.

![Graph showing emotion ratings](image)

Data are mean (standard error of the mean values)

Figure 3.5.1.3 shows the mean amount of each emotion reported for sad
pictures by the suppress and control groups. Repeated measures ANOVA found a
significant effect of Emotion, $F(3, 126) = 99.94, p < .01$, no interaction between
Emotion and Condition, $F(3, 126) = 0.25, p = .86$, and no main effect of Condition, $F
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\( (1, 42) = 0.94, p = 0.34 \). The sad images induced medium levels of sadness, small amounts of disgust and fear, and negative amounts of happiness (relative to neutral images) across all participants, but this pattern was not mediated by being in the suppress or control conditions.

Figure 3.5.1.3: Emotion Ratings of the Sad Pictures by the Suppress and Control Conditions.

![Graph showing emotion ratings for sad images by suppress and control conditions.]

Data are mean (standard error of the mean values).

Figure 3.5.1.4 shows the mean amount of each emotion reported for disgusting pictures by the suppress and control groups. Repeated measures ANOVA found a significant effect of Emotion, \( F (3, 126) = 121.27, p < .01 \), no Emotion by Condition interaction, \( F (3, 126) = 0.29, p = 0.83 \), and no main effect of Condition, \( F (1, 42) = 0.31, p = 0.58 \). The disgusting images induced medium levels of disgust, small levels of fear and sadness, and negative levels of happiness (relative to neutral images) across all participants, but this was not influenced by whether assignment was to the suppress or control groups.
In summary, all of the emotional picture types induced the intended target emotions. There were no differences between conditions in experience of the target emotion to each image type or experience of the other emotions to each image type.

3.5.2 Valence and Arousal Ratings

Figure 3.5.2.1 plots the arousal ratings for each of the picture types by participants in the suppress and control conditions. As with the basic emotions data, the ratings of neutral pictures were subtracted to act as a baseline. A 4 by 2 repeated measures ANOVA was then conducted to analyse the data, with Picture Type (positive, fearful, sad, disgusting [relative to neutral]) as the within-subjects factor and Condition (suppression, control) as the between-subjects factors. There was a significant effect of Picture Type, $F(3, 126) = 4.44, p < 0.01$, no Picture Type by Condition interaction, $F(3, 126) = 0.23, p = 0.88$, and no main effect of Condition, $F$
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(1, 42) = 0.87, p = 0.36. There were no differences in arousal ratings between the suppress and control conditions, but all participants tended to rate fear pictures as more arousing than the other emotional image types (relative to neutral).

Figure 3.5.2.1: Arousal Ratings of Each Picture Type by the Control and Suppress Groups.

Data are mean (standard error of the mean) values.

Figure 3.5.2.2 shows the mean valence ratings of each image type by the suppress and control groups. As with the arousal data, a 4 by 2 repeated measures ANOVA explored valence ratings of each emotional picture type (relative to neutral images) as a function of condition. There was an effect of Picture Type, F (3, 126) = 323.72, p < .01, no interaction of Picture Type and Condition, F (3, 126) = 0.64, p = 0.59, and no main effect of Condition, F (1, 42) = 2.27, p = 0.14. The emotional images (relative to neutral) were not rated differently by participants in the suppress and control conditions, but all participants rated the positive images as pleasant and the three negative image classes as unpleasant. The disgusting images were rated as more unpleasant than the fearful and sad images.
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Figure 3.5.2.2: Valence Ratings of Each Picture Type by the Control and Suppress Groups.

Data are mean (standard error of the mean) values.

3.5.3 Psychophysiological Response

One participants' data were missing from the suppress group due to equipment failure, meaning that in the analyses below the final sample size was 23 in the control group and 20 in the suppress group. GSR was measured in terms of the mean change in activity during the six-second picture viewing period, relative to a three-second pre-stimulus baseline. HR physiological response to each image was indexed following the recommendations of Bradley et al. (2002) to control for the triphasic heart rate response typically seen when viewing static images. Data were first resampled into half second bins. The initial deceleration during the 1st to the 3rd second of picture viewing and the subsequent acceleration during the 4th to the 6th second of picture viewing were then both computed, relative to a 3s pre-stimulus baseline. The mean response on each physiological index across the ten images in each block was computed for each participant. Difference scores were then computed, taking the response to the neutral pictures away from the comparable index for each
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of the emotional images. These psychophysiological variables were then analysed using a series of 4 by 2 repeated measures ANOVAs, with Picture Type (positive, fearful, sad, disgusting [relative to neutral]) as the within-subjects factor and Condition (suppression, control) as the between-subjects factor. One participants’ data from the suppression group was missing due to equipment failure.

Figure 3.5.3.1 plots the mean GSR change to each image type for the two experimental conditions. Analysis found a significant effect of Picture Type, $F(3, 123) = 6.68, p < .01$, no Picture Type by Condition interaction, $F(3, 123) = 1.07, p = 0.37$, and no main effect of Condition, $F(1, 41) = 0.26, p = 0.61$. Participants tended to show a greater GSR to fear pictures than other images, but this did not vary as a function of condition.

Figure 3.5.3.1: Mean GSR Change to each Picture Type in the Suppress and Control Conditions.

![Graph showing mean GSR change to each picture type](image)

Data are mean (standard error of the mean) values.
GSR = galvanic skin response.
GSR measured in micro-siemens.

Figure 3.5.3.2 plots the mean HR deceleration in the first three seconds of picture viewing for each image class in the control and suppress conditions. Analysis
found no effect of Picture Type, $F (3, 123) = 1.59, p = 0.19$, no interaction between Picture Type and Condition, $F (3, 123) = 0.32, p = 0.81$, but a significant main effect of Condition, $F (1, 41) = 4.29, p = .05$. The suppress group showed a significantly greater initial HR deceleration to the emotional images (relative to neutral), compared to the control group.

Figure 3.5.3.2: Mean Initial HR Deceleration to each Picture Type in the Suppress and Control Conditions.

\[ \text{Data are mean (standard error of the mean) values.} \]
\[ \text{HR = heart rate.} \]
\[ \text{HR measured in beats per minute (bpm).} \]

Figure 3.5.3.3 plots the mean HR acceleration in the second three seconds of picture viewing for each image class in the control and suppress conditions. Analysis found no effect of Picture Type, $F (3, 123) = 2.01, p = 0.11$, no interaction between Picture Type and Condition, $F (3, 123) = 1.23, p = 0.30$, and no main effect of Condition, $F (1, 41) = 0.18, p = .89$. 

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Figure 3.5.3.3: Mean Subsequent HR Acceleration to each Picture Type in the Suppress and Control Conditions.

Data are mean (standard error of the mean) values.

HR = heart rate.
HR measured in beats per minute (bpm).

3.6 Intrusions Diary

**Hypothesis 4:** Participants in the emotional suppression group will report experiencing a higher number of intrusive thoughts and images about the trauma film, compared to volunteers in the control condition.

A number of participants’ data were missing in the analyses reported below as they did not attend the follow-up session (3 in the control group; 3 in the suppress group). This meant the sample analysed consisted of 20 in the control group and 18 in the suppress group. Table 3.6.1 shows the compliance ratings with the diary instructions reported by the suppress and control groups. In general, both groups reported keeping the diary accurately, suggesting that the data are valid to analyse. Independent samples t-tests found no significant difference between conditions.
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Similar non-significant results were found in the non-parametric analysis using Mann-Whitney U-tests, so are not reported here.

Table 3.6.1: Compliance with the Intrusions Diary Instructions in the Suppress and Control Conditions.

<table>
<thead>
<tr>
<th></th>
<th>Suppress Condition</th>
<th>Control Condition</th>
<th>Statistical Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
<td>(n = 18)</td>
<td>(n = 20)</td>
<td></td>
</tr>
<tr>
<td>Compliance with Diary</td>
<td>2.00 (2.11)</td>
<td>2.14 (1.32)</td>
<td><em>t (1, 37) = 0.26, p = 0.80</em></td>
</tr>
</tbody>
</table>

Data are mean (standard error of the mean) values.
Compliance measured on an 11 point scale, ranging from 0 (complied with diary instructions) to 11 (did not comply with diary instructions)

Figure 3.6.1 plots the mean number of intrusions of each type (thoughts, images, both [an intrusion that was made up of thoughts and images]) experienced in the week after the trauma induction by the suppress and control groups.

Figure 3.6.1: Number of Intrusions in the Week after the Trauma Induction Reported by the Control and Suppress Groups.

Data are mean (standard error of the mean) values.
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Independent samples t-tests were used to analyse the effects of condition on the intrusions. These revealed no effect of Condition on intrusive thoughts, $t(1, 37) = 1.35, p = 0.19$, intrusive images, $t(1, 37) = 0.54, p = 0.59$, or both thoughts and images, $t(1, 37) = 1.05, p = 0.29$. The intrusion data were significantly positively skewed in the control group and could not be corrected using log transformation, so the analysis was repeated using non-parametric Mann Whitney U-tests. These also revealed no significant effect of condition on the number of intrusions.

Figure 3.6.2 plots the mean distress caused by each intrusion for the suppress and control groups. An independent samples t-test found no effect of condition on distress, $t(1, 37) = 0.07, p = 0.95$, and an identical non-significant finding emerged in the non-parametric analysis.

Figure 3.6.2: Mean Distress Reported During Intrusions by the Control and Suppress Groups.

Data are mean (standard error of the mean) values. Distress was rated on 100 point scale, ranging from 0 (not at all) to 100 (extremely).
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3.7 Memory Tests

**Hypothesis 5:** Participants in the emotional suppression group will show impaired episodic memory for the trauma film, compared to volunteers in the control condition.

A number of participants' data were missing in the analyses reported below as they did not attend the follow-up session (3 in the control group; 3 in the suppress group). This meant the sample analysed had 20 in the control group and 18 in the suppress group. Figure 3.7.1 plots the mean percentage of correct answers given on the recognition and free recall memory tests of the trauma induction content by the suppress and control groups.

Figure 3.7.1: Percentage Correct on the Free Recall and Recognition Memory Tests of the Trauma Induction Content by the Control and Suppress Groups.

![Graph showing memory test results]

Data are mean (standard error of the mean) values.

Independent samples t-tests were used to analyse the data. These found a significant effect of Condition on free recall memory, $t(1, 37) = 2.66, p = 0.01$, but
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not the recognition memory test, $t(1, 37) = 1.58, p = 0.12$. The suppress group had significantly worse free recall of the content of the trauma video than the control group. An identical pattern of results was found in non-parametric analysis using Mann-Whitney U-tests.
Chapter 4: Discussion

4.1 Overview of Thesis Rationale

The thought suppression literature has demonstrated that the harder a thought is pushed out of conscious experience, the more frequently the thought returns later (Wegner et al., 1987; Wegner & Erber, 1992). This 'rebound effect' has been implicated in PTSD (Steil & Ehlers, 2000; Mayou et al., 2002; Shipherd & Beck, 1999) and other forms of psychopathology (Purdon, 1999). The thought rebound effect, while not always replicated, is a powerful illustration of the more general finding that the way in which information is processed during encoding can have subsequent, and often adverse, effects on cognitive and emotional processing (in both healthy populations and psychological disorders).

While the consequences of regulating the cognitive content of consciousness when processing traumatic material have been examined, emotion regulation processes are less well understood. It is increasingly realised that people try to control their emotional experience as well as their cognitive experience (Lazarus, 1991; Gross 1998, 2001). One common form of emotion regulation is to suppress the emotions that are being felt and expressed in response to particular stimulus.

A growing body of work has begun to explore how successfully attempts to control emotional expression lead to a down-regulation of affective experience in healthy populations. These studies have found that suppression increases physiological response, does not alter self-report of affect, and impairs memory for the emotional material (Gross & Levenson, 1993; Gross, 1998; Richards & Gross, 1999; 2000). As yet it has not been systematically empirically examined whether emotional suppression subsequently leads to a rebound effect analogous to that seen
in thought suppression experiments. Further, the consequences of experiential
suppression, as opposed to expression suppression, have not been explored.

The use of emotion regulation strategies such as suppression has not yet been
investigated when coding traumatic material specifically. It seems plausible that the
attempts people make to control their emotions during trauma encoding may
determine whether they show a PTSD-like profile of symptoms.

In particular, there may be an effect similar to that found in the thought
suppression literature (Wegner & Erber, 1992; Wegner, 1994), where attempts to
minimise affect expressed and experienced at time one lead to an increase in emotions
and a disturbance in memory at time two. The form any such 'rebound' would take
can perhaps be predicted by multiple representation theories of PTSD, such as the
dual representation framework (Brewin, Dalgleish & Joseph, 1996; Brewin, 2001).
This argues that PTSD results from a failure to integrate verbal and situational (or
visual) memory, such that situational memory is not integrated into episodic memory
and intrudes as re-experiencing symptoms.

It is plausible that emotional suppression may result in a similar
‘disconnection’ (Berenbaum et al., 2003) in representation, such that verbal memory
is weakened and situational memory is strengthened. The efforts made to suppress
emotions may take processing resources away from integrating the trauma experience
into autobiographical memory, therefore impairing verbal memory acquisition.
Further, the process model of emotion regulation has shown that emotional expression
suppression leads to an increase in physiological response to negative stimuli (Gross
& Levenson, 1993; Gross, 1998), perhaps consistent with greater activity in more
implicit levels of representation. Such a disconnection between verbal and situational
encoding following emotional suppression may lead to a deficit in episodic memory
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for the trauma event, an increase in intrusive thoughts and images about the trauma, and a subsequent rebound in affect.

Alternatively, it may be the case that emotional suppression is an effective way to limit over arousal and remain effective in a traumatic situation, thereby minimising the likelihood of developing a post-traumatic reaction. Consistent with this prediction, Ozer et al. (2002) found that intense emotion after the traumatic event was a risk factor for subsequently developing PTSD, which suggests that any ways of down regulating emotional experience in this period should be helpful rather than counter-productive. Similarly, emotional suppression may also be a successful way of controlling re-experiencing symptoms when they occur without having any secondary costs on later information processing.

To begin to explore whether emotional suppression is an effective or ineffective form of emotion regulation when processing trauma, the experiment reported in this thesis examined whether an emotional rebound effect could be found following emotional suppression of response to an analogue trauma induction. How effective emotional suppression was in regulating initial response to the traumatic material was measured using both self-report and psychophysiological indices. The secondary consequences of emotional suppression were measured in terms of immediate and longer term mood change, subsequent processing of emotional material, recall of the trauma content, and experience of intrusive memories of the trauma content.

There were two primary aims of the experiment: first, to assess whether use of emotional suppression effectively controls emotion at the time of coding traumatic material (reduced experience of distressing emotions, less marked physiological response); and second, to examine whether use of emotional suppression increased or
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decreased the likelihood of showing a post-traumatic like response to the material
(blunted positive affect and/or increased negative affect, poor episodic memory,
increased experience of intrusions).

This discussion will first summarise the main findings of the study. Second, it
will evaluate whether use of emotional suppression when coding traumatic material is
an effective form of emotion regulation. Third, it will examine whether there are any
secondary costs of adopting emotional suppression on subsequent mood and memory.
Where appropriate, implications for theoretical models of emotion regulation will be
identified in these sections. Fourth, a number of methodological limitations of the
study that limit generalisation of the findings will then be highlighted. Fifth, bearing
in mind the methodological problems identified, tentative clinical implications for
understanding and treating PTSD and related conditions will be put forward.
4.2 Summary of Results

4.2.1 Group Comparison

- The suppress and control conditions were comparable on the key demographic variables, the pre-induction mood measures, resting state psychophysiology measures, and a majority of the trait individual difference variables.
- This pattern of results suggests the groups were statistically comparable and that any differences that emerged were most likely to be due to the experimental manipulation.

4.2.2 Experimental Manipulation Checks

- The suppress group reported making greater use of suppression during the trauma induction but not the other emotion regulation strategies, compared to the control group. This suggests participants were attempting to follow the experimental instructions.
- Participants in both conditions reported a significant increase in negative affect (particularly sadness, horror and distress) and a decrease in positive affect following the road traffic accident video, suggesting the video was acting as a negative mood induction.
- Participants in both conditions reported experiencing the target emotions to the happy, sad, fearful, and disgusting emotional images, suggesting the pictures were acting as the intended emotional induction.
4.2.3 Experimental Results

The data will be summarised in terms of the experimental hypotheses to which each task pertains.

**Hypothesis One:** Participants in the emotional suppression group will show a decrease in experienced negative affect but an increase in psychophysiological response while viewing the trauma film, compared to volunteers in the control condition.

*Road Traffic Accident Video*

- There were no global differences in reported emotional response to the video in the suppress and control conditions, suggesting that attempts to suppress emotional response in the experimental condition were not successful.
- There was some minor indication of a difference in psychophysiological response to the road traffic accident video between the two conditions. The suppress group had higher HR variability (relative to the rest task) during the video, compared to the control group.
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**Hypothesis Two:** Participants in the emotional suppression group will show a subsequent increase in negative mood and a decrease in positive mood, compared to volunteers in the control condition.

*Mood Change Measures*

- There were no significant differences in immediate mood change between the suppress and control conditions.
- There were no global differences in week-long mood change between the suppress and control conditions.
- There was, however, a small magnitude but significant difference in changes in BDI score between the two experimental conditions, with the suppress groups showing a slight increase and the control group a slight decrease.

**Hypothesis Three:** Participants in the emotional suppression group will show an elevated self-report and psychophysiological emotional response when viewing subsequent negative affective material and a decreased self-report and psychophysiological emotional response when viewing subsequent positive affective material, compared to volunteers in the control condition.

*Affective Picture Task*

- The suppress and control conditions did not differ in self-reported emotions in response to the images.
- The suppress group showed a significantly greater initial HR deceleration to the emotional images (relative to neutral), compared to the control group.
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**Hypothesis Four:** Participants in the emotional suppression group will report experiencing a higher number of intrusive thoughts and images about the trauma film, compared to volunteers in the control condition. This will be indexed by verbalising a higher number of intrusions and talking about the film for longer during the stream of consciousness task and recording more intrusions in the week-long intrusion diary.

**Stream of Consciousness Task**

- The suppress group showed a non-significant trend to report fewer content related intrusions about the road traffic accident video, compared to the control group.
- There were no differences in length of time spent talking about the video or in psychophysiological response during the task.

**Intrusions Diary**

- There were no differences between groups in terms of the number of intrusive memories about the road traffic accident videos reported in the following week or the amount of distress caused by each intrusive memory.

**Hypothesis Five:** Participants in the emotional suppression group will show impaired episodic memory for the trauma film, compared to volunteers in the control condition.

**Memory Questionnaires**

- The suppress group showed impaired free recall memory of the video, compared to the control group.
- There were no differences in recognition memory between conditions.
4.3 Evaluating the Efficacy of Emotional Suppression during Encoding

It will now be discussed to what extent emotional suppression functions effectively as a form of emotion regulation. Based on the work on the consequences of expressive suppression in the Process Model literature (Gross, 1998; 2001), the first prediction of the current study was that emotional suppression would lead to an increase in psychophysiological response. Further, in contrast to the expressive suppression work, it was predicted that emotional suppression would also lead to a decrease in emotions induced by the video. The rationale for this differing prediction was that the definition of suppression had been extended to include both internal feeling state and external expression in the current study. The hypothesis was only partially supported. While the suppress group did show a more variable HR response to the video than the control group, there was no difference between conditions in self-report of emotional experience.

This pattern of findings broadly replicates the normative emotion regulation literature, which has found that expression suppression does not change subjective experience of emotion and increases physiological response (Gross & Levenson, 1993; Gross, 1998). The current data extend these findings by showing that a similar pattern emerges if suppression is broadened to include both expression and experience suppression.

The current findings also support the observation in the health psychology literature that suppression of emotions leads to increases in physiological response parameters (Alexander, 1950; Krantz & Manuck, 1984).

The data do not fit with the discovery in the early stress response literature that ‘detachment’ during viewing of unpleasant stimuli actually reduces physiological
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response and experience of negative affect (Lazarus, 1966; Koriat et al., 1972).

Subsequent work did not replicate the positive effects of detachment (Steptoe &
Vogele, 1986), however, and it may be that the detachment instructions used in these
experiments encouraged participants to use both reappraisal and suppression emotion
regulation strategies. Further, it is possible that detachment is in some other way
different from emotional suppression that has not yet been identified.

It is important to point out, however, that the nature of the
psychophysiological change following suppression may be more complicated than a
simple increase in activity. The current study showed more variable HR response but
no change in mean HR, mean GSR, or GSR variability, which is more consistent with
a specific change in cardiovascular regulation rather than a global increase.

A complex response pattern also emerges if the Gross data are analysed in
more detail. Gross and Levenson (1993) measured HR, GSR, finger temperature,
finger pulse amplitude, pulse transmission time, respiration depth, and general
somatic activity. They found that suppression led to an increase in GSR, a decrease in
finger pulse amplitude, and a shortening of pulse transmission time, all of which are
consistent with greater sympathetic nervous system activation. In addition, they also
found decreased heart rate acceleration and decreased somatic activity following
suppression, which is not consistent with greater physiological arousal. Gross (1998)
replicated the pattern of increased sympathetic nervous system activation but found
no differences in either somatic activity or heart rate. What this illustrates is the
complexity of psychophysiological response following suppression.

The current data showed a somewhat different profile on the measures in
common to the Gross studies. In particular, there was no difference in GSR between
suppress and control, not replicating the Gross pattern of data of increased GSR
response. Further, a difference in HR variability emerged (not measured in the Gross study), rather than a change in mean activity level. It is currently unclear what the finding of greater heart rate variability in the current data actually means. It suggests that the consequences of suppression can not be seen in terms of a simple increase or decrease in system activity and perhaps should be framed in terms of emotional dysregulation. Thus, the reliable finding across studies is that suppression leads to changes in psychophysiological response, but exactly how this is expressed differs between studies. Further work is needed to explore these differences more systematically.

In summary, emotional suppression appears to be an ineffective form of emotion regulation in that it does not reliably reduce negative emotional experience and leads to more variable, perhaps dysregulated, physiological response at the time of coding.

4.4 Delineating Longer Term Consequences of Emotional Suppression

It will now be considered whether initial attempts to suppress emotion led to any secondary costs on mood and memory. The post-induction consequences of emotional suppression were measured in terms of change in immediate and longer term mood, subsequent response to emotional material, memory for the induction, and immediate and longer term experience of intrusions about the induction. These measures will be considered in turn.
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4.4.1 Processing of Subsequent Emotional Material

The second hypothesis predicting that suppression would lead to elevated self-report and psychophysiological response when viewing subsequent emotional material was not supported for the self-report data but was partially supported for the psychophysiology data. The suppress and control conditions did not differ in valence ratings, arousal ratings, and report of the target emotion to each of the emotional image types, suggesting that suppression has no effect on subsequent emotional experience.

In the psychophysiology analysis, the suppress group did show significantly greater initial negative HR deceleration to the emotional images (relative to neutral images) than the control group, which is superficially indicative of greater psychophysiological response. This index is actually somewhat complex to interpret, however.

Consistent with the increased activation hypothesis, research into the IAPS (e.g. Bradley, 2003) generally shows a triphasic response of initial HR deceleration, subsequent HR acceleration, and finally tertiary HR deceleration when viewing emotional images. Negative pictures tend to lead to more marked initial deceleration, whereas positive pictures tend to lead to greater subsequent acceleration. Therefore, greater HR deceleration in the current study may suggest the suppress group found the images more negative than the control group.

On the other hand, Fowles (1980) suggests that HR activity is a measure of the behavioural activation system (BAS; Gray, 1982; 1987: the motivational system that regulates approach towards rewarding stimuli), such that an increase in HR means higher BAS activity. Thus, greater HR deceleration in initial picture viewing suggests
decreased BAS activity, which may reflect either ongoing attempts at suppression of emotional response or a less marked positive emotional reaction to the images.

In summary, it is unclear if HR deceleration reflects a less marked approach response to the images or a more marked negative emotional response to the images. Nevertheless, this finding does show that one cost of using emotional suppression to regulate mood is that, in physiological terms at least, when processing subsequent emotional material there is a change in response. Further work is needed to interpret what the consequences are of this change in psychophysiology profile might be.

4.4.2 Mood Following the Trauma Induction

The third hypothesis predicting that emotional suppression would lead to a subsequent increase in negative mood and a decrease in positive mood, compared to the control condition, was only very weakly supported.

The immediate mood change data (comparing mood ratings immediately prior to the induction and five minutes after the induction) found that the suppress and the control groups did not differ on the self-report variables. The week-long mood change data (comparing ratings for the week prior to the experiment to the week after the experiment) also found no global differences in mood in the suppress and control conditions. Interestingly, however, there was a significant difference between groups on depression scores reported on the BDI, with the suppress group showing a slight increase and the control group a slight decrease. This was an extremely small magnitude effect (1 point on the BDI), which cannot be interpreted as a clinically significant level of change. Effects of such a small size would have very limited ecological validity in terms of predicting real world emotional response. Further, due
to the large number of statistical comparisons run on emotional self-report variables, it is possible this significant finding is a Type I error. The effect would not survive correction for multiple comparisons.

This pattern of findings offers only very partial, tentative support for the rebound hypothesis in relation to mood change (Wegner et al., 1987; Wegner, 1994). It seems most parsimonious to conclude that emotional suppression does not have lasting, marked effects on subsequent mood, so is therefore not a particularly harmful form of affect regulation. Thus, findings of a reliable rebound effect on thoughts following thought suppression do not clearly extend to mood rebound following affect suppression. It is important to bear in mind, however, that there may be a rebound effect if emotions are successfully suppressed at initial coding.

4.4.3 Episodic Memory for the Trauma Content

The fifth hypothesis that suppression would lead to impaired episodic memory was partially supported. As predicted, the suppress group showed impaired free recall memory of the content of the video at one week follow up compared to the control group. This finding is consistent with the expression suppression literature, where attempts to control visible displays of affect impairs memory for the material (Richards & Gross, 1999; 2000). Further, it resembles the finding of impaired episodic memory of a trauma induction found following thought suppression (Wegner et al., 1996). There were no differences in recognition memory for the trauma induction, however. This finding suggests that the mnemonic consequences of emotional suppression may differ depending on the type of memory assessed.
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The range of scores found on the two memory measures in the control group was comparable to that reported in the Holmes, Brewin & Hennessy (2004) study (cued recall: 60% correct in the current study, compared to around 50% correct in Holmes et al. data; recognition memory: around 65% correct in the current study, compared to around 50 – 70% correct in the Holmes et al. data). This suggests that the fractionation between the recall and recognition measures is unlikely to be due to sampling differences.

It seems plausible that free recall memory would require access to more explicit, verbal memory whereas recognition memory could be achieved through access to either explicit, verbal memory or implicit, visual memory. Thus, the differentiation of these measures could be modelled by the dual representation theory of PTSD (Brewin, Dalgliesh & Joseph, 1996).

4.4.4 Experience of Intrusions

The fifth hypothesis predicting that emotional suppression would lead to a higher rate of subsequent intrusions was not supported. The suppress group tended to report fewer intrusions during the stream of consciousness task, but did not differ in the length of time they spent talking about the video. While the decrease in intrusions was not significant (p = .06), the findings run in the opposite direction to the original hypothesis. In the week after the film the suppress and control group did not differ in the number of intrusions they reported in their diary.

These findings are interesting given that a series of earlier studies have shown that attempts to cut off from experience through dissociation while processing traumatic material leads to a subsequent increase in intrusions (Brewin & Saunders,
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An alternative data pattern may have emerged for a number of reasons. First, there may be important differences between suppression and dissociation. In particular, dissociation involves cutting off from cognitive, emotional, and bodily experience, whereas emotional suppression involves distancing only from affect (see section 1.5). Second, participants in the current study may not all have followed the suppression instructions, therefore masking the emergence of an increase in intrusions following suppression. Third, findings of increased intrusions following dissociation may not be robust. For example, Murray (1997) did not demonstrate an increase in intrusions following dissociation.

4.4.5: Implications for Modelling the Consequences of Emotional Suppression

In summary, there was little support for the concept of 'affective rebound' following emotional suppression in the current data in terms of reported experience of affect or experience of intrusive memories. There was partial support for the rebound hypothesis in terms of psychophysiological response, with the suppress group showing greater HR deceleration during the affective picture task. Further, the suppress group did show impaired free recall of the content of the trauma induction, consistent with an impairment in episodic memory resulting from emotional suppression. This suggests that thought suppression and emotional suppression do not have analogous consequences on subsequent information processing.

This complex data pattern suggests that the original conceptualisation of affective rebound based on dual representation theory (Brewin, Dalgleish & Joseph, 1996; Brewin, 2001) outlined in the introduction may have partial validity. The finding of impaired free recall of the material is consistent with a weakened explicit,
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verbal trace of the trauma material following suppression and the finding of ongoing physiological arousal is consistent with a strengthened implicit, perhaps situational, memory trace. Crucially, however, this framework would predict that a strengthened situational trace should lead to an increased number of intrusions, which was not found to be the case following suppression. This suggests that the consequences of emotional suppression during trauma encoding cannot be understood fully through recourse to dual representation theory.

4.5 Methodological Concerns

A range of methodological issues should be born in mind when interpreting the results of this thesis, which limit how confidently theoretical and clinical implications arising from the data can be put forward.

4.5.1 Sample Size

A relatively small sample size was used in the thesis, meaning the study has limited statistical power. The power calculation estimated a required sample size of 26 participants in each group, whereas due to recruitment difficulties the final sample was 23 in the control group and 21 in the suppress group. This weakness was exacerbated by missing data in some of the analyses, resulting from not all participants attending the follow up session and from equipment failure. It may be the case that clearer consequences of emotional suppression would have emerged in a larger study.
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In partial defence of this criticism, logistical constraints meant that it was not possible to test a larger population. Over 250 letters were sent out to volunteers on the MRC CBU panel, of whom only a relatively small number replied and then participated. At the end of data collection, available participants on the panel who had not previously done similar experiments had been exhausted.

Further, it can be argued that, for emotional suppression to have any clinical utility as a concept, then a large magnitude effect of applying it would be required (i.e. a large effect size of the experimental manipulation would be predicted). The current study was only slightly under powered to detect large effect sizes. While it may not have been adequately powered to detect smaller effect sizes, any such effects would be unlikely to have much ecological validity in informing clinical practice.

Finally, the sample size in the current thesis is actually comparable to that used in the original Gross and Levenson (1993) study which showed significant effects of expression suppression (n = 22 in the control condition; n = 21 in the suppress condition). This suggests the current sample size may have been adequate to detect reliable differences between the two conditions.

4.5.2 Sample Selection

The sample used in the thesis may not be representative of the general population, because of the recruitment methods used. For ethical reasons all participants were approached by letter prior to the study to outline what it would involve. Of the people written to (all of whom were on a panel of research volunteers and regularly help out in research), only about twenty percent agreed to participate. This means that the sample is in a sense self-selected and it is therefore unclear how
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representative this group is of the general population. For example, the people who were willing to take part may have been confident they were unlikely to show a strong emotional reaction (i.e. are not easily upset).

4.5.3 Type I Error Rate

The complex design of the experiment means that a large number of statistical comparisons were run between conditions (particularly on the emotion and mood variables), potentially inflating the possibility of making a Type I error in interpretation (false positive effect of experimental condition). In defence of this criticism, no correction was made for multiple comparisons in a majority of the analyses run as they were based on a priori hypotheses.

Further, the significant findings that emerged came from measures where a relatively small number of contrasts were run (the psychophysiology data, the intrusions data, and the episodic memory data), suggesting Type I error is not a major issue. The exception to this was the finding of elevated BDI at one week follow up in the suppression group. A large number of comparisons were run on emotion self-report variables and this was the only significant effect that emerged. The BDI difference would not have survived correction for multiple comparisons, so therefore this positive finding should be interpreted very cautiously and requires replication.

4.5.4 Violation of Assumptions of Parametric Statistics

A number of variables analysed were significantly non-normal in their distribution, meaning they violated some of the assumptions of the parametric
assumptions of the statistical tests used. To partially control for this, data were transformed where possible and equivalent non-parametric tests were also run where available. In the case of repeated measures ANOVA, however, there was no non-parametric equivalent to use. Further, non-parametric techniques are less powerful, so it is hard to interpret unambiguously whether the disappearance of an effect in these analyses is due to violations of data assumptions in the original analysis or a lack of power in the non-parametric analysis.

4.5.5 Differentiation between the Suppress and Control Conditions

How distinct the two experimental groups were in terms of their use of emotional suppression can also be questioned. While participants in the suppress group reported making greater use of suppression overall than the control group, there was considerable overlap between the two conditions. A number of participants in the control group reported high levels of suppression (perhaps reflecting that suppression is a typical emotion regulation strategy used in the general population) and a number of participants in the suppress group reported low levels of suppression (perhaps reflecting that people may have habitual emotion regulation strategies that they use and are not always amenable to instruction in other methods). It is possible that clearer group differences may have emerged if the groups had been more distinct in the use of suppression.

One way round this problem would have been to exclude participants in the control group who reported high levels of suppression and participants in the suppress group who reported low levels of suppression. This was not possible in the current study, as this would have left the samples too small to analyse validly. A second
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solution would be to repeat the study but splitting groups in terms of use of trait suppression rather than using an instruction manipulation.

4.5.6 Interpretation of the Suppression Manipulation

It is also somewhat difficult to interpret the meaning of the suppression manipulation. While suppress participants differed from control participants in how hard they reported attempting to suppress, there were no clear and strong differences in self-report of emotional response to the video. This means that the experiment looks at the consequences of attempts to suppress emotional response to material as opposed to the consequences of successful suppression of emotional response to material. It is possible that the consequences of successful versus unsuccessful suppression may be quite different. One way to investigate this possibility would be to split the suppression group based on how successful they were (i.e. those who showed a large emotional response to the video compared with those who showed a small emotional response to the video). Again, this analysis was not possible with the current data set due to the relatively small sample size.

4.5.7 Construct Validity of Emotional Suppression

It should also be pointed out that the suppression manipulation used in the current study was novel, extending Gross’s definition of emotional suppression (Gross, 1998; Gross, 2001) to down-regulation of experienced affect as well as expression of affect. The validity of this broader definition has yet to be established.
Further, it is possible that the suppression manipulation served as form of distraction, whereby participants’ attentional resources were diverted towards ensuring they were suppressing rather than in processing the content of the video. Distraction could potentially explain why episodic memory was impaired and intrusions decreased following suppression, although it would struggle to account for the change in psychophysiological response. To explore whether the experimental manipulation worked specifically via suppression or more generally via distraction, additional work seems warranted to contrast these two processes.

Finally, it could be argued that the instructions in the suppress condition focused on the goal of the manipulation (i.e. to suppress expression and experience of emotion) without giving participants any clear advice or suggestion of techniques about how to do this (i.e. use relaxation, think of other things and so on). It may be that certain forms of suppression are more or less effective (for example, distancing, reappraisal, use of relaxation) and have different consequences. Future research could potentially delineate and contrast the consequences of different ways to achieve emotional suppression.

4.5.8 Impact of Trait Emotional Suppression

The current study focused on the consequences of an emotional suppression induction without considering the impact of trait individual differences in adoption of emotional suppression. Lazarus (1993) points out that group differences as a result of experimental manipulation are often washed out by individual differences within each of the samples. In relation to the current study, individual differences in trait use of emotional suppression may determine to what extent participants can follow the
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emotional suppression instructions. Further, trait differences in emotional expressivity could mediate the impact suppression would have on reported and experienced affect.

One way to explore this issue would have been to run a correlational analysis between individual differences measures and the experimental tasks in the current project. This approach was not adopted due to the lack of statistical power in the current design. The large number of correlations that would need to be run, often in the absence of any clear *a priori* hypotheses, would have resulted in a marked inflation of Type I error rate. Future research with a larger sample size is warranted to explore the impact of trait measures.

4.5.9 Ecological Validity of the Trauma Induction and Other Measures

Another limitation of the study is that the ecological validity of the trauma induction can be questioned. There is obviously an important difference between watching a video of a traumatic event and being personally involved in a trauma. A number of participants commented that they felt they were watching the television programme *Casualty*, and so were not particularly upset. They felt their reaction would have been very different if they or a loved one were personally experiencing the accident, rather than being in an observer position. Therefore, considerable caution needs to be taken before generalising these findings to the consequences of emotional suppression in a personally experienced traumatic event. It is possible that the consequences of emotional suppression are very different in a situation that is more arousing and personally salient.

In addition, some participants commented that the quality of the images in the video were poor (as they are based on old footage of accidents that have some
Finally, a number of participants reported that the film was ‘not as bad as they were expecting’, so that the emotions they had experienced while watching it had partially been relief and/or guilt that they were not showing a more marked reaction. Again, this may have been an inadvertent consequence of using letters to recruit participants in the most ethical fashion available.

A similar critique could be made about the ecological validity of the affective picture task, where static images are used to induce moderate amounts of happiness, sadness, fear, and disgust. Differences resulting from the use of emotional suppression may have only emerged on a more powerful emotional induction.

In defence of these criticisms, it is clearly not ethical to expose experimentally volunteers to a more severe trauma or emotional induction, particularly when it is predicted that the emotion regulation instructions being used will be unhelpful.

Further, the use of analogue trauma inductions is a common research strategy in the literature which has helped develop clinical understanding of conditions like PTSD (for example, Davies & Clark, 1998; Rassin et al., 1997 to understand the consequences of thought suppression; Holmes, Brewin & Hennessey, 2004 to understand the consequences of dissociation). This body of work therefore suggests that analogue inductions may have some relevance to understanding PTSD.

In addition, there are specific advantages in the use of an analogue design. First, when studying a group of people with a diagnosis of PTSD it is obviously not possible to systematically examine coding of the traumatic event (since this has necessarily already occurred for a diagnosis to be obtained). Investigation of initial encoding can be undertaken in an analogue design. Second, the nature of the trauma
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stimuli can be carefully controlled by the experimenter (as opposed to there being marked variation in trauma exposure in naturalistic settings). Third, it is possible to have gathered normative data on typical responses to the trauma material to inform interpretation of the data.

A naturalistic design could potentially be adopted in future research to increase the ecological validity of the work. For example, people routinely exposed to trauma (for example, emergency services personnel) could be trained in different forms of emotion regulation (for example, reappraisal versus suppression) and the short and long term consequences of this measured. Obviously, there are ethical issues about conducting such a study if emotional suppression does turn out to be an ineffective or potentially harmful way of managing emotions. Careful thought would need to be given to this issue in the experimental protocol, outlining how and when the experiment would be terminated.

4.5.10 Intrusion Methodology

A number of issues about how the intrusion data were collected may also be problematic. First, a number of participants’ data were missing in the analysis, either due to equipment failure or the participant not attending follow-up. Second, the data were scored by the experimenter only, whereas an optimal design would be to have the data double-scored to control for interpretation bias. Third, the distinction between length of time spent talking about the video and the number of content related intrusions used in the analysis of the stream of consciousness task may not be valid. Fourth, use of a stream of consciousness task may not have been the optimal way of monitoring intrusions immediately post-experiment in the first place. The failure to
find significant differences in reported intrusions may therefore partially be the result of these problematic methodological issues.

Interestingly, failure to find an effect of condition on experience of intrusions appears to not be the result of a floor effect. If anything, a higher than average number of intrusions were found in the diary in the current study (around 12 on average in the control group; around 6 on average in the suppress group) compared to previously published research using the road traffic accident video (for example, Holmes, Brewin & Hennessy, 2004 found an average number of intrusions ranging from 2 to 7 across experiments in their control conditions)

Alternative ways to monitor the impact of emotion regulation on thought content could have been a written stream of consciousness task, where participants write down what was running through their mind, or a button press task, where participants press a button whenever they think about the trauma induction. The written task was not chosen because it was felt it might lead to ‘narrative smoothing’, where participants could potentially miss out important parts of their phenomenological experience in an attempt to produce fluent prose. The button press task was not selected because it would not be possible to verify or analyse the content of participants’ thoughts for each button press. A further alternative could have been to combine the verbal stream of consciousness task with the button press task. It was felt that this would effectively require ‘dual task performance’ and increase the cognitive load on participants, thus potentially altering their experience. All of the potential ways of measuring immediate memory rely on participants self-report and are thus open to the contaminating effects of response bias.
4.5.11 Psychophysiology Methodology

The psychophysiological recording methods used can be criticised. Two peripheral measures were taken, meaning that only limited aspects of body-state were studied. A more complete picture would have emerged if other measures such as facial muscle contraction were adopted. Additionally, the validity of the analysis approach used is not fully established. In particular, it is currently unclear in the literature how best to model the interaction between phasic and tonic aspects of system response and the change scores reported in this thesis are only one of a variety of methods available.

These comments reflect the fact that psychophysiology is a developing field and many basic issues regarding recording and analysis are unresolved. Indeed, the development of the recording and analysis system used in this thesis may present a reasonable advance on existing approaches to event-related psychophysiology. The use of digital markers to indicate when certain events occur on a physiological record and the programming of powerful and flexible analysis software gives the researcher more control over the analysis of data and allows a more extensive analysis to be run.

4.5.12 Experimenter Demand Effects

The information sheet given to participants implied that emotional suppression may have some influence over how they felt and what they remembered afterwards. It is possible that this may have biased how participants reported their experience after the experiment through an experimenter demand effect. Consistent with this possibility, a number of volunteers 'apologised' at the one week follow up for not
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having shown a more marked response to the trauma induction and not reporting any intrusions in the diary. To minimise this potential confound, the experimenter attempted to remain neutral when discussing the study and the information sheet did not state in which direction it was hypothesised mood and memory would change. While it was ethically important for participants to be fully briefed about the nature of the experiment, this may nevertheless have influenced how they responded. This confound may be particularly relevant for interpretation of the intrusive memory findings.

4.6 Clinical Implications of Findings

The methodological limitations of the current study and the use of an analogue design mean that only very tentative comments can be made about the clinical implications of the results. Nevertheless, a number of the findings, if replicated and extended to clinical populations, may have some theoretical and clinical implications for understanding PTSD and related conditions.

4.6.1: Emotional Suppression is an Ineffective Form of Affect Regulation

Perhaps the major implication of the current data is that emotional suppression does not appear to be a particularly effective form of emotion regulation. Replicating findings from the process model of emotion regulation (Gross, 1998; 2001), emotional suppression does not reliably reduce experience of negative affect and may actually increase physiological arousal during encoding. This means that clients who
Chapter 4: Discussion

report using emotional suppression to cut off from aversive emotional experience should perhaps be encouraged to adopt other forms of emotion regulation (for example, reappraisal). Further, professionals regularly exposed to trauma in their every day working lives (for example, emergency service personnel, clinical psychologists) should be trained in other, more effective, ways of down regulating emotional experience.

Given the ineffectiveness of emotion suppression found in the current experiment, it seems something of a paradox that people would ever use this as a form of emotion regulation in the first place. Work on trait use of emotion regulation strategies does appear to suggest that emotion suppression is a commonly used form of naturalistic mood regulation (Gross & John, 2002; 2003), so is not purely a laboratory phenomenon. One possibility explanation of why this strategy continues to be used is that people hold the false belief that it is an effective form of mood control. Fear of overwhelming affect if they do not adopt emotional suppression may prevent people ever trying other strategies, and emotions eventually passing may reinforce the belief that emotional suppression led to this desired outcome. In other words, emotional suppression may be maintained in a similar fashion to safety behaviours in anxiety disorders. Further research seems warranted to investigate lay beliefs about the efficacy and consequences of different forms of emotion regulation to test these speculative notions.

An important caveat to this discussion is that the current data do not differentiate between successful and unsuccessful application of emotional suppression, which may have quite different consequences.
4.6.2: The Costs of Emotional Suppression: Implications for PTSD Symptomology

An additional implication of the current data is that there appear to be a variety of secondary costs of adopting emotional suppression as a form of affect regulation. Some of these costs mimic the symptoms seen in PTSD, perhaps suggesting that use of suppression could potentially contribute to the maintenance and development of these difficulties. The three main symptom clusters identified in PTSD are hyper-arousal, re-experiencing, and avoidance/numbing (APA, 1994).

There was some evidence to suggest that emotional suppression led to an ongoing elevation of physiological response, consistent with the notion that it could contribute to hyper-arousal symptoms. Participants in the suppress group showed more variable HR response during the video and exaggerated initial HR deceleration on the affective picture task. Southwick, Yehuda and Charney (1997) review neurobiological alterations in PTSD and conclude that there is strong evidence of a hyper-responsive reaction to trauma reminders in the sympathetic nervous system (both in terms of increased initial activation and impaired habituation of response). Given the similar profile of hyper-arousal found following emotional suppression, it seems plausible to suggest that use of emotional suppression could be one of the contributing factors to the hyper-arousal symptoms seen following trauma in PTSD. Obviously, this tentative claim needs to be validated in clinical studies looking at the consequence of emotional suppression of trauma-related material in sufferers of PTSD.

There was no evidence to suggest that emotional suppression led to any re-experiencing symptoms, indicating it should not be implicated as a contributing factor to this aspect of PTSD. The suppress group actually had fewer content-related
intrusions immediately afterwards and did not differ from the control group in number of intrusions in the week afterwards. This suggests that emotional suppression, in contrast to use of dissociation (for example, Holmes, Brewin & Hennessey, 2004) or thought suppression (see Purdon, 1999 for a review), does not confer vulnerability to re-experiencing symptoms found in PTSD. If anything, the opposite may be the case, where suppressing emotions is protective against PTSD in that people experience lower rates of re-experiencing symptoms. This would be superficially consistent with accounts that emphasise how high levels of affect peritraumatically confer vulnerability to PTSD (Ozer et al., 2003), although the fact that emotional suppression did not actually reduce reported negative affect is hard to reconcile within these frameworks. Again, care is needed when extending the findings from an analogue study to understand PTSD, so this should be viewed as a tentative possibility and more systematically examined in subsequent research.

Similarly, there was no suggestion that emotional suppression led to any avoidance or numbing symptoms, since there was no change in subsequent mood or reported affect to novel emotional material. This again indicates that emotional suppression should not be viewed as a candidate contributing factor to these symptoms.

Interestingly, adoption of emotional suppression did appear to have mnemonic costs, in that free recall of the content of the trauma was impaired. Lack of clear memory for events is often a barrier to effective work in therapy, since it is difficult to reprocess thoughts and feelings associated with previous events when they cannot be recalled in detail. It is possible that habitual use of emotional suppression may increase the likelihood or exacerbate the extent of these mnemonic deficits. Additionally, use of emotional suppression during recall of the material in session
could further limit the material that can be recovered. Encouraging clients to adopt other forms of emotion regulation may therefore minimise difficulties in recall of distressing material and facilitate working through in PTSD.

In summary, the current data show that use of emotional suppression leads to secondary costs of mnemonic impairment and hyper-arousal. Further work with clinical populations seems warranted to test out the speculative notion that use of emotional suppression could actually be contributing to the emergence and maintenance of these symptoms in psychopathology. Intriguingly, the finding of reduced frequency of intrusions following suppression suggests that there may also be a secondary gain of this form of emotion regulation. Again, additional work in clinical populations seems appropriate to help clarify this profile of costs and benefits following emotional suppression.

4.7 Summary and Overview

The thought suppression literature illustrates how attempts to control the contents of conscious experience may have paradoxical subsequent costs (Wegner et al., 1987; Wegner, 1994). A growing body of work is also suggesting that attempts to regulate emotions may sometimes backfire (Gross, 1989; 2001), which could potentially contribute to the development and maintenance of different forms of psychopathology. As yet there has been limited empirical examination of the costs of emotion regulation in psychological disorders.

This thesis reports an experiment looking at the concurrent and subsequent impact of emotional suppression while processing traumatic material in a healthy population, in a preliminary attempt to investigate whether emotional suppression is implicated in PTSD. It was found that emotional suppression was an ineffective form
of emotion regulation, in that it led to no reduction in reported negative affect while viewing the trauma induction. There was also a more variable heart response to the video when suppressing, but it is important to note that other physiological measures were not affected and what this heart rate change means at a psychological level is currently unclear.

The subsequent consequences of emotional suppression were mixed. The secondary costs of emotional suppression were that physiological response continued to be altered when processing subsequent material and there was impaired free recall (but not recognition memory) of the trauma material. A potential secondary gain of emotional suppression was that it led to experiencing fewer intrusions of video content in the five minutes after the induction, but it is important to note that this trend did not reach statistical significance and there was no difference in the number of intrusions reported in the week after the experiment. There was no clear impact on emotional experience, either in terms of background mood or response to novel emotional material, following suppression.

In terms of theories of emotion regulation, these data replicate and extend the process model of emotion regulation (Gross, 1998; 2001) by showing that findings of no change in experienced affect, altered physiological response, and impaired episodic memory are also demonstrated when broadening the definition of emotion suppression to include inhibition of internal feelings as well as their expression.

In terms of understanding PTSD, this pattern of results suggests that emotional suppression during trauma encoding could potentially contribute to the hyper-arousal symptoms seen in the disorder, may minimise re-experiencing symptoms, and has no clear impact on avoidance/numbing symptoms. The deficit in episodic memory found following suppression could also be a potential barrier to successful resolution of
trauma in therapy, since recall of the traumatic event may be poor if suppression has been used during initial encoding.

A broad clinical implication arising from the thesis is that emotional suppression appears to be an ineffective form of emotion regulation with some mild secondary costs, so clients presenting to clinical psychologists should perhaps be discouraged from using it as a primary form of mood control. It is important to note, however, that overall there were few differences between the suppress and control groups, suggesting that suppression is an ineffective form of mood control rather than a clearly harmful one. These tentative implications for understanding PTSD and guiding clinical practice should be used cautiously until results are replicated and extended with clinical populations.

The demonstration of secondary costs following suppression of emotions during trauma encoding, whereby physiological response is altered and free recall episodic memory is impaired, suggests that adopting an emotion regulation perspective may be a useful avenue to follow to better understand the development and maintenance of PTSD and other related forms of psychopathology.
Appendices

Appendix One: Copy of Ethics Approval Letter

UNIVERSITY OF CAMBRIDGE
CAMBRIDGE
PSYCHOLOGY RESEARCH
ETHICS COMMITTEE

Application No: 2003.15

Dr B Dunn
MRC Cognition & Brain Sciences Unit
15 Chaucer Road
Cambridge CB2 2EF

Dear Dr Dunn

The Cambridge Psychology Research Ethics Committee has given ethical approval to your research project: **Consequences of Emotion Regulation When Processing Traumatic Material** as set out in your application dated June 2003. The Committee attaches certain standard conditions to all ethical approvals. These are:

(a) that if the staff conducting the research should change, any new staff should read the application submitted to the Committee for ethical approval and this letter (and any subsequent letter concerning this application for ethical approval);

(b) that if the procedures used in the research project should change or the project itself should be changed, you should consider whether it is necessary to submit a further application for any modified or additional procedures to be approved;

(c) that if the employment or departmental affiliation of the staff should change, you should notify us of that fact.

Members of the Committee also ask that you inform them should you encounter any unexpected ethical issues. If you would let us know that you are able to accept these conditions, I will record that you have been given ethical approval.

Yours sincerely

KS Douglas

Old Press Site, Silver Street
Cambridge CB3 9EW
Telephone: 01223 766894
Fax: 0 1223 332355
E-mail: sbs@mole.bio.cam.ac.uk
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Appendix One: Letter to Participants

Dear Panel Member,

We are writing to invite you to take part in an experiment taking place at the MRC Cognition and Brain Sciences Unit. The study aims to investigate whether the way in which we control our emotions when we are experiencing unpleasant events influences our memory of the event and how we feel afterwards. The results of the study may help us understand what leads to the development of Post-Traumatic Stress Disorder following exposure to stressful life events.

The experiment will involve you viewing a video of the aftermath of road traffic accidents and looking at emotional images (pictures of crying people, decaying food, frightening animals), which you may find upsetting. We will measure how this makes you feel, what you remember about the material, and the physiological response in your body, recorded by attaching a small number of electrodes to your face, hand, and leg. Due to these unusual features of the study, we wanted to write to you in advance to explain what it will involve. If you feel you may be interested in taking part in the study, please read the enclosed information sheet for more information. If you have any further questions you can contact Tim Dalgleish on the above telephone number.

We would be grateful if you could indicate whether you may be interested in taking part in the study by completing the enclosed form and returning it in the stamped addressed envelope provided. If you say you are potentially interested we will then contact you by telephone to answer any questions you may have and arrange times for testing. Testing is most likely to take place on Wednesdays or Fridays, so please indicate on the form whether these days are convenient for you. As with all experiments at the unit, you will receive five pounds an hour for your time and have your travelling expenses reimbursed. You are also free to withdraw from the experiment at any stage of testing. Thank you for considering this request and we hope to hear from you soon.

Yours sincerely,

Dr. Tim Dalgleish
(researcher and clinical psychologist)

Dr. Barney Dunn
(researcher and trainee clinical psychologist)
Appendices

Appendix One: Information Sheet

"Exploration of the Cognitive and Affective Consequences of Suppression and Reappraisal of Emotional Response to Traumatic Material"

Please read the information below to decide if you would like to take part in the project:

What is the purpose of the study?
The aim of the study is to investigate if the way in which people manage their thoughts and feelings when they experience traumatic events effects how much they remember about the event and how they feel about it afterwards. This is important because it may help us understand what makes some people go on to develop posttraumatic stress disorder (PTSD) when they experience traumatic events, and possibly lead to the development of new therapies for the condition.

Why have I been asked to take part?
You are being asked to take part so we can see how healthy volunteers respond to different ways of processing mildly traumatic material.

What will I have to do?
If you decide to take part, it will take up to two hours to complete the experiment. This will take place over two sessions at the Cognition and Brain Sciences Unit, 15 Chaucer Road, Cambridge, at a time of your convenience. We will reimburse your travelling expenses for getting to and from the unit and give you an honorarium of £5 an hour for your time. In the first session you will be asked to watch a film about the aftermath of road traffic accidents, which you are likely to find upsetting. The content of the film includes emergency service personnel working to extract trapped victims, injured victims screaming, dead bodies being moved, and body parts among car wreckage. We will give you some instructions about how we would like you to control your thoughts and feelings while you watch this film. We will then measure how these instructions influence your emotions during the film, your memories about the film, and your response to a set of emotional pictures after the film. Some of these pictures may be unpleasant, including images of people crying, frightening animals, and decaying food. We will measure your emotions in terms of what you describe, how much your heart rate changes, and how much you sweat through the finger tips. We do this by placing a small number of electrodes on your arm, leg and face, which most people find comfortable to wear. After the first session we will ask you to keep a diary for two weeks, recording whether or not you had any thoughts about the film each day and how it made you feel. This should take up to ten minutes to complete each day. In the second session we will review your diary and ask you to complete some questionnaires measuring your thoughts and feelings.

Are there any risks in taking part?
All of the tasks we will ask you to complete and equipment we use have been used safely in previous research. You may, however, find the film we ask you to watch upsetting. For this reason, we do not think anyone who currently has or previously had a mental health condition (for example, clinical depression or clinical anxiety) should take part in the study. If you become upset during the film we will stop the experiment and you will have the opportunity to talk to a clinical psychologist about your reaction if you wish to.

Other information
This study has received ethical approval from the Ethics Committee of the University of Cambridge. The data we collect will be used in the strictest confidence, and no identifying will be stored with the data, to safeguard your confidentiality. The data will be stored in a locked filing cabinet, which only the investigators will have access to. Results from the study will be presented at conferences and written up in journals. Results will be presented in terms of groups of participants, so individual data will not be identifiable. You are free to decide not to take part in the study and can withdraw from the study at any time and for whatever reason. If you do decide not to take part or to withdraw you do not need to explain your reasons to us if you do not want to.

If you have would like any further information about the project please contact Dr. Tim Dalgleish on the above contact details. Thank you for reading this information sheet.
Appendices

Appendix One: Consent Form

CONSENT BY VOLUNTEERS TO PARTICIPATE IN A STUDY ENTITLED:

"Exploration of the Cognitive and Affective Consequences of Suppression and
Reappraisal of Emotional Response to Traumatic Material."

I....................................................................................................................................
Of..................................................................................................................................

hereby fully and freely consent to participate in the above study. I understand and
acknowledge that the trial is designed to add to medical knowledge. I note that I may
withdraw my consent at any stage in the investigation and I acknowledge that the
purpose of the trial, the risks involved from any procedures, and the nature and
purpose of such procedures have been explained to me by:

and that I had an opportunity to discuss these matters with him/her.

I have received a written explanation of these matters, a copy of which is attached to
this form. I understand that I may change my mind and withdraw from the study at
any time without any effect upon my rights.

Signed......................................................................................................................
Date............................................................................................................................

I confirm that I have explained to the volunteers the nature and effect of these
procedures (team member acting on behalf of the person responsible for the project).

Signed......................................................................................................................
Date............................................................................................................................

Place...........................................................................................................................
Appendices

Appendix 2: Emotion Regulation Instructions

Control Condition

Prior to Practice Task:

We will now show you a short film. Please watch the film carefully and we will then ask you to rate how you feel at the end of it. It is important you stay focused on the film and do not look away from the screen. Also, try not to move too much while watching the film. We will start off with a short practice film about the Nagasaki bombing before moving on to the test film. Please ask the experimenter any questions if these instructions are not clear. Otherwise, press the button to begin the practice.

Prior to Test Film:

You will now move onto the test film. This will show real life video footage of the aftermath from five road traffic accidents, which you are likely to find upsetting. It is important for the experiment that you watch the film, but if you become so distressed that you wish to stop the film let the experimenter know by saying 'stop' and we will terminate the experiment. Remember to pay attention to the film and do not look away from the screen, as we will ask you questions about it afterwards. After the video we will ask you to rate how you are feeling. Press the button below when you are ready to begin.
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Suppression Condition

Prior to Practice Task:

We will now show you a short film. It is very important for the experiment that when you watch the film you try and suppress any emotional responses to it you are having. What we mean by this is that you should adopt a detached and unemotional attitude as you watch the film. Try to think about what you are seeing objectively in such a way that you don't feel anything at all. Further, if you do have any feelings try not to let these show and keep a 'straight face'. In other words, as you watch the film, try to behave in such a way that a person watching you would not know that you were feeling anything. For example, if the film makes you feel afraid, we would like you to decrease the intensity of fear that you feel and show. While suppressing your emotions, it is important you should stay focused on the film and do not look away from the screen. Also, try not to move too much while watching the film. We will start off with a short practice film about the Nagasaki bombing, before moving on to the test film. Please ask the experimenter any questions if these instructions are not clear. Otherwise, press the button to begin the practice.

Prior to test film:

The experimenter will now ask how easy you found the suppression instructions to follow. If the instructions are not clear please ask for clarification. You will now move onto the test film. This will show real life video footage of the aftermath from five road traffic accidents, which you are likely to find upsetting. It is important for the experiment that you watch the film, but if you become so distressed that you wish to stop the film let the experimenter know by saying 'stop' and we will terminate the experiment. Remember to keep suppressing how much emotion you feel and show. Also, remember to pay attention to the film and do not look away from the screen, as we will ask you questions about it afterwards. After the video we will ask you to rate how you are feeling. Press the button below when you are ready to begin.
Appendices

Appendix 3: Compliance with Emotion Regulation Instructions

Control Condition

We are interested in how you controlled your emotional responses while viewing the road accident video. Please rate the following questions from 0 not at all to 100 extremely by marking a point on the line:

How much did you find yourself trying to suppress your emotional response to the video?

0--------------------------------------------50----------------------------------------100

How much did you find yourself trying to change the meaning of the video while you watched it?

0--------------------------------------------50----------------------------------------100

How much did you find yourself not looking at the video?

0--------------------------------------------50----------------------------------------100

How much did you find yourself not paying attention to the video?

0--------------------------------------------50----------------------------------------100

How much did you find yourself deliberately thinking about other things while watching the video?

0--------------------------------------------50----------------------------------------100
Suppression Condition

We are interested in how you controlled your emotional responses while viewing the road accident video. Please rate the following questions from 0 not at all to 100 extremely by marking a point on the line:

How hard did you try to suppress your emotional response to the video?

0--------------------------------------------50----------------------------------------100

What strategies did you use to attempt to suppress your emotional response to the video?

0--------------------------------------------50----------------------------------------100

How much did you find yourself trying to change the meaning of the video while you watched it?

0--------------------------------------------50----------------------------------------100

How much did you find yourself not looking at the video?

0--------------------------------------------50----------------------------------------100

How much did you find yourself not paying attention to the video?

0--------------------------------------------50----------------------------------------100

How much did you find yourself deliberately thinking about other things while watching the video?

0--------------------------------------------50----------------------------------------100
Appendices

Appendix 4: Video tape commentary

Scene 1.
After a sudden rain storm, several collisions occurred at one spot on the motorway due to the slippery conditions and bad visibility. Eight people died, and one of these four died before they could be taken to hospital. Here is a 21-year old women who was trapped in her car. Unfortunately she died before she could be taken to hospital. The baby survived the accident. The parent, 26 and 30 years old, also died during the accident.

Scene 2.
Here a 58-year old man skidded onto the wrong side of the road because he was driving too fast around a corner. He hit a minibus which was coming the other way, and the occupants, a 51-year old woman and her adult daughter, were both injured. The daughter was knocked unconscious but received only cuts and bruises. By the time this video was taken, the man and the older woman, both severely injured, had been trapped in their vehicles for over an hour, since because of the remote location ambulance and fire crews took 20 minutes to reach them. The woman was permanently disabled by her injuries, due to spinal cord damage, although the man did recover completely.

Scene 3.
These two men were involved in a multiple pile up on the motor way. Their wives, who were sitting in the back of the car, survived the accident although they sustained major injuries. Both men had grown up children who were still financially dependent on them.

Scene 4.
This 56-year old man and his 52-year old wife were on the way to visit their son, a student, in a near by town when their car went out of control on the motorway after one tyre was punctured. They skidded and crashed. The woman died shortly after the accident as a result of the injuries she received. The man remained conscious throughout the accident, although he had suffered extremely severe injuries. However, he was trapped in the car next to his wife and it proved too difficult to rescue him in time. He died of internal bleeding about 30 minutes after the accident, and could only be removed from the wreckage when he was already dead.

Scene 5.
This woman, a 20-year old student, and her friend, were on the way to Italy in a car during the summer. On a major road they drove straight into the rear of a traffic jam going round a blind corner. Both women were not hurt by this. However, a lorry which they had overtaken earlier also came round the corner and hit them from behind. Both women suffered very serious injuries. The student sustained massive internal injuries, an injured skull and deep cuts to her face. The lorry driver was not hurt.
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Appendix 5: Visual Analogue Mood Rating Scales

Week Version

Over the past week, how much have you experienced each of the following emotions (please mark a point on the line from 0 not at all to 100 very much so).

HAPPINESS 0-------------------------------------50-----------------------------------100
SADNESS 0-------------------------------------50-----------------------------------100
FEAR 0-------------------------------------50-----------------------------------100
DISGUST 0-------------------------------------50-----------------------------------100
SURPRISE 0-------------------------------------50-----------------------------------100
ANGER 0-------------------------------------50-----------------------------------100
GUILT 0-------------------------------------50-----------------------------------100
SHAME 0-------------------------------------50-----------------------------------100
HELPLESS 0-------------------------------------50-----------------------------------100
HORROR 0-------------------------------------50-----------------------------------100
TERROR 0-------------------------------------50-----------------------------------100
DISTRESS 0-------------------------------------50-----------------------------------100

Rate how aroused and pleasant you felt over the past week (circle a number):

<< not at all very much so>>

AROUSAL 1 2 3 4 5 6 7 8 9

<<very unpleasant neutral very pleasant>>

VALENCE 1 2 3 4 5 6 7 8 9
Appendices

Immediate Version

*Right at this point in time*, how much are you experiencing each of the following emotions (please mark a point on the line from 0 not at all to 100 very much so).

<table>
<thead>
<tr>
<th>Emotion</th>
<th>0</th>
<th>50</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happiness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sadness</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Fear</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Disgust</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Surprise</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Anger</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guilt</td>
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<td></td>
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<tr>
<td>Shame</td>
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<tr>
<td>Helpless</td>
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<tr>
<td>Horror</td>
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<tr>
<td>Terror</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distress</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Rate how aroused and pleasant you felt *over the past week* (circle a number):

<table>
<thead>
<tr>
<th>Arousal</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendices

Appendix 6: Instructions Used for Verbal Stream of Consciousness Task

For the next few minutes you will simply be asked to speak your stream of consciousness out loud, letting us know whatever is going through your mind. This might include, but is not limited to, images, ideas, memories, feelings, fantasies, plans, sensations, observations, daydreams, objects that catch your attention, and efforts to solve a problem. There are no restrictions, qualifications, conventions, or expectations. Measures have been taken to ensure your privacy and to guarantee confidentiality concerning your participation in the study, so please speak out loud whatever goes through your mind. Do not worry if what goes through your mind seems silly, embarrassing or disturbing, just keep speaking. We will tape record your speech, but only the experimenter will listen to this tape after the experiment has finished. The experimenter will sit in the adjacent room and the door will be shut, so he will not be able to hear what you are saying at the time. Remember to try to keep speaking out loud all of the time to indicate what is going through your mind. If nothing comes to mind, just stop speaking and wait. When something else comes to mind starts speaking about this. Try not to move too much during the task. Let the experimenter know when you are ready to begin a one-minute practice of speaking your stream of consciousness out loud.
Appendices

Appendix 7: Images Selected from the IAPS for the Picture Task

Fear 1  Fear 5

Fear 2  Fear 6

Fear 3  Fear 7

Fear 4  Fear 8
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Happy 5

Happy 6

Happy 7

Happy 8

Happy 9

Happy 10

Disgust 1

Disgust 2

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Neutral 1

Neutral 2

Neutral 3

Neutral 4

Neutral 5

Neutral 6

Neutral 7

Neutral 8
Appendices

Neutral 9

Neutral 10
Appendices

Appendix 8: Instructions for Affective Picture Task

In this task we are interested in how people respond to pictures that represent different events that occur in life. You will be asked to look at photographs on the computer screen and rate how they make you feel. There are no right and wrong answers and we would like you to be as honest as possible. We will give you no particular instructions about how we would like you to control your emotions - please just view the images as you normally would. We are interested in how you actually feel, rather than how you think you should feel. Some of the pictures may be upsetting, similar to images you may see in television news broadcasts. We will ask you to rate how you feel using the same scales as in the video task. Please remember to rate all emotions on each of the sliders. After you have rated the picture, there will be a break of a number of seconds before the next picture is shown. We will begin with three practice trials. Please click the button when you are ready to start.
### Appendix 9: The Intrusion Diary

<table>
<thead>
<tr>
<th>TIME OF DAY</th>
<th>TOTAL NUMBER of intrusions (please write a number for each intrusion you have for that time period; if no intrusions please put a 0 in the box)</th>
<th>Was the intrusion as IMAGE (I) THOUGHT (T) or BOTH (IT)</th>
<th>CONTENT: please describe briefly the content of each intrusion</th>
<th>How DISTRESSED were you by the intrusion (0 = not at all to 100 = extremely)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning</td>
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</tr>
<tr>
<td>Afternoon</td>
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</tr>
<tr>
<td>Evening</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Please try to keep this daily diary as it is vital for the experiment. THANK YOU)

Volunteer Number: Day of Week: Date: 169
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Instructions for Intrusions Diary

Volunteer Number
Date
Experimenter and their contact details: e-mail barney.dunn@mrc-cbu.cam.ac.uk

An important part of the experiment is measuring whether people’s memory is influenced by how they control their emotions when they view traumatic material. To assess this we would like you to complete a daily diary saying whether you have experienced any spontaneously occurring intrusions about the road traffic accident film you have just watched. By ‘intrusions’ I mean memories (thoughts or images) of the video that suddenly pop into your mind spontaneously. I do not mean times when you deliberately think about it or mull it over in the diary. Please carry the diary around with you, and if you notice yourself having an intrusion about the film please fill it in. If you forget or are too busy at that time, please try and fill it in as soon as possible afterwards.

The diary is divided into four periods: morning (when you wake to 12), afternoon (12 – 6pm), evening (6pm – when you go to bed), and night (when you go to bed till you wake). Please fill in for each time period for each day. In Column 1 indicate what number intrusion it is for that time period. In Column 2 please say whether it was a thought (words in your mind), an image (a picture in your mind), or a combination of the two. In Column 3 very briefly describe the content of the intrusion (for example, a fire engine driving up the road). In Column 4 rate how distressing the intrusion was, ranging from 1 not at all distressing to 100 very distressing. This process should take no more than a minute to complete for each intrusion. If you do not have any intrusions during a time period, please place a 0 in the column. Please use one diary sheet per day. If you cannot fit all the intrusions for one time of day into the space provided, please continue on another sheet. On the back of this sheet is an example of a completed diary for one day to help clarify the process.
Appendices

Appendix 10: Memory Questionnaires

a) Cued Recall Memory Test

Please answer these questions about the film you watched last week.
The questions are difficult so don’t worry if you’re not sure, just put down your best guess.

1. What colour was the car that was on fire in a field, by a tree, at the beginning of the first scene?
2. What part of a body did you see sticking out of the upside down car in the first scene?
3. What was in the blanket that the man wearing the cap and long coat was carrying at the end of the first scene?
4. What colour was the t-shirt worn by the middle-aged woman trapped in the mini-bus in scene two?
5. When the woman was finally cut out of the mini-bus and placed on a stretcher, which parts of her body was/were cut and bleeding in scene two?
6. In scene two, once they got the man out of the car onto the stretcher, what did they do to him?
7. What part of the injured man’s body was zoomed in on in scene two?
8. In scene three, a body was still in a car covered by a stripy blanket. What body part did you see hanging out from under the blanket?
9. What kind of vehicle had the mangled car from the above question crashed into?
10. In scene four, what colour was the car that had its roof cut off in order to remove the dead?
11. How many doctors in white coats were shown at the scene of the accident in scene four?
12. How many people were put in coffins in scene four?
13. In the final scene, what was the female student receiving medical attention wearing?
14. In the final scene, what part of the female student’s body was bandaged by the paramedics?
15. Can you remember any other medical procedures that were performed on the injured girl?
Appendices

b) Recognition Memory Test

For each statement indicate whether you believe the event occurred in the film by answering Yes or No.

Scene 1
a) The baby in the blanket is passed to a paramedic and placed in an ambulance.

b) An upside down car is focused on and a paramedic manipulates a naked leg which is sticking out.

c) A team of firemen race to a car that is on fire and spray foam on it in order to quench the flames.

d) A distraught teenager is led away from the scene by a member of the public.

e) Three members of the public help the emergency personnel carry a body to the side of the road.

Scene 2
a) A woman being cut out of a crashed vehicle cries out, and appears to lose consciousness.

b) When the man with the injured leg is on the stretcher the paramedics shine a light into his eyes.

c) A team of firemen attach metal equipment to the front of the minibus to pull the wreckage away from the woman's legs.

d) A policeman stands watching the wreckage whilst making notes on a clipboard.

e) When the man with the injured leg is on the stretcher the paramedics cut his trousers and reveal a bloody wound.

Scene 3
a) A body which had been covered by a blanket inside a wrecked car is removed and placed on the ground. Two blankets are then laid over it.

b) Rescue workers put up a yellow and blue police incident tape in order to keep the crowd back from the scene.

c) Before covering a man's body with a blanket, the fireman closes the man's eyes.

Scene 4
a) Emergency personnel use cutting equipment to remove the body of a man from a beige car who has been crushed in the driver's seat.

b) A fireman struggles to release the trapped woman's seatbelt.

c) A bent car number plate lies on the ground close to the coffin the man is placed in.

d) Two men lift up two bodies and bundle them into metal coffins.

Scene 5
a) A female student is moaning as she is treated in an ambulance. She is naked and electrodes are attached to her chest.

b) A paramedic injects the female student in her right arm, whilst the others attend to her injuries.

c) As her head is bandaged, a relative arrives at the ambulance and is kept to one side by paramedics.
References


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