Controllability and its effect on psychological functioning

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Controllability and its Effect on Psychological Functioning

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This program of research investigated the effect of lacking control over negative situations on psychological functions involved in psychopathology. Controllability over various aversive stimuli was manipulated in healthy student participants. Studies 1 and 2 explored the impact of controllability on autobiographical memory. Study 1 found that lacking perceived control led to the retrieval of more categoric memories. Study 2 confirmed this finding and found that the effect of controllability on retrieval specificity was associated with limited executive resources. Study 3 examined the impact of controllability on future-related cognitive functioning. Participants who were led to believe they had no control subsequently imagined future events that were characterised by themes of impoverished mastery. These participants also demonstrated impaired social problem-solving. Studies 4-6 investigated the impact of controllability on distress tolerance. Study 4 found no effect of controllability on the ability to tolerate subsequent physical distress assessed by a cold pressor task. In Study 5, participants who did not previously have control subsequently reported a greater increase in anxiety following a secondary cognitively distressing task. However, this did not translate to a higher tendency to terminate the task earlier. Study 6 showed that lacking control led to more avoidance in response to a subsequent emotionally distressing task. Study 7 investigated the effect of lacking and losing control on hypervigilance. Unexpectedly, attentional and interpretation bias towards threat remained unaffected by the manipulation of controllability. Finally, Study 8 examined the effect of lacking and losing control on a physiological index of emotion regulation, heart rate variability. Participants who had lost control during the aversive stimulation exhibited a greater decrease in heart rate variability during the recovery period from the stressing task, reflecting poorer emotion regulation. No difference was found between participants who kept control the whole time and those who never had control. Overall, this program of research provides experimental evidence for the critical role of stressor controllability on different cognitive, emotional, behavioural, and physiological processes, and in doing so sheds light on a critical determinant on some of the core mechanisms implicated in traumatic stress.

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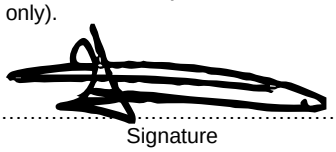

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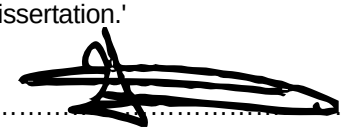
Signed 

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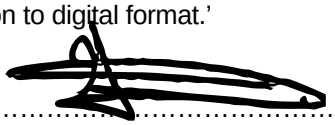
Signed 

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ABSTRACT

This program of research investigated the effect of lacking control over negative situations on psychological functions involved in psychopathology. Controllability over various aversive stimuli was manipulated in healthy student participants. Studies 1 and 2 explored the impact of controllability on autobiographical memory. Study 1 found that lacking perceived control led to the retrieval of more categoric memories. Study 2 confirmed this finding and found that the effect of controllability on retrieval specificity was associated with limited executive resources. Study 3 examined the impact of controllability on future-related cognitive functioning. Participants who were led to believe they had no control subsequently imagined future events that were characterised by themes of impoverished mastery. These participants also demonstrated impaired social problem-solving. Studies 4-6 investigated the impact of controllability on distress tolerance. Study 4 found no effect of controllability on the ability to tolerate subsequent physical distress assessed by a cold pressor task. In Study 5, participants who did not previously have control subsequently reported a greater increase in anxiety following a secondary cognitively distressing task. However, this did not translate to a higher tendency to terminate the task earlier. Study 6 showed that lacking control led to more avoidance in response to a subsequent emotionally distressing task. Study 7 investigated the effect of lacking and losing control on hypervigilance. Unexpectedly, attentional and interpretation bias towards threat remained unaffected by the manipulation of controllability. Finally, Study 8 examined the effect of lacking and losing control on a physiological index of emotion regulation, heart rate variability. Participants who had lost control during the aversive stimulation exhibited a greater decrease in heart rate variability during the recovery period from the stressing task, reflecting poorer emotion

regulation. No difference was found between participants who kept control the whole time and those who never had control. Overall, this program of research provides experimental evidence for the critical role of stressor controllability on different cognitive, emotional, behavioural, and physiological processes, and in doing so sheds light on a critical determinant on some of the core mechanisms implicated in traumatic stress.

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List of Abbreviations

AMS	Autobiographical Memory Specificity
AMT	Autobiographical Memory Test
CPT	Cold-Pressor Task
CVC	Cardiac Vagal Control
DASS-21	Depression Anxiety Stress Scales – Short Form
DRN	Dorsal Raphae Nucleus
FIT	Future Imagining Task
HF	High Frequency Power (Hrv)
HRV	Heart Rate Variability
IAPS	International Affective Picture System
LH	Learned Helplessness
MEPS	Means-Ends Problem Solving Task
NGSE	New General Self-Efficacy Scale
OGM	Overgeneral Memories
PASAT-C	Modified Computer Version Of The Paced Auditory Serial Auditory Test
PTSD	Posttraumatic Stress Disorder
RMSSD	Square Root Of The Mean Squared Difference Of Successive RR Intervals (HRV)
RSA	Respiratory Sinus Arrhythmia
SPS	Social Problem Solving
vmPFC	Ventromedial Prefrontal Cortex

Chapter 1: General Introduction

Control and Psychopathology

Control is a complex and multidimensional construct that has spawned a large body of research in psychology since the end of the 1950s. Several theories of control and control-related constructs have been developed, acknowledging that the ability to feel in control over emotions, behaviours and cognitions is an essential element of mental and physical health across the lifespan (Shapiro, Schwartz, & Astin, 1996). One dimension of control that is suggested to be particularly of interest in psychopathology is the perception that one lacks control over negative events and emotional experiences (Weems & Silverman, 2006).

Research has shown that a diminished sense of control is associated with the experience of negative emotion and mood disorders. Numerous theories posit that a lack of perceived control is central in the aetiology of depression (Abramson, Seligman, & Teasdale, 1978) and anxiety (Barlow, 1991). For example, early experiences of a lack of control over aversive events have been hypothesised to contribute to the formation of a cognitive vulnerability which mediates the relation between aversive events and anxiety later in life (Chorpita & Barlow, 1998). Consistent with these proposals, a diminished sense of control has been associated with depression (Brown & Siegel, 1988) and various anxiety disorders, including Generalised Anxiety Disorder (Craske, Rapee, Jackel, & Barlow, 1989), Obsessive-Compulsive Disorder (McLaren & Crowe, 2003), Panic Disorder (Sanderson, Rapee, & Barlow, 1989) and Posttraumatic Stress Disorder (PTSD; e.g. Dunmore, Clark, & Ehlers, 1999).

Three main theoretical perspectives have attempted to explain the observed links between diminished sense of control and impaired subsequent functioning: locus of control (Rotter, 1966), self-efficacy (Bandura, 1982), and learned helplessness (LH;

Seligman, 1975). These theories tend to have more in common than they are different, and most experimental work has been conducted within the framework of LH. Moreover, LH has formed the basis of much work on the aetiology and maintenance of psychological disorders, such as depression. Accordingly, this thesis now turns to briefly review the history of LH as the formative background to the study of the effects of impoverished control.

History of Learned Helplessness

The phenomenon of LH was discovered by accident in the mid-1960's by researchers who were studying the mechanisms of avoidance learning in dogs. Overmier and Leaf (1965) exposed dogs to a Pavlovian fear conditioning procedure in which a tone was paired with a subsequent electrical shock to the foot; however, no response made by the dogs could stop the shock. Unexpectedly, Overmier and Leaf found that the dogs subsequently failed to learn avoiding the shocks and instead, were passively accepting them. In a series of subsequent experiments, Overmier and Seligman (1967) isolated the observed effect to a lack of motivation in the dogs during the escape/avoidance training. This led them to propose that the interference observed in dogs exposed to inescapable shocks could be due to a learned 'helplessness' and suggested that the degree of control the dog was allowed over a shock was responsible for the interference phenomenon.

This hypothesis was investigated by Seligman and Maier (1967), who placed three groups of dogs in a hammock with panels on both sides of their heads. Dogs in the escapable shock condition could terminate the shock by pressing either side of the panel with their head, whereas another group had no means to control the shock. Their exposure to shock was however 'yoked' to the dogs in the escapable shocks such that when a dog in the escapable shocks terminated the shock, it would terminate it as well

for the matched dog in the inescapable shocks group, resulting in both groups being exposed to the shocks for the same duration. A third group served as controls and were not exposed to any shocks. Subsequent escape learning was severely impaired for the inescapable shocks group but not for the escapable shocks group, which performed identically to the control group. This confirmed that it was the uncontrollability of the shocks that led to later interference in escape/avoidance learning.

Animal Studies of Uncontrollability

Following these original experiments, hundreds of experiments on LH in animals have shown that the effect is not limited to the use of a shock as a stressor, and leads to impairments in a wide range of behaviours. These experiments are usually conducted in rats and tend to follow a similar procedure, using the same triadic yoking design as the one used in the original studies of LH. The rats in the escapable shocks and inescapable shocks groups are first exposed to a series of aversive stimuli (e.g. electric shocks), while the naïve/control group is placed in a comparable situation without receiving any stimuli. All animals are then tested on a subsequent task assessing a specific behaviour.

Impact of Uncontrollability on Behavioural and Physiological Responses

A wide range of behaviours has been tested after exposure to inescapable shocks. Results consistently show that experience of uncontrollability impairs subsequent escape response (e.g. de Paula Soares et al., 2011). This deficit is present even when the task requires the animal to choose the correct response on every trial, showing that uncontrollability interferes with the learning of the association between a behaviour and shock termination (Jackson, Alexander, & Maier, 1980). Exposure to inescapable shocks also leads to deficits in avoidant behaviours (Overmier, 1968), reduced activity in the presence of shocks (Drugan & Maier, 1982), increased analgesia

when exposed to subsequent shocks (Jackson, Maier, & Coon, 1979), decreased shock-induced fighting (Maier, Anderson, & Lieberman, 1972), reduced aggressive and increased defensive behaviours (Williams, 1982), decreased water and food intake and the development of stress ulcers (Weiss, 1968). Studies also show that exposure to escapable shocks has an immunizing effect and blocks the negative behavioural effects of subsequent exposure to inescapable shocks (e.g. Amat, Aleksejev, Paul, Watkins, & Maier, 2010; Williams & Maier, 1977). Similarly, training a rat to exercise control after having been exposed to inescapable shocks has a beneficial effect and prevents deficits in safety behaviours (Williams & Maier, 1977). Recent research has shown that rats exposed to escapable shocks demonstrated less freezing during a subsequent fear conditioning task than control rats which had not been previously exposed to any shocks suggesting that experiencing control has a protective effect (Baratta et al., 2007).

Neurobiological Model of Uncontrollability

Many studies have focused on the neurobiological mechanisms of LH. On the basis that the behaviours impaired by uncontrollability reflect an increase in anxiety and deficits in the fight/flight response, studies focused more specifically on the serotonin neurons within the dorsal raphae nucleus (DRN), as previous research had shown that their stimulation produced a similar pattern of behaviour (Graeff, Guimarães, De Andrade, & Deakin, 1996). Grahn et al. (1999) showed that inescapable shocks led to a greater activation of the Serotonin neurons within the DRN than escapable shocks. However, this effect only lasted for a few hours and could not explain the impairments observed 24 hours after exposure to inescapable shocks. This was interpreted to mean that being exposed to an uncontrollable negative stimulus sensitizes Serotonin neurons in the DRN, and accordingly subsequent exposure to a stressful task leads to exaggerated releases of Serotonin in the projected regions that are involved in the

observed behavioural changes. Indeed, when rats received two brief shocks 24 hours after exposure to inescapable shocks, escapable shocks or no shock, only those which received inescapable shocks demonstrated a large increase in extra-cellular levels of Serotonin in the amygdala (Amat, Matus-Amat, Watkins, & Maier, 1998). Further, the consequences of experiencing uncontrollability are blocked when the DRN is lesioned (Maier et al., 1993) or pharmacologically inactivated (Christianson et al., 2008; Maier, Grahn, & Watkins, 1995).

It would seem from animal models that the DRN detects the amount of control the organism experiences. However, the DRN does not receive the input necessary to perform this kind of operation, suggesting that another structure is involved in the detection of the organism's degree of control. This structure was identified as the ventromedial prefrontal cortex (vmPFC). It appears that when the organism has control over the negative stimulation, it is detected by the vmPFC which is then activated and inhibits the DRN serotoninergic activity (e.g. Christianson, Thompson, Watkins, & Maier, 2009; Jankowski & Sesack, 2004). When the animal has no control over an aversive stimulation, the DRN is activated and this sensitizes the Serotonin neurons projecting to brain regions involved in anxiety and impaired fight/flight response. As a result of this sensitization, subsequent exposure to another stressor produces excessive release of Serotonin, leading to the deficits typical of the LH effect.

Human Studies of Uncontrollability

The first studies aimed to replicate animal studies of LH in humans showed similar results. However, due to the complexity of human behaviours, the applicability of the LH hypothesis at the human level was more difficult to formulate. The theory was reformulated and the importance of the causal attribution made by a person when faced with an uncontrollable stressor was recognised as a key component of the LH

phenomenon in humans (Abramson et al., 1978). Interest in the applicability of the LH theory in humans grew as similarities were noted between the reactions observed in animals which had developed LH and the symptoms observed in depression (Seligman, 1974). This led to the suggestion that LH was an animal model of depression and as such could be used to further the understanding of this disorder. Later, LH was applied toward the explanation of anxiety disorders, and more specifically to PTSD (Foa, Zinbarg, & Rothbaum, 1992).

In an early study, Glass, Singer, and Friedman (1969) showed that participants exposed to uncontrollable aversive noise exhibited an impaired performance on a proofreading task, decreased tolerance to frustration and evaluated the noise as more aversive than did participants with control. Similarly, participants believing they could shorten the length of electric shocks by pressing a button, exhibited less reactivity to the shocks and were less aroused during the task than participants led to believe they had no control over the duration of the shocks (Geer, Davison, & Gatchel, 1970). Lacking control over aversive stimulation has also been shown to lead to a more painful subjective experience of the shocks, to impaired performance on a subsequent cognitive task (e.g. Stroop task) (Glass et al., 1973), and to increases in the participants' anxiety during exposure to shocks (Szpiler & Epstein, 1976).

A recent study showed that when participants were led to believe they had no control over the termination of shocks, they subsequently exhibited an increased level of glutamate in the vmPFC compared to baseline levels (Bryant, Felmingham, Das, & Malhi, 2014). This increase was not observed in participants who believed they had control over the shocks. Lack of control also led participants to demonstrate lower levels of distress tolerance than those observed in participants believing they had control.

Studies have also used administration of unsolvable cognitive tasks to induce a sense of uncontrollability in participants. Using this paradigm, it has been found that experience of uncontrollability subsequently leads to deficits in an escape task and an anagram solving task (Hiroto & Seligman, 1975), to higher self-reported levels of sadness (Klein, Fencil-Morse, & Seligman, 1976) and to more negative ratings of emotionally ambiguous pictures (Cemalcilar, Canbeyli, & Sunar, 2003). Controllability has also been shown to influence strategies used to cope with a situation. When a higher sense of control is induced in individuals, they seem to rely less on emotion-coping and more on task-coping, which in turn decreases state anxiety (Endler, Speer, Johnson, & Flett, 2000).

Together, these findings suggest that when humans perceive a stressful stimulus as being uncontrollable, they experience the stimulus as being more aversive and respond with increased physiological arousal, anxiety, distress and cognitive performance impairment, and that these effects seem to implicate the vmPFC activity.

Controllability and Trauma

Models of PTSD give an important role to control in the development and maintenance of the disorder. Noting that the deficits observed in animals exposed to inescapable shocks are similar to the symptoms present in PTSD, Foa et al. (1992) proposed that LH could be considered as an animal model of this disorder. They hypothesised that all other factors being equal, a more uncontrollable trauma would be more likely to lead to the development of PTSD, although they emphasised that it was the perception the individual had of the controllability of the stressor that was critical.

The interest in the impact of perceived controllability over subsequent psychological disturbances has led to a large amount of research in a wide range of trauma-affected populations. A study conducted in survivors of sexual assault found

that compared to participants who did not develop PTSD, those who developed PTSD were more likely to report having experienced the assault as uncontrollable (Dunmore et al., 1999). Basoglu and colleagues have demonstrated that uncontrollability of the trauma was strongly associated with PTSD and depression symptoms in survivors of war (Basoglu et al., 2005), earthquake (Başoglu, Kılıç, Şalcıoglu, & Livanou, 2004), and torture (Basoglu et al., 1997).

Ehlers and Clark (2000) suggested that perception of uncontrollability during a trauma might become generalised. Some evidence for this hypothesis comes from studies showing that compared to a control population, individuals who have been exposed to a traumatic event report lower levels of general perceived controllability (e.g. Mellon, Papanikolau, & Prodromitis, 2009) which is then associated with higher levels of pathology. However some studies also support the hypothesis that prior experience of controllability has an immunizing effect (e.g. Basoglu et al., 1997). The two hypotheses should not be considered mutually exclusive. Some theories suggest that prior experience of control would protect the individual against the deleterious effect of an uncontrollable event happening in a different context. However, it would become pathogenic when the trauma happens in a situation similar to one where control was previously held (Foa et al., 1992; Mineka & Kihlstrom, 1978).

Finally, some research has focused on coping self-efficacy, a concept rooted in Bandura's social cognitive theory (Bandura, 1997), which refers to an individual's belief in their ability to manage psychological and environmental events after a trauma. Studies have been conducted following various traumatic experiences and consistently show that low coping self-efficacy is associated with more severe symptomatology and predicts post-traumatic distress in the short and long term (Benight et al., 2000; Cieslak, Benight, & Caden Lehman, 2008).

Despite the extensive research on controllability and trauma, studies have focused only on general symptomatology and relied on cross-sectional and longitudinal designs which preclude firm causal conclusions. There is a need for experimental studies examining the impact of perceived uncontrollability on cognitive functions that are known to be involved in the development and maintenance of disorders in which lack of control has been shown to play a key role, such as PTSD and depression. This would allow for a better understanding of how uncontrollability leads to more severe symptomatology. This chapter now turns to a description of cognitive functions that might be sensitive to the experience of uncontrollability over negative events.

Cognitive Functions Potentially Impacted by Uncontrollability

The cognitive functions described in this section do not represent an exhaustive list. Rather, their selection was driven by the fact that these cognitive processes have been identified in naturalistic settings in disorders characterised by the experience of lack of control. Thus, the following functions were selected to understand the causal relationship between uncontrollability and these functions.

Autobiographical Memory Specificity

Autobiographical memory specificity (AMS) refers to the ability to recall a personally experienced event that lasted for less than one day and that occurred at a specific time and place. Research shows that people with suicidal ideation (e.g. Williams & Broadbent, 1986), depression (e.g. Williams & Dritschel, 1992), PTSD (e.g. McNally, Lasko, Macklin, & Pitman, 1995), acute stress disorder (e.g. Harvey, Bryant, & Dang, 1998), and complicated grief (e.g. Maccallum & Bryant, 2010a) display impaired retrieval of specific memories. Instead, they retrieve overgeneral memories (OGM) which can be differentiated in categoric memories (referring to a whole class of events) and extended memories (referring to an extended period of time) (Williams &

Dritschel, 1992). Understanding AMS deficits is of particular importance because it is associated with impaired problem-solving (Raes et al., 2005b), problems in imagining future events (Williams et al., 1996) and delayed recovery from affective disorders (Dalgleish, Spinks, Yiend, & Kuyken, 2001). It has also been shown to be a risk factor for developing PTSD following a traumatic event (Bryant, Sutherland, & Guthrie, 2007).

Conway and Pleydell-Pearce (2000) proposed that autobiographical memory is organised hierarchically and that the retrieval of a specific memory is a staged process of progressive elaboration. A search criteria first activates the higher levels of the autobiographical knowledge through verbal associations. This results in the generation of a general description (i.e. abstract, conceptual summaries of past experiences). The activation then spreads through the lower structures of the knowledge where more concrete aspects of related events are located. OGM occur when individuals interrupt their search too early during the process, when only general descriptive information has been activated and accessed.

CaR-FA-X Model

Building on this model, Williams et al. (2007) developed their CaR-FA-X model. They suggested three mechanisms - capture and rumination (CaR), functional avoidance (FA) and impaired executive control (X) – which either alone, or in combination, are responsible for this premature interruption of the specific retrieval process.

Williams and colleagues suggested that depressed individuals were “captured” during the early stages of the retrieval process by ruminative processes. During the search for a specific memory, conceptual information related to self-representation or personal concerns can be activated. This activation is more likely to occur if this

information is elaborated, as is the case in individuals suffering from emotional disorders. If the individual is prone to a ruminative thinking style, he/she will process these self-representations iteratively resulting in difficulties in progressing further down the autobiographical memory hierarchy to access a specific memory. Accordingly, studies have shown that experimentally inducing a ruminative style led to higher levels of categorical retrieval (e.g. Sutherland & Bryant, 2007; Watkins & Teasdale, 2001). It has also been found that self-relevant cues, as evaluated by the participant, produced more categoric memories compared than non-self-relevant cues (e.g. Crane, Barnhofer, Mark, & Williams, 2007) .

The functional avoidance component of the CaR-FA-X model suggests that individuals with traumatic experiences or affective disorders learn to interrupt their progression down the hierarchy since a specific memory is more likely to produce affective disturbance than a general memory. As this leads to the absence of emotional disturbance, it is negatively reinforced and eventually leads to a tendency to retrieve OGM in the future. Thus overgeneral memory is here considered as a cognitive avoidance strategy serving an affect-regulation function. Consistent with this suggestion, avoidance strategies have been found to be positively correlated with higher levels of OGM in PTSD sufferers (e.g. Schonfeld & Ehlers, 2006). Similarly, healthy controls with a higher levels of cognitive avoidant coping style have been shown to exhibit a larger increase of categoric memories retrieved following exposure to a stressor (Debeer et al., 2012)

The third mechanism hypothesised to be responsible for an overgeneral retrieval style is an executive control impairment. The retrieval of a specific memory is an effortful process requiring the use of cognitive resources. Deficits in processing capacities control may affect the voluntary (as opposed to spontaneous) retrieval

process at different stages by reducing the ability to either hold a retrieval goal in active memory or to inhibit irrelevant autobiographical memory during the search. In line with this suggestion, studies have found that higher levels of categoric memory retrieval was associated with difficulties in tasks assessing various aspects of executive control both in clinical (e.g. Dalgleish et al., 2007) and non-clinical population (Yanes, Roberts, & Carlos, 2008). It has also been shown that after being exposed to a Stroop task depleting their executive resources, individuals retrieved fewer specific memories than participants whose executive resources had not been reduced (Neshat-Doost, Dalgleish, & Golden, 2008).

Future Imagining

Literature suggests that deficits in AMS are associated with difficulties in imagining the future, particularly specific future events. As with deficient AMS, impaired specific future imagining is associated with various psychopathologies (e.g. Maccallum & Bryant, 2011; MacLeod, Tata, Kentish, & Jacobsen, 1997). Future imagining has also been found to serve important functions in healthy controls such as action planning, decision making, emotion regulation and the likelihood to take action (e.g. Brown, Macleod, Tata, & Goddard, 2002; D'Argembeau, Renaud, & Van der Linden, 2011; Libby, Shaeffer, Eibach, & Slemmer, 2007). Thus understanding the factors potentially impacting the simulation of future events is of particular importance and requires empirical investigation.

Similar neural and cognitive mechanisms have been found to underlie memory retrieval and future simulation (e.g. Szpunar, Watson, & McDermott, 2007; see also, Schacter, Addis, & Buckner, 2008). Williams et al. (1996) used a modified version of the AMT to assess future imagining and found that compared to controls, individuals recovering from a suicide attempt recalled fewer specific memories and more general

future events. The performance on both the AMT and the Future Imagining Task (FIT) was also correlated. These findings have been replicated in people with dysphoria (Dickson & Bates, 2006), PTSD (Brown et al., 2013; Kleim, Graham, Fihosy, Stott, & Ehlers, 2014), complicated grief (Maccallum & Bryant, 2011) and schizophrenia (D'Argembeau, Raffard, & Van der Linden, 2008). Inducing general autobiographical memory retrieval in healthy participants leads to more general future events, which suggests that reduced specificity in future thinking may be a function of impaired AMS (Williams et al., 1996). In a study asking participants to verbalise their thought process during retrieval of specific autobiographical memories and imagination of specific future events, D'Argembeau and Mathy (2011) found that both processes activated a general description before producing a specific event. In line with these suggestions, Schacter and Addis (2007) proposed that to generate future events, individuals draw on details from past experiences stored in autobiographical memory and flexibly recombine them into a novel event that is consistent with their goals.

Social Problem Solving

Social problem solving (SPS) refers to the cognitive-behavioural process by which an individual seeks to solve effectively every day interpersonal and intrapersonal problematic situations. As such, it is a conscious and effortful process that aims to improve a problematic situation and/or remove the distress associated with it and is a core component of healthy psychological functioning (D'Zurilla, Nezu, & Maydeu-Olivares, 2004). Deficits in SPS have been identified in parasuicidal patients (Evans, Williams, O'Loughlin, & Howells, 1992), individuals with depression (e.g. Goddard, Dritschel, & Burton, 1996, 2001), PTSD (Sutherland & Bryant, 2008) and complicated grief (Maccallum & Bryant, 2010b).

Research has shown that impaired SPS is negatively associated with AMS. This led to the suggestion that effective SPS depends on specific autobiographical memory retrieval. Experimental studies lend support to this hypothesis. Eade et al. (2006) experimentally induced a more or less specific autobiographical memory retrieval style in healthy students and found that this subsequently led to an improved or reduced SPS performance, respectively. AMS is thought to facilitate effective problem solving by enhancing the access to past experiences of successful solving strategies which allow for the generation of more concrete and effective strategies that serve as a guide to solve new problems (Beaman, Pushkar, Etezadi, Bye, & Conway, 2007; Goddard et al., 2001). Poor SPS skills have also been linked to rumination (e.g. Watkins & Moulds, 2005) and it has been suggested that OGM might mediate the impact of rumination on problem-solving effectiveness (Raes et al., 2005b).

Distress Tolerance and Behavioural Avoidance

Distress tolerance can be defined as the ability to tolerate the experience of negative emotional and physical states (Simons & Gaher, 2005). Individuals with low distress tolerance respond maladaptively to distress, and exhibit a tendency to avoid aversive states by using a range of avoidance strategies. Low distress tolerance has been involved in a wide range of psychological disorders such as substance use (e.g. Buckner, Keough, & Schmidt, 2007), borderline personality disorders (e.g. Bornovalova, Gratz, Daughters, Hunt, & Lejuez, 2012), PTSD (e.g. Berenz, Vujanovic, Coffey, & Zvolensky, 2012; Vujanovic, Bonn-Miller, Potter, Marshall, & Zvolensky, 2011), and depression (e.g. Ellis, Vanderlind, & Beevers, 2012).

As individuals with low distress tolerance are unable to withstand negative emotional and physical states, they are more motivated to use avoidance coping strategies. This includes the use of avoidance behaviours to cope with the distress

elicited by negative situations (Fetzner, Peluso, & Asmundson, 2014). Avoidance behaviours have been shown to mediate the effect of traumatic events on later depression and anxiety (Dulin & Passmore, 2010) and to be positively related to psychological symptoms in soldiers (Riolli & Savicki, 2010). Behavioural avoidance has also been found to be associated with depression independently of anxiety levels (Moulds, Kandris, Starr, & Wong, 2007).

Low distress tolerance and the resultant behavioural avoidance strategies have been hypothesised to be risk factors in trauma-related pathologies (Vujanovic et al., 2011). Yet research examining the factors related to the experience of a traumatic event, such as perceived controllability, that might contribute to enhance the ability to tolerate subsequent distress and reduce the associated behavioural avoidance is lacking and thus requires further investigation.

Hypervigilance to Threat

Anxiety is characterised by constant hypervigilance for threat, including PTSD (e.g. Dalgleish, Moradi, Taghavi, Neshat-Doost, & Yule, 2001; Williams, Watts, MacLeod, & Mathews, 1997). Hypervigilance serves to ensure that the organism is alert and to facilitate the detection of a threat that might endanger survival (Dolan & Vuilleumier, 2003). In anxious individuals, this leads to the constant allocation of attentional resources towards monitoring the environment for potential threats which enhance their detection, including in non-threatening contexts. (Eysenck, 1992; Eysenck, Derakshan, Santos, & Calvo, 2007). Thus hypervigilance in anxiety and PTSD results in an attentional bias towards threat characterised by a faster detection of, and difficulties disengaging from threat stimuli (e.g Bryant, Harvey, Gordon, & Barry, 1995). This has received large empirical support. One meta-analysis showed that attentional bias had been demonstrated in populations diagnosed with various anxiety

disorders, using different paradigms (e.g. dot-probe task, emotional Stroop task, eye-tracking) (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg, & van Ijzendoorn, 2007). Similarly, it has consistently been shown that individuals who developed PTSD after experiencing various types of trauma exhibit an attentional bias towards trauma-related threat stimuli (see Buckley, Blanchard, & Neill, 2000 for a review).

Anxious individuals also exhibit a tendency to interpret ambiguous situations as threatening (e.g. MacLeod & Cohen, 1993). This leads individuals to perceive threat when there is none, increasing arousal which in turn enhances attentional bias towards threat (e.g. Chemtob, Roitblat, Hamada, Carlson, & Twentyman, 1988). Thus interpretation biases are thought to be involved in the development and maintenance of hypervigilance. Studies have shown that experimentally inducing an interpretation bias in individuals subsequently leads to more anxiety (Mathews & Mackintosh, 2000). Although less investigated than the attentional bias towards threat, research demonstrate that individuals with PTSD make more threatening interpretation of ambiguous stimuli (e.g. Elwood, Williams, Olatunji, & Lohr, 2007; Kimble et al., 2002).

Threatening and traumatic events are typically characterised by loss of control, and so interpreting the environment as being uncontrollable may enhance hypervigilance. Thus the impact of uncontrollability over a stressor on hypervigilance warrants investigation.

Emotion Regulation

Emotion Regulation has been suggested to be a transdiagnostic process involved in many types of psychopathology. Emotion regulation refers to the extrinsic and intrinsic processes responsible for modulating the experiential, behavioural and physiological reactions to an emotional situation (Gross, 1998; Thompson, 1994). Adaptive emotion regulation skills are flexible, context-specific and consistent with

one's long-term goals (Gratz & Roemer, 2004). Deficits in emotion regulation stem from the use of maladaptive strategies that do not produce the desired emotional outcome and from the implementation of these strategies in a rigid way that do not take the context into account (Werner & Gross, 2010). This leads to negative long-term consequences. Difficulties in emotion regulation are strongly correlated with poor mental health (Gross & Muñoz, 1995). For example, emotion regulation deficits have been observed in PTSD (e.g. Kulkarni, Pole, & Timko, 2013) and MDD (e.g. Berking, Wirtz, Svaldi, & Hofmann, 2014). Research also suggests that emotion regulation skills training during therapy leads to improvement in emotion regulation and that this is associated with a reduction of symptom severity (Radkovsky, McArdle, Bockting, & Berking, 2014).

One psychophysiological index of emotion regulation is cardiac vagal control (CVC), which has been suggested to reflect the activity of the vagus nerve, one of the main components of the parasympathetic nervous system. The polyvagal theory (Porges, 1995, 2001) provides an account of the adaptive and functional role of CVC. The theory posits that the autonomic nervous system (ANS) contains three neural circuits which developed at different times of the mammalian evolution and are hierarchically organised. The unmyelinated vagus was the first to be acquired and allows for immobilization of the organism in the face of danger. The sympathetic response circuit was then acquired and is the system supporting the fight or flight response by mobilizing energy or arousal. Finally, the most recently acquired circuit was the myelinated vagus. This system actively inhibits the sympathetic nervous system's influence on the heart and dampens HPA axis activity. As such it allows calm behavioural states which are necessary for engaging with the social environment and promotes social communication and behaviours and inhibits arousal. The myelinated

vagus acts as a vagal brake that can calm or mobilize an individual by rapidly withdrawing or reinstating its inhibitory influence on the heart pacemaker depending on the demands of the situation. This allows individuals to rapidly engage or disengage with their environment. The myelinated vagus also has projections to various visceral organs that are involved in emotion and communication (e.g. facial muscles). According to this theory, CVC plays a critical role in emotional expression and regulation through the flexible inhibition or activation of autonomic arousal.

Lower CVC has been found in individuals with anxiety disorders (see Friedman, 2007), including PTSD (Hauschildt, Peters, Moritz, & Jelinek, 2011). It has also been shown to predict the development and severity of PTSD (Shaikh al arab et al., 2012) and to be associated with higher depression (e.g. Kemp, Quintana, Felmingham, Matthews, & Jelinek, 2012). Stressor controllability may represent one factor that could contribute to the development of impaired CVC, reflecting impoverished emotion regulation skills, and this requires further investigation.

Methodological Issues

Immediate versus Delayed Effect of Controllability

One characteristic of the LH phenomenon is the delayed effect of exposure to inescapable shocks. Animal research paradigms use a 24-hour interval between the manipulation (i.e. exposure to inescapable shocks/escapable shocks) and the test phase (i.e. assessment of a target behaviour). Studies manipulating controllability over a stressor have looked at both the immediate and delayed impact on different variables. For example, research has studied the physiological and subjective reactions *during* the control manipulation task (e.g. Szpiler & Epstein, 1976), showing that uncontrollable stimuli are experienced as being more aversive and lead to increased anxiety. However, the main focus in human studies has been, like in animal studies, on the delayed impact

of uncontrollability. Maier and Watkins (1998) proposed that experiencing a stressor as uncontrollable sensitizes the neural circuit underlying fear and suggesting that the impact of uncontrollability is delayed. In line with this hypothesis, Glass et al. (1969) found no difference in the performance of students who had control or no over the termination of aversive noise on cognitive tasks administered during the exposure to the noises.

From a theoretical and clinical point of view, the experience of a traumatic or aversive event is a short lived phenomenon. Thus although it is informative to identify the immediate effects of such an event, it seems more important to examine the delayed effect on subsequent every day functioning as this is likely to influence the development of potential psychopathology. Accordingly, this program of research will focus mainly on examining the delayed effect of uncontrollability.

Perceived versus Actual Control

Research has emphasised the key role of *perceived* uncontrollability of a negative event in psychopathology. Theoretical models suggest that perceived control is more strongly associated with the outcomes than objective (actual) control (e.g. Foa et al., 1992; Weems & Silverman, 2006). Some studies have manipulated perceived control by leading the participants to believe that a specific action would impact the aversive stimulation when in reality it did not (e.g. Sanderson et al., 1989). In other studies, the termination of the stimulus is contingent on the individual's response and thus actual control is manipulated. These studies use yoked designs to ensure that all participants are exposed to stimuli of equal duration (e.g. Glass et al., 1969). The results yielded by manipulation of perceived and actual control are similar.

One study examined the differential contribution of objective and perceived control on subsequent stress (Endler et al., 2000). Results showed that perceived control

was more strongly associated with anxiety than actual control. However, only actual control was manipulated in this study. Perceived control was measured via questions assessing the individual's evaluation of the controllability of the stressor. Hence, perceived control is likely to have resulted from the manipulation of actual control.

Together these studies suggest that, in a laboratory setting, perceived and actual control lead to similar outcomes and that the use of objective control might actually reflect the effect of perceived control. There is a lack of a clear distinction between perceived and actual control in the literature and careful considerations must be taken when designing a study manipulating one of these concepts.

Manipulation of Control

Controllability in human studies can be experimentally manipulated in a number of ways. Some studies have used instrumental designs that are similar to the animal paradigms. That is individuals can either perform an action to terminate the aversive stimuli or they cannot (e.g. Glass et al., 1969). A variation of this manipulation consists in telling participants that they can stop the negative stimulation if their reaction time to perform the action is fast enough while the no-control group is either not given any option to terminate the stimuli (e.g. Glass et al., 1973) or wrongly led to believe that their performance was not fast or accurate enough (e.g. Henderson, Snyder, Gupta, & Banich, 2012). Other studies have used cognitive designs in which uncontrollability is induced by exposing the participants to unsolvable cognitive tasks such as anagram task (Hiroto & Seligman, 1975).

Although these various paradigms all yield a significant deleterious effect of uncontrollability on subsequent tasks, the latter two types of designs might indirectly affect self-efficacy as well by inducing a sense of failure or success in participants. Higher self-efficacy has been shown to be a protective factor against the negative effect

of an aversive stimulus (e.g. Bandura, Reese, & Adams, 1982).Thus the effects observed in these kind of studies might be due not only to uncontrollability but also self-efficacy.

In order to examine the effect of controllability alone, this program of research will manipulate control by using a simple instrumental design in which control is manipulated by giving or not the participants the option to press a key to terminate the aversive stimulus. Levels of self-efficacy will also be indexed by measuring this construct and considering it in analyses.

Measurement of Cognitive Functions

Autobiographical Memory Specificity

Various methods have been used to examine OGM in the literature, including narrative approach such as the life story interview (McAdams, 2008). The gold standard measure predominantly used in studies is a cue word task developed by Williams and Broadbent (1986), the Autobiographical Memory Test (AMT). This task consists of presenting participants with a series of cue words and asking them to retrieve a specific event that each of the cue words reminds them of within a set time. The AMT has been used in a wide range of clinical and non-clinical population and in different age groups. It demonstrates good reliability (Griffith, Kleim, Sumner, & Ehlers, 2012) and has been shown to measure a unidimensional construct of AMS (Griffith et al., 2009).

Future Imagining

Two main types of paradigms have been used to study future imaginings. The first one, the future thinking task (MacLeod & Byrne, 1996), consists in asking participants to generate, in a set time (e.g. 60 seconds), as many positive (i.e. events they look forward to) and negative (i.e. events they do not look forward to) future events as they can.

The second type, the FIT (Williams et al., 1996), is a modified version of the AMT in which individuals are presented with a series of cue words, embedded in a sentence, and are asked to imagine a specific event that might occur in their future. Although the future thinking task allows to measure the amount of future events an individual is able to generate, the FIT presents the advantage of assessing the ability to imagine specific future events which plays a key role in important functions such as decision making and action planning (D'Argembeau et al., 2011).

The FIT has been used across a wide range of clinical conditions and has demonstrated reliable results. Research shows that the performance on the FIT correlates to that on the AMT (e.g. Maccallum & Bryant, 2011) and thus similar methodological considerations as those taken in the AMT must be taken into account when designing the task.

Social Problem Solving

Studies have predominantly relied on the use of the Means-Ends Problem Solving task (MEPS; Platt & Spivack, 1975a) to assess SPS skills. In this task individuals are presented with the beginning of a problematic situation and its conclusion and are asked to outline the strategy the protagonist used to reach their goal. The situations relate to different life areas (e.g. friendship, work, romantic relationships). Responses were originally only coded in terms of number of relevant means generated, that is the number of discrete steps described allowing the individual to reach the stated goal or to overcome obstacles. Marx, Williams, and Claridge (1992) also suggested that the overall effectiveness of the solution was an important criteria to take into account when scoring the solutions. The performance on the MEPS has been associated with difficulties to solve problems in real life and with self-reported

problem-solving abilities (Marx et al., 1992). Studies suggest that the MEPS has a good validity (D'Zurilla & Maydeu-Olivares, 1995).

Distress Tolerance and Behavioural Avoidance

One way distress tolerance has been assessed in the literature is through self-report measures. This approach is limited by potential self-report bias. Thus, behavioural methods have been developed to assess the objective ability to cope with negative states. These consist in exposing individuals to an aversive stimulus eliciting distress and recording the duration of time he or she chooses to terminate the task. The type of stimulus used to elicit distress varies across studies. Some experiments have indexed tolerance of physical distress, using a stressor such as the cold pressor task (CPT) to induce an aversive state. In the CPT, participants are required to put their forearm in icy cold water for as long as they can. The time taken to remove their hands is recorded to evaluate the tolerance levels of the participants. This task has been shown to reliably induce stress in a laboratory and to be a valid measure of distress tolerance (e.g. Burns, Bruehl, & Caceres, 2004). Studies also show that this task is sensitive to experimental manipulations such as induction of a negative mood, suggesting that it does not simply reflect a stable tolerance for pain (e.g. Willoughby, Hailey, Mulkana, & Rowe, 2002)

Other studies have relied on difficult, frustrating cognitive tasks to induce stress and measure the ability to persevere on these tasks to index distress tolerance. For example, in the modified computer version of the Paced Auditory Serial Auditory Test (PASAT-C; Lejuez, Kahler, & Brown, 2003), participants are presented with a series of number on a computer screen and have to continually add the two most recently presented digits by clicking on the correct answer. After an error or no answer, a loud bursting noise is delivered through headphones. The inter-stimulus interval is reduced in

each level making the task increasingly difficult. For the third (last) level, participants are given the option to terminate the task when they want to although they are encouraged to persist for as long as they can. The time taken to quit level 3 is used as an index of psychological distress tolerance. The PASAT-C has been shown to induce stress and negative mood in participants (Holdwick Jr & Wingenfeld, 1999) and thus has been used as a measure of cognitive and emotional distress tolerance in various studies (e.g. Tull, Gratz, Coffey, Weiss, & McDermott, 2013).

Finally, some studies have focused on the ability of individuals to tolerate exposure to stimuli of negative emotional valence such as distressing pictures. The participants are given the choice to move on to the next picture whenever they want and again, the time taken to do so is recorded and used as an index of distress tolerance (Cooper, Miranda, & Mennin, 2013).

These different types of measures are related but are likely to reflect different aspects of distress tolerance (namely tolerance for physical, cognitive and emotional distress). Thus it may be important to include all three types of measures to obtain a comprehensive picture of the impact of one variable on distress tolerance. It is also important to note that behavioural avoidance results from low distress tolerance and as such, these measures can be used to index both these functions.

Hypervigilance

Hypervigilance is one core feature of emotional disturbance in disorders characterised by lack of control. Hypervigilance involves attentional bias towards threat, which can be measured using the dot-probe task, the emotional Stroop task, the emotional spatial cuing task and the visual search task. Although these measures all index the operation of the attentional process they tend to tap into different components of it (Bar-Haim et al., 2007). Some studies suggest that the effect observed in the

Emotional Stroop is likely to be due to a facilitated detection of threat (Peach, Jovev, Foster, & Jackson, 2012) and thus could be a more sensitive measure of hypervigilance. In the Emotional Stroop, participants are presented with threatening and neutral words in different ink colours and are asked to name the colour of the word and ignore its meaning. The rapid allocation of attention to the threatening meaning of the word creates an interference with the task performance leading to slower response times and more errors for threatening compared to neutral words. This interference is thus considered as an index of an attentional bias and more specifically of a facilitated orientation towards threat (i.e. hpervigilance).

Hypervigilance has also been shown to be aggravated by an interpretation bias. One paradigm that assesses the tendency to interpret ambiguous situations as threatening comes from research on cognitive bias modification interventions (Mathews & Mackintosh, 2000). In this task, participants are sequentially presented with scenarios that have an ambiguous ending and are identified by a title. They are then presented with the title of the scenarios accompanied by four recognition statements that have a similar meaning to the original situations but not the exact same wording. Two of these statements represent a positive and negative threatening interpretation of the scenario (targets). The other two statements are foils and relate to the emotional valence of the situation while containing details that were not included in the original scenario. Participants are asked to rate how similar each statement is to the original situation. The foils are included to verify that the bias is an interpretation bias and not a simple valence bias. This measure has been shown to be highly sensitive to interventions aimed at reducing threat interpretation bias and has been validated in various population samples (e.g. Lothmann, Holmes, Chan, & Lau, 2011).

Emotion Regulation

As reviewed above, one physiological index of emotion regulation is CVC. CVC cannot be directly measured but is known to be responsible for the beat-to-beat variation in heart rate. This is due to the respiratory sinus arrhythmia (RSA) which reflects the naturally occurring variations in heart rate during a breathing cycle. As such RSA provides an index of the dynamic influence of the myelinated vagus on the heart. RSA has been shown to be sensitive to experimental manipulation (e.g. Sack, Hopper, & Lamprecht, 2004) providing an index of the physiological reaction to the stimulus. It is possible to measure the variation in the heart rate due to RSA by assessing heart rate variability (HRV).

Greater variability during a breathing cycle related heart period (i.e. higher RSA and HRV) reflects greater CVC and thus indicates a better ability to appropriately and flexibly engage or withdraw CVC's inhibitory influence when faced with environmental demands, allowing rapid engagement or disengagement with the environment. Thus it has been suggested to reflect better emotion regulation and to facilitate psychological functioning. Conversely, low HRV has been suggested to be involved in psychopathology, including anxiety disorders and PTSD (e.g. Friedman, 2007; Hauschildt et al., 2011). Various studies have found that higher resting levels of HRV were associated with better emotion regulation skills (e.g. Thayer & Lane, 2009).

The Program of Research

This chapter has outlined several cognitive functions that contribute to the development and maintenance of trauma related disorders and that might be particularly sensitive to the experience of uncontrollable negative events. Accordingly, the present research experimentally manipulated control over various aversive stimuli across five non-clinical samples to explore the impact on subsequent cognitive functioning. Table

1.1 summarises the eight studies presented in this program of research and the samples on which they were conducted.

Table 1.1

Overview of samples and studies in this program of research

SAMPLE	*SAMPLE SIZE*	*STUDIES*
A	*N*= 40	1 and 4
B	*N*= 32	2 and 5
C	*N*= 39	3
D	*N*= 29	6
E	*N*= 58	7 and 8

Chapter 2 was designed to examine the effect of lack of control on AMS. In Study 1, perceived control over the termination of a negative situation was experimentally manipulated to investigate its impact on retrieval specificity. Study 2 further investigated the relationship between lack of control and AMS by examining whether it could be explained by a diminution of executive resources (Study 2) as this is one of the mechanisms postulated to lead to OGM (Williams et al., 2007). AMS deficits have been related to difficulties in generating specific future events and effectively solve problems in population suffering from trauma pathologies. It is possible that previous experiences with uncontrollability also contributes to the development of such difficulties. Thus Chapter 3 studied the potential deleterious effect of lacking control on the specificity and content of events generated during a FIT and on problem solving performance (Study 3).

It is also important to consider how the perception that life stressors are outside of one's control impacts the ability to cope with further distress as low distress tolerance plays a key role in the development of trauma pathologies. Consequently, Chapter 4

investigated the effect of experimentally manipulating control on subsequent distress tolerance across three studies by examining patterns of behavioural avoidance in response to physical (Study 4), cognitive (Study 5) and emotional (Study 6) distress.

Appraising aversive events as uncontrollable might also lead individuals to be in a constant state of hypervigilance, which is another important variable in the etiology and maintenance of trauma pathology. Accordingly, Chapter 5 examined the impact of manipulating stressor controllability on attentional and interpretation biases towards threatening stimuli (Study 7). Finally, it is important to examine the effect of experiencing negative events as uncontrollable on physiological reactions, such as HRV, as this allows for an objective evaluation of emotion regulation abilities which are a critical risk factor for the development of trauma-related disorders. Consequently, Chapter 6 investigated the effect of manipulating control over an aversive task on the changes in HRV (Study 8). Chapter 5 and 6 also set out to examine the proposition that *losing* control is more pathogenic than *lacking* control (Mineka & Kihlstrom, 1978) by including a third experimental condition (loss of control) across both Study 7 and Study 8. Finally, Chapter 7 reviews the findings of the research and interprets the outcomes in the context of current theories and evidence.

This thesis now turns to present the eight studies that were conducted in this program of research.

Chapter 2: Controllability and Autobiographical Memory Specificity

General Introduction

The literature reviewed in Chapter 1 outlines that difficulties in retrieving specific autobiographical memories are observed in individuals suffering from various emotional disorders, including suicidal ideation (Williams & Broadbent, 1986), Major Depressive Disorder (Williams & Dritschel, 1992), PTSD (McNally et al., 1995) and acute stress disorder (Harvey et al., 1998). Instead these individuals tend to retrieve OGM, particularly categoric memories. This deficit is thought to contribute to the development and maintenance of these disorders (Bryant et al., 2007; Dalgleish, Spinks, et al., 2001) and has been associated with poor psychological outcomes including impaired problem-solving (Raes et al., 2005a), and difficulties in imagining future events (Williams et al., 1996).

According to the dominant explanatory model of AMS (Carfax model; Williams et al., 2007), categoric memories result from three mechanisms acting alone or in combination: a tendency to ruminate which captures individuals at a categoric level of retrieval, an attempt to avoid the negative emotions that might be elicited by a specific memory, and a diminished executive control that impacts the effortful retrieval process of a specific memory preventing the access to a specific memory.

Interestingly, the disorders in which the retrieval of specific autobiographical memories is impaired are also disorders in which lack of perceived controllability over aversive situations has been suggested to play a key role. Indeed, literature suggests that traumatic events perceived as uncontrollable are associated with more severe posttraumatic stress and depressive symptomatology (e.g. Basoglu et al., 2005). Experimental manipulation of controllability has also demonstrated that believing a stressor is uncontrollable subsequently leads to elevated levels of anxiety, sadness and

impaired cognitive performance on subsequent tasks (e.g. Glass, Reim, & Singer, 1971; Klein et al., 1976). Despite these convergent findings, no research to date has directly examined the causal effect of perceived control on subsequent retrieval style of autobiographical memories.

Accordingly, the studies presented in this chapter manipulated perceived control prior to eliciting autobiographical memories to more fully understand the impact of perceived control on autobiographical memory. Study 1 examined the effect of lack of perceived control on retrieval specificity. Study 2 built upon this by exploring one potential mechanism responsible for this effect, namely executive resources impairment.

Study 1: The Effect of Controllability on Autobiographical Memory Specificity

Introduction

As outlined above, the disorders marked by impaired AMS include disorders which are thought to develop as a result of experiencing uncontrollable situations. Yet, there is a lack of experimental studies exploring the causal effect of perceiving an aversive situation as uncontrollable on subsequent autobiographical memory retrieval style. There is preliminary evidence for a relationship between AMS and helplessness, insofar as increasing the specificity of autobiographical memories in depressed individuals during therapy has led to a reduction in the feelings of helplessness and depression (Serrano, Latorre, Gatz, & Montanes, 2004). Accordingly, the present study experimentally manipulated perceived control over a distressing stimulus in a non-clinical sample and examined the impact of this manipulation on subsequent AMS retrieval. The Carfax model posits that OGM can occur as a result of rumination, avoidance, or impaired executive control (Williams et al., 2007). Lacking perceived control can potentially exacerbate each of these factors. Thus, it was hypothesized that

participants who thought they had no control over an aversive situation would recall less specific and more categorical memories than participants who were led to believe they had control over the termination of the situation.

Method

Participants

Sample A was used in this study (see Table 1.1). It comprised 40 undergraduate psychology students who took part in the research in return for course credit (30 females). The mean age of the sample was 19.68 years (*SD*=2.23). Participants were randomly allocated to one of the experimental conditions.

Materials

Depression Anxiety Stress Scales – Short Form (DASS-21; Lovibond & Lovibond, 1995). The DASS-21 is a reliable shortened version of the DASS which contains three 7-item subscales measuring states of depression, anxiety and stress. Participants are asked to rate the degree to which the statements apply to how they have been feeling in the past week on a 4-point scale (see Appendix 2). The DASS-21 has been extensively used in past research and validated in non-clinical sample (Henry & Crawford, 2005).

New General Self-Efficacy Scale (NGSE; Chen, Gully, & Eden, 2001). The NGSE is a reliable and valid measure of general self-efficacy that has been shown to have sound psychometric properties (Chen et al., 2001). It comprises eight items to which participants indicate their degree of agreement on a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*) (See Appendix 3). The NGSE was included to control for levels of self-efficacy, as this individual difference may moderate the effect of perceived control.

Aversive stimuli. Participants were presented with a slideshow of 30 pictures (15 neutral and 15 negative). The negative pictures were selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2008) and depicted scenes of violence and/or injured people (see Appendix 4). The use of negative pictures have been shown to induce distress in participants and has been employed as an analogue of an aversive situation in previous research (e.g. Hagenaars, Stins, & Roelofs, 2012) The order of presentation of the pictures was randomized. Each picture was displayed for 6000ms. The task was programmed using Presentation® software (V 14.9, www.neurobs.com) and presented on a laptop with a 15-inch screen placed in front of the participants.

Autobiographical Memory Test (AMT; Williams & Broadbent, 1986). Participants were presented with five positive (*happy, brave, special, successful, safe*) and five negative (*tense, angry, clumsy, hurt, fear*) cue words and asked to recall a specific autobiographical memory for each word. Participants were explained what a specific event was and examples of acceptable and non-acceptable responses were given (see Appendix 5 for full instructions). Participants were given two practice cue words ("*egg*" and "*music*") to ensure they understood the task. Words were matched for frequency of use and intensity. Participants were presented with one of four alternate word lists in a counterbalanced way. Within each list, the order of presentation of the cue words was randomized. Participants were given 30 seconds to respond to each cue. Each cue word was printed on a white card (15cm x 7cm). If participants did not initially provide a specific memory, they were prompted by the experimenter with "*Can you think of a specific time this happened?"*. If no memory was recalled within 30 seconds, participants were presented with the next word. The responses were audio-recorded.

Procedure

Participants were randomly allocated to one of the conditions upon signing up for one of the experimental sessions. Each session had been randomly assigned an experimental condition using an online random number generator.

Following written informed consent, participants indicated their initial general level of distress by using an 11-point scale (0 = *not distressed at all*, 10 = *extremely distressed*). They were then administered the DASS-21 and the NGSE. Participants were then seated in front of a laptop computer and told they would be presented with a series of pictures on the screen and then to indicate how distressed they were by each picture. Participants in the Controllability condition (C+) were told that if they felt too distressed by some of the pictures, they could press the space bar to indicate that they no longer wish to look at it and that this will start the termination process to move on to the next picture. Participants in the no controllability condition (C-) were told that they were required to watch each picture until the program terminated it and moved on to the next one (for a full description of the instructions, see Appendix 4). In reality, all participants saw the pictures for the same amount of time. After each picture, participants had to rate how distressing they found the picture on a 7-point scale (1 = *Not at all distressing*, 7 = *Extremely distressing*). During the task, the experimenter monitored that the participants did not close their eyes to ensure that they would not avoid watching the negative pictures.

After participants saw all 30 pictures, they were asked to indicate again their general level of distress on the 11-point scale. They were then administered the AMT. Participants were then debriefed and thanked.

Scoring

Audio-recorded responses on the AMT were coded for specificity. A memory was coded as ‘specific’ if it referred to a particular event that took place on a specific day, as ‘categoric’ if it referred to a series of repeated events and as ‘extended’ if it described an event that lasted more than one day. If participants did not recall anything, it was coded as ‘omitted’. Latency to retrieve the memory was scored in seconds. A second independent rater blind to experimental condition and the hypotheses of the study coded 20% of memory responses. The mean interrater reliability coefficient was .71.

Results

Participant characteristics

Table 2.1 presents participants’ characteristics. Independent sample t-tests and chi-square analyses (for gender) revealed that participants in the control and no-control conditions did not differ in terms of age, scores on the three scales of the DASS-21, self-efficacy scores and gender ($p > .05$).

Table 2.1

Participant characteristics according to experimental group

	Controllability Condition ***n* = 20**	**No-Controllability Condition** ***n* = 20**
Number of females	14 (70%)	16 (80%)
Age	19.75 (2.05)	19.60 (2.46)
DASS-21		
Anxiety Scale	5.60 (6.24)	7.70 (7.98)
Depression Scale	7.30 (5.52)	9.10 (7.91)
Stress Scale	10.20 (8.53)	12.20 (8.61)
NGSE	30.65 (4.51)	28.55 (3.50)

Note: Values indicate means with standard deviation in parentheses. DASS = Depression Anxiety Stress Scales; NGSE = New General Self-Efficacy Scale.

Levels of distress

Means and standard deviations of the levels of distress at baseline and after the stressful task are presented in Table 2.2. A 2 (Condition) x 2 (Time of Ratings) mixed models analysis of variance (ANOVA) on levels of distress indicated a significant main effect for Time of Ratings, $F(1,38) = 55.91$, $p < .001$. Overall, participants reported significantly higher levels of distress after being exposed to the slideshow of pictures, showing that the stress induction manipulation was successful. No main effect of Condition, $F(1,38) = 1.03$, $p = .32$, or significant interaction, $F(1,38) = .57$, $p = .46$, was found.

Ratings of pictures

The means and standard deviations for the ratings of negative and neutral pictures are presented in Table 2.2. A 2 (Condition) x 2 (Valence) mixed models ANOVA on picture ratings indicated significant main effects for Condition, $F(1, 38) = 4.45$, $p < .05$, and Valence, $F(1, 38) = 531.15$, $p < .001$. Overall, participants rated the

negative pictures as more distressing than the neutral pictures and participants in C- gave more negative ratings of the pictures than participants in C+. Results also indicated a significant main Participant Condition x Valence interaction, $F(1,38) = 5.75$, $p < .05$. Follow-up testing indicated that participants in C- rated the negative pictures as more distressing than participants in C+, $t(38) = -2.28$, $p < .05$. The groups did not differ in their ratings of neutral pictures.

Table 2.2

Levels of distress and pictures ratings according to experimental group

	Controllability condition n = 20	**No-Controllability condition n = 20**
Levels of distress		
DIS_1	1.45 (1.96)	1.70 (2.06)
DIS_2	4.35 (2.60)	5.25 (2.34)
Pictures Ratings		
Negative pictures	4.72 (1.27)	5.57 (1.07)
Neutral pictures	1.14 (.30)	1.15 (.19)

Note: Values indicate means with standard deviation in parentheses. DIS_1 = Baseline level of distress; DIS_2 = Level of distress after the slideshow.

Autobiographical memory recall

Table 2.3 presents the mean number of specific, categoric, extended memories and omissions in response to cue words.

A 2 (Condition) x 2 (Cue Valence) mixed models ANOVA on specific memories indicated significant main effects for Cue Valence, $F(1, 38) = 8.46$, $p < .01$, and Condition, $F(1, 38) = 4.70$, $p < .05$. Overall, participants retrieved significantly more specific memories in response to positive words than negative words and participants in the controllability condition retrieved significantly more specific

memories than participants in the no-controllability condition. No significant interaction was found between Condition and Cue Valence, $F(1,38) = .66$, $p = .42$.

A 2 (Condition) x 2 (Cue Valence) mixed models ANOVA on categoric memories indicated a main effect of Condition, $F(1, 38) = 8.16$, $p < .01$. Participants in the no-controllability condition retrieved significantly more categoric memories than participants who believed they had control. There was no main effect of Cue Valence, $F(1,38) = .93$, $p = .34$, or significant interaction, $F(1,38) = .41$, $p = .52$.

There were few extended and omitted memories and 2 (Condition) x 2 (Cue Valence) mixed models ANOVAs of extended memories and omitted memories indicated no significant main or interaction effects.

Table 2.3

Mean number of specific, overgeneral memories and omissions recalled

	Controllability condition n = 20	**No-Controllability Condition n = 19**
Specific		
Positive cues	4.15 (.93)	3.25 (1.45)
Negative cues	3.35 (.88)	2.80 (1.61)
Categoric		
Positive cues	.4 (.68)	1.15 (1.09)
Negative cues	.35 (.59)	.90 (1.02)
Extended		
Positive cues	.10 (.31)	.20 (.52)
Negative cues	.15 (.49)	.30 (.57)
Omissions		
Positive cues	.35 (.59)	.50 (.61)
Negative cues	.20 (.41)	.35 (.75)

Note: Standard deviations appear in parentheses

Predictors of autobiographical memory specificity

To analyse the extent to which individual difference factors may moderate the observed effect of perceived control on autobiographical memory recall, two multivariate linear regressions were conducted predicting specific and categoric recall, respectively. Depression levels have been shown to impact autobiographical memory recall, and Self-Efficacy is suggested to be associated with increased persistence on a task. Accordingly, these two variables were entered in Step 1 and Control Condition was entered in Step 2. VIF values ranged from 1.08 to 1.20, indicating little evidence for problematic multicollinearity among the variables.

Table 2.4 presents the final model for both equations. In the first regression that predicted categoric memories, only Control Condition emerged as a significant predictor, with not having perceived control being associated with more categoric memories, $F(1,36) = 6.72$, $p < .05$. Controllability contributed to approximately 15.2% of the variance in categoric memories, although the final model was only marginally significant, $F\ (3,36) = 2.75$, $p = .06$.

In the regression that predicted specific memories, none of the variables significantly contributed to the variation in the number of specific memories recalled, although the addition of Control Condition showed a trend towards statistical significance, $F(1,36) = 3.38$, $p = .07$, predicting approximately 7.8% of the variance in specificity. The final model was also only marginally significant, $F(3,36) = 2.49$, $p = .08$.

Table 2.4

Summary of multivariate linear regression model for memory specificity

Outcome	Variables	*B*	SE *B*	β	*t*	*p*
Categoric	DASS-21 Depresion	.02	.04	.09	.57	.57
Recall	NGSE	-.01	.06	-.02	-.10	.92
	Condition	1.25	.48	.40	2.59	.01
Specific	DASS-21 Depression	-.05	.06	-.14	-.89	.38
Recall	NGSE	.08	.09	.14	.86	.40
	Condition	-1.34	.73	-.29	-1.84	.07

Note: DASS-21 = Depression Anxiety Stress Scales; NGSE = New General Self-Efficacy Scale. *Results for Categoric Recall*: Step 1 R^2 = .03, Δ R^2 = .03; Step 2 R^2 = .19, Δ R^2 = .15. *Results for Specific Recall*: Step 1 R^2 = .09, Δ R^2 = .09; Step 2 R^2 = .17, Δ R^2 = .08.

Summary of findings

Study 1 aimed to examine the impact of experimentally manipulating perceived controllability over an aversive stimulus on subsequent AMS. Consistent with the hypotheses, participants who believed they had no control over the distressing stimuli recalled fewer specific and more categoric memories than participants who thought they had control over them. This was true independent of the valence of the cue word. The results also showed that controllability significantly and independently predicted categoric recall but failed to predict specific recall, suggesting that perceived uncontrollability might be particularly important in the premature interruption of the search for a specific memory. In line with previous research of controllability in humans, it was also found that participants in the control condition rated the negative pictures as less distressing than participants in the no-control condition.

Study 2: Controllability and Autobiographical Memory Specificity: The role of executive resources

Introduction

Study 1 found preliminary evidence that perceiving a negative situation as uncontrollable impairs the retrieval of specific memories. The question remains as to the potential mechanisms responsible for this relationship. According to the Carfax model, diminished executive control leads to overgeneral retrieval (Dalgleish et al., 2007). LH paradigms in humans have shown that leading an individual to believe he/she has no control over the termination of a negative stimulation results in an impaired performance on cognitive tasks, such as a Stroop task (Glass et al., 1973) or an anagram task (Cemalcilar et al., 2003), which are tasks relying heavily on working memory capacity. It is possible that the lack of control over a stressful situation limits the executive resources necessary to retrieve a specific memory, leading to an increased retrieval of OGM.

Accordingly, Study 2 investigated the role of cognitive resources in the context of perceived control on autobiographical memory retrieval. In order to analyse the cognitive demands of autobiographical memory retrieval, a dual task paradigm was used, in which autobiographical memories were retrieved while simultaneously completing another cognitive demanding task. On the premise that lack of perceived control would diminish executive control, it was predicted that participants in the no-control condition would display more errors and longer response latencies on a secondary task and be less specific in their memory retrieval compared to the control group.

Method

Participants

Sample B was used in this study (see Table 1.1). This included 32 undergraduate psychology students participated in return for course credit (18 females). The sample's mean age was 19.38 (*SD* = 1.91). Participants were randomly allocated to one of the experimental conditions.

Materials

Self-report measures. The same self-report measures as used in Study 1 (DASS-21 and NGSE) were used in this study (see also Appendices 2 and 3)

Aversive Stimuli. Participants were presented with a series of 8 short video clips, lasting between 25 and 44 seconds. The video clips depicted distressing scenes, such as scenes of violence or real-life surgeries (see Appendix 7). The task was programmed in Presentation® software (V 16.0) and presented on a laptop with a 15-inch screen placed in front of the participants.

Manipulation Check. To check whether the manipulation of controllability was effective, participants were asked the following question: "*How much control do you feel you had over the termination of the video?"*. Participants were asked to give their answer on an 11-point Likert scale (0 = *I had no control at all,* 10 = *I had full control*)

Autobiographical Memory Test (AMT). The AMT was identical to the one administered in Study 1 except that it was presented on a computer. The same 10 words were used and presented in a counterbalanced order (see also Appendix 5).

Secondary Key-Pressing Task. The secondary task was a computerized, 26-choice reaction-time task programmed using Inquisit (V 3.0.6.0, Millisecond Software, Seattle). In this task, one of the letters of the alphabet appeared in the center of the 15-inch laptop screen for a duration of 2000 milliseconds. Participants responded by

pressing the corresponding key on the keyboard as quickly as possible. If a response was not made within the maximum 2000 milliseconds, the target stimulus was replaced with another letter. If a response (correct or incorrect) was made, the screen went blank until another stimulus appeared after a 2000 milliseconds interstimulus interval. All stimuli were randomly presented. As the maximum duration of the primary task (AMT) was 30 seconds for each cue word, the computerised task was designed with enough trials to cover this time period.

Procedure

Participants were randomly allocated to one of the conditions upon signing up for one of the experimental sessions. Each session had been randomly assigned an experimental condition using an online random number generator.

Following written informed consent, participants were asked to indicate their initial general level of distress with same 11-point scale used in Study 1 (0 = *not at all distressed*, 10 = *extremely distressed*). They then completed the DASS-21 and the Self-Efficacy Scales. They were then seated in front of a laptop computer and told they would be presented with a series of video clips on the screen and then required to indicate how distressed they were by each video. Participants in the control condition (C+) were told that if they felt too distressed by some of the videos, they could press the space bar to indicate that they no longer wish to look at it and that this will stop the video. Participants in the no-control condition (C-) were told that they were required to watch the video until the program terminated it and moved on to the next one (for a full description of the instructions, see Appendix 7). If participants in C+ pressed the space bar, the time they took to do so was recorded and each participant in C- was yoked to a participant in C+ such that if a participant in C+ saw one or more of the videos for a shorter period of time, one subject in C- was assigned videos with the same length.

After each of the video segments, participants had to rate how distressing they had found the video on a 7-point scale (1 = *Not at all distressing*, 7 = *Extremely distressing*). After participants saw all eight video clips, they were asked to indicate again their general level of distress, and were asked the manipulation check question. Participants were then administered the AMT concomitantly with the dual task. Both tasks were presented simultaneously via a seamless computer interface. A cue word appeared at the top of the screen at the same time that alphabetical stimuli appeared in the centre of the screen. Participants immediately began searching for a specific memory while pressing the corresponding response key in the secondary task. They were instructed to retrieve memories in silence and once they had one in mind, to press the space bar, and then verbalise the memory. Once the participants pressed the space bar, the secondary task was programmed to stop. This measure was introduced to prevent confounding of memory retrieval and reporting. Dual task mean latency (time to press key in response to stimuli), percentage of correct responses and mean latency to produce a correct answer (time to press the correct key) were scored for the period of time taken to retrieve each memory.

After finishing the AMT, participants were debriefed and the study finished.

Scoring

The scoring procedure was the same as the one used in Study 1. A second independent rater blind to experimental condition and the hypotheses of the study coded 20% of memory responses. The mean interrater reliability coefficient was .74.

Results

Participant characteristics

Table 2.5 presents participants' characteristics. Participants in the control and no-control conditions did not differ in terms of age, scores on the three scales of the DASS-21 and self-efficacy scores ($p > .05$).

Table 2.5

Participant characteristics according to experimental group

	Controllability Condition ***n* = 16**	**No-Controllability Condition** ***n* = 16**
Number of females	8 (50%)	10 (62.5%)
Age	18.88 (.81)	19.88 (2.53)
DASS-21		
Anxiety Scale	7.13 (7.41)	7.50 (7.14)
Depression Scale	7.13 (6.61)	7.00 (6.01)
Stress Scale	15.00 (10.78)	10.63 (6.80)
NGSE	28.44 (5.90)	28.81 (3.88)

Note: Values indicate means with standard deviation in parentheses. DASS = Depression Anxiety Stress Scales; NGSE = New General Self-Efficacy Scale.

Manipulation check

Independent sample t-test revealed that the perception of control over the duration of the videos was significantly different between conditions, $t(30) = 8.77$, $p < .001$. Participants in C+ reported perceiving more control over the termination of the video ($M = 8.25$, $SD = 2.27$) than participants in C- ($M = 1.63$, $SD = 2.00$), indicating that the manipulation of controllability was effective.

Levels of distress

Means and standard deviations of the levels of distress at baseline and after the video task are presented in Table 2.6. A 2 (Condition) x 2 (Time of Ratings) mixed models ANOVA of levels of distress indicated a significant main effect for Time of Ratings, $F(1,30) = 95.53$, $p < .001$, and a significant Time of Ratings x Condition interaction $F(1,30) = 4.30$, $p < .05$. The video task led to an increase in distress in all participants and this was larger in participants in the no-controllability condition than in participants in the controllability condition.

Videos rating

The mean and standard deviations of the ratings made by the participants for the videos are presented in Table 2.6. An independent t-test revealed no significant difference between the two groups, $t(30) = -1.73$, $p = .09$, indicating that the participants gave similar ratings of how distressing each video was.

Table 2.6

Levels of distress and videos ratings according to experimental group

	Controllability condition n = 16	**No-Controllability condition n = 16**
DIS_1	0.69 (1.08)	0.88 (1.59)
DIS_2	3.94 (2.38)	5.87 (2.55)
Videos Rating	3.90 (1.50)	4.80 (1.44)

Note: Values indicate means with standard deviation in parentheses. DIS_1 = Baseline level of distress; DIS_2 = Level of distress after the videos.

Autobiographical memory recall

Table 2.7 presents the mean number of specific, categoric, extended memories and omissions retrieved by the participants in each condition for negative and positive

to cue words. A 2 (Condition) x 2 (Cue Valence) mixed models ANOVA on specific memories indicated a main effect for Condition, $F(1, 30) = 12.54$, $p < 0.001$. Participants in the controllability condition generated significantly more specific memories overall than participants in the no-control condition. No significant main effect of Cue Valence, $F(1, 30) = 1.31$, $p = 0.26$, or interaction between Condition and Cue Valence, $F(1, 30) = 0.27$, $p = 0.61$, were observed indicating that the valence of the cue word had no impact on the retrieval of specific memories.

A 2 (Condition) x 2 (Cue Valence) mixed models ANOVA on categoric memories indicated a main effect for Condition, $F(1, 30) = 11.17$, $p < .01$. When participants had no control over the duration of the videos, they subsequently recalled more categoric memories than participants who had control. The valence of the cue word had no effect on the number of categoric memories recalled as no significant main effect of valence, $F(1, 30) = 0.00$, $p = 1.00$, or interaction effect, $F(1, 30) = 1.07$, $p = 0.31$, were observed.

The number of extended and omitted memories was very low and separate 2 (Participant Condition) x 2 (Cue word) mixed models ANOVAs of extended and omitted memories did not yield any significant effects.

Table 2.7

Mean number of specific, overgeneral memories and omissions recalled

	Controllability condition n = 20	No-Controllability Condition n = 19
Specific		
Positive cues	3.69 (1.25)	2.62 (1.41)
Negative cues	4.19 (1.05)	2.81 (1.42)
Categoric		
Positive cues	.69 (.87)	1.25 (.58)
Negative cues	.44 (.81)	1.5 (1.41)
Extended		
Positive cues	.31 (.60)	.37 (.62)
Negative cues	.25 (.45)	.25 (.45)
Omissions		
Positive cues	.31 (.60)	.44 (1.09)
Negative cues	.12 (.34)	.31 (.70)

Note: Standard deviations appear in parentheses

Dual task

Table 2.8 presents the mean percentage of correct responses on the dual task as well as the mean total latency to respond and the mean latency taken to correctly respond to the task. Independent samples t-tests indicated that participants in the no-controllability condition performed as well, $t(30) = -.30$, $p = .76$, took the same amount of time to produce an answer, $t(30) = .30$, $p = .77$, and were as fast to press the correct key, $t(30) = .29$, $p = .77$, than participants in the controllability condition.

Pearson correlation coefficients were calculated between dual task and AMT results for each condition. For the no-controllability condition, there was a significant positive correlation between mean latency to produce a correct answer on the dual task and mean number of specific memories recalled ($r = 0.61$, $p < 0.05$); that is, specific

retrieval was associated with longer correct responses on the dual task. This correlation was not significant for participants in the control condition ($r = 0.25$, $p = 0.36$).

Table 2.8

Mean percentage of correct answers, total latency to answer and latency to produce correct answers on the dual task

	Controllability condition n = 20	**No-Controllability Condition n = 19**
Proportion of correct answers	95.33% (6.18)	95.96% (5.72)
Mean total response latency (ms)	950.57 (201.10)	931.01 (170.24)
Mean correct response latency (ms)	931.15 (189.20)	911.70 (192.21)

Note: Standard deviations appear in parentheses

Predictors of memory specificity

To index the potential influence of individual differences in depression and self-efficacy, two separate regression analyses were conducted for specific memories and categoric memories. In Step 1, depression and self-efficacy scores were entered. An interaction variable (Condition x Correct Response Latency) was entered in Step 2. VIF values were acceptable across all variables (range = 1.06 – 1.42).

The final models for both regressions are presented in Table 2.9. For the first regression predicting categoric memories, depression and self-efficacy scores accounted for 24.8% of the variance. When the interaction effect was added, an additional 12.4% of the variance in categoric memories was predicted, $F(1,28) = 5.54$, $p < .05$. In the final model, depression and the interaction variable emerged as the two sole significant predictors of the variation in categorical recall. In terms of specific recall, none of the variables significantly contributed to the variation in the number of specific memories recalled although the addition of the interaction variable showed a trend towards

statistical significance, $F(1,28) = 3.36$, $p = .08$, predicting approximately 9.2% of the variance in specificity. The final model approached statistical significance, $F(3,28) = 4.42$, $p = .06$.

Table 2.9

Summary of multivariate linear regression model for memory specificity

Outcome	Variables	*B*	SE *B*	β	*t*	*p*
Categoric	DASS-21 Depresion	.10	.04	.40	2.24	.03
Recall	NGSE	-.08	.06	-.26	-1.46	.15
	Condition x Mean Latency	.001	.000	.36	2.35	.03
	Correct					
Specific	DASS-21 Depression	-.11	.07	-.30	-1.55	.13
Recall	NGSE	.09	.09	.20	1.02	.32
	Condition x Mean Latency	-.001	.001	-.31	-1.83	.08
	Correct					

Note: DASS-21 = Depression Anxiety Stress Scales; NGSE = New General Self-Efficacy Scale. *Results for Categoric Recall*: Step 1 $R^2 = .25$, $\Delta R^2 = .25$; Step 2 $R^2 = .37$, $\Delta R^2 = .12$. *Results for Specific Recall*: Step 1 $R^2 = .14$, $\Delta R^2 = .14$; Step 2 $R^2 = .23$, $\Delta R^2 = .09$.

General Discussion

This chapter aimed to examine the causal role of perceived uncontrollability over negative stimuli on subsequent autobiographical memory retrieval style. Consistent with the hypotheses, Studies 1 and 2 found that participants who perceived no control recalled fewer specific and more categoric memories than participants who perceived control over the stimuli. These results are consistent with evidence that increasing the specificity of the memory during treatment leads to reduction of feelings of helplessness (Serrano et al., 2004). Controllability was found to be a unique significant predictor of categoric recall indicating that the differences in autobiographical memory recall observed were not due to participants' pre-existing characteristics. Since controllability

did not significantly predict specific recall, it is possible that the perceived lack of control may be more impactful on leading to categoric recall rather than limiting specific retrieval. The fact that OGM is a risk factor for increased emotional distress and developing emotional disorder has been well established in the literature (e.g. Bryant et al., 2007; Harvey et al., 1998; Williams et al., 2007). The present findings extend on this research by showing that the reverse might also be true and that emotional stress could cause OGM thus highlighting a potential bidirectionality of the relationship between distress and AMS.

Study 2 further investigated the role of lack of controllability on autobiographical memory by examining one potential mechanism, limited executive resources. The hypothesis specific to Study 2 was not confirmed. Participants' performance on the secondary task was the same regardless of their prior experience of control. This finding could be due to a ceiling effect resulting from the task employed making inadequate demands on cognitive resources. It is very possible that because the secondary task used was a simple key pressing task it did not impose enough cognitive demands to affect performance on the secondary task and the AMT.

However, correlational analyses showed a positive association between the number of specific memories recalled and the mean response latency on the key-pressing task for the no-control group. That is, when participants had no control over the aversive stimuli, the more specific memories they retrieved, the longer they took to respond on the secondary task. This suggests that the retrieval of a specific memory was more cognitively demanding for participants in the no-control group. Interestingly this pattern of results was not observed in participants who could stop the videos at any time they wanted. Additionally, the regression analysis conducted showed that the interaction between controllability and mean latency to produce a correct answer on the dual task

significantly and independently predicted categoric recall. This provides preliminary evidence of a relationship between reduced executive resources and retrieval of specific memories in individuals who perceive diminished control.

Across both Study 1 and Study 2, it was found that participants who perceived no control over the distressing stimuli rated negative pictures as more distressing (Study 1) and were more distressed overall by the film scenarios (Study 2) than participants in the control condition. This accords with previous research showing that participants who think they have control rate potentially distressing stimuli as less aversive then people who think they have no control (e.g. Geer et al., 1970).

We note several limitations of the current studies. First, as previously mentioned, the dual task used in Study 2 might not have been cognitively demanding enough and might not have been the most appropriate task to examine the potential mediating effect of executive control in the relationship between uncontrollability and impaired AMS. Second, Study 1 did not include a manipulation check and as such it is not possible to infer whether the manipulation of perceived control was effective. It is possible that participants in the perceived control condition realised that their action actually had no impact on the length of the pictures display. Although few participants decided to exert their control, research suggests that, in a laboratory environment, the perception individuals have of their ability to control a negative situation is critical regardless of actual control. Study 1 did not allow to measure this. Third, whereas the stimuli used in these studies were negatively valanced, they may not have been aversive enough to elicit strong motivation in participants to want to exert control. Other human studies that have shown strong effects of perceived control have manipulated perception of control over electric shocks (Bryant et al., 2014), which may lead to stronger effects than presenting negative visual stimuli. Fourth, we recognise that the studies reported

here were based on small sample sizes. This limits the reliability of the current findings. It may also have resulted in a lack of power to detect differences between conditions in their performance on the secondary key pressing task for example. Finally, we note that it is possible that demand characteristics of the experiments may have influenced both reporting of distress and performance on the AMT and secondary task.

Despite these limitations, the studies presented in this chapter provide evidence for the role of depleted control perception on autobiographical memory. This sheds light on one possible mechanism of the well-documented overgeneral retrieval in depression and traumatic stress conditions and points to a potential mechanism underlying the relationship between uncontrollability and these pathological conditions. This thesis now turns to the examination of the impact of diminished control perception on two correlates of AMS deficits, future imaginings and social problem-solving.

Chapter 3: Controllability and Future-Related Cognitive Functioning

Study 3: The Effect of Controllability on Future Imagining and Social Problem Solving

Introduction

Chapter 2 demonstrated that lacking perceived control led to a deficit in retrieving specific autobiographical memories. Such a deficit has been associated with impairments in two future-related cognitive functions that are important for healthy psychological functioning: future imagining and social problem solving.

In healthy individuals, there is a tendency to imagine the future with a positive bias (Berntsen & Bohn, 2010). However, this bias is not found in clinical populations. Depressed individuals have been found to experience difficulties in imagining events they look forward to when prompted to do so (MacLeod et al., 1997). Individuals with PTSD have also been found to imagine their future functioning in a more negative way (Brown, Buckner, & Hirst, 2011).

Deficits in future imaginings in clinical populations also translate in difficulties imagining the future in a specific way. This tendency to think about the future in a general manner has been identified in individuals suffering from suicidal ideation (Williams et al., 1996), dysphoria (Dickson & Bates, 2006), complicated grief (Maccallum & Bryant, 2011) and PTSD (Kleim et al., 2014). This impairment has been linked to the tendency found in this population to retrieve OGM as research shows that the difficulties to imagine specific future events is associated with poor performance on the AMT; further, inducing an overgeneral retrieval style in participants lead them to think about the future in a more general way (Williams et al., 1996). Indeed, individuals have been shown to follow a similar process to retrieve past memories and generate future scenarios (D'Argembeau & Mathy, 2011), suggesting that to generate future

events, individuals draw on their experiences stored in autobiographical memories and recombine them into a novel event (Schacter & Addis, 2007). Thus, the mechanisms responsible for OGM (i.e. rumination, functional avoidance and impaired executive control) may also explain deficits in imagining specific future events.

The ability to generate specific future events serves important functions such as action planning and decision making (D'Argembeau et al., 2011) which are important aspects of the problem-solving process. SPS is an effortful process that aims to improve a problematic situation and/or alleviate the distress associated with it (D'Zurilla et al., 2004). Research has predominantly used the MEPS (Platt & Spivack, 1975b) to assess SPS skills. In this task, individuals are presented with the beginning and the resolution of a problematic situations and are asked to describe the different steps the protagonist would take to reach the described outcome. When administered this task, individuals with various psychological disorders, including depression and PTSD, generate fewer means and less effective solutions demonstrating deficits in their problem-solving abilities (Goddard et al., 1996; Sutherland & Bryant, 2008). These difficulties have been shown to be associated with impaired AMS, in particular with categorical retrieval of autobiographical memories (Goddard et al., 2001). Thus it has been argued that the ability to access specific past experiences of successful problem resolution helps the individual to generate more effective solving strategies when faced with new problematic situations (Beaman et al., 2007). Recently, deficits in SPS skills have also been associated with difficulties in the generation of specific future imaginings (Brown, Dorfman, Marmar, & Bryant, 2012).

Deficits in future imaging and SPS are important factors in the maintenance of depression and PTSD and are thought to result from impaired AMS. It is possible that these deficits are associated with the perception that negative events are uncontrollable.

Difficulties with future imagining have been shown to be associated with feelings of helplessness in individuals with depression (MacLeod et al., 2005). Williams et al. (1996) also proposed that the reduced specificity of future imaginings could lead to deficits in SPS which could escalate a problematic situation into a crisis thus reinforcing the feeling that events are outside of one's control. A study by Ross and Mirowsky (1989) also found that individuals who perceived being more in control over their lives were more likely to actively attempt to solve problems and that this reduced the risk to develop depression. This suggests that impairments in future imagining and problem-solving contribute to maintaining the perception that negative events are uncontrollable. However, it is also possible that these deficits developed as a result of experiencing a lack of control over a traumatic event to start with. Yet there is a lack of empirical investigations in this area.

Accordingly, the aim of this study was to examine the impact of uncontrollability on subsequent future imagining specificity and SPS skills. Participants were exposed to distressing videos and given the option or not to terminate each video prior to planned completion. They were then administered a FIT and the MEPS. Future imagining specificity and SPS skills have been shown to be associated with AMS and Chapter 2 found that a lack of control led to the retrieval of less specific and more categoric memories. Consequently, it was hypothesized that participants who were led to believe they had no control over the stressing stimuli will generate less specific future events than participants who could control the duration of the stimuli. It was also hypothesized that when participants think they have no control, they will generate fewer means and overall less effective solutions on the MEPS than participants who thought they had control. Finally, in line with the findings from Brown et al. (2012), it was

hypothesized that reduced future imagining specificity will be predict poorer performance on the MEPS.

Method

Participants

Participants were undergraduate psychology students at the University of New South Wales who took part in the research in return for research credit. The sample (Sample C, see Table 1.1) comprised 39 participants (26 females) with a mean age of 19.56 years (*SD*=3.05). They were randomly allocated to one of two experimental conditions.

Materials

The ***Depression Anxiety Stress Scales – Short Form*** (DASS-21; Lovibond & Lovibond, 1995) and the ***New General Self-Efficacy Scale*** (NGSE; Chen et al., 2001) were administered. These measures are described in detail Chapter 2 (see also Appendices 2 and 3).

Aversive stimuli. A video depicting real-life footage of the intervention of emergency personnel to the scene of a car crash was used. The video showed the personnel attending to seriously injured victims, including one deceased person (see Appendix 9). It was approximately 10 minute long and was divided into 10 segments of approximately one minute each. This video has previously been used in research and has been shown to be a laboratory analogue of a trauma situation and to effectively induce distress in participants (Devilly & Varker, 2008). Participants were informed that the video depicted a car crash at the time of informed consent. The task was programmed in Presentation® software (V 16.0) and presented on a laptop with a 15-inch screen.

Manipulation check. The same question used as a manipulation check in Study 2 was used to verify that the manipulation of control was effective.

Future Imaginings Task (FIT; Williams et al., 1996). In this task, participants were given a series of cue words and ask to imagine a specific future event evoked by the word within a 45-second limit. Five positive (e.g. *lucky*) and five negative (e.g. *lonely*) cue words were used (see Appendix 10). The cue words were embedded in a sentence ("*Picture a specific event or situation in the future where you will feel…"*) in line with the Williams et al. (1996) procedure. Participants were explained what was understood by specific event and examples of acceptable and non-acceptable answers were given (see Appendix 10 for full instructions). Participants were given two practice cue words (*"movie"* and *"chocolate")*. The order of presentation of the cue words was randomized but the valence of the cue words was alternated. Participants were presented with a negative or a positive cue words first in a counterbalanced way. The task was programmed in Inquisit (V 3.0.6.0) and was administered on a computer. Participants were asked to press the space bar when they had generated a specific future event. They were then asked to describe the event out loud and responses were audio-recorded.

Means-Ends Problem Solving Task (MEPS; Platt & Spivack, 1975b). Participants were presented with the beginning and the end of a problematic situation and asked to generate a step-by-step strategy that the protagonist of the story would use to achieve the desired goal. Four scenarios were used as this has been shown to provide a valid estimate of problem solving cognitions (Marx et al., 1992). The four situations represented different life areas (i.e. relationship, friendship, work, lost property) (see Appendix 11). Participants were first presented with a practice situation. Once the task was understood, they were presented with one of four alternate scenario lists in a counterbalanced way on a computer. The scenarios were presented on the laptop screen

for 2 minutes each, using Microsoft Powerpoint software. Participants were asked to respond verbally and their responses were audio-recorded.

Procedure

Participants were randomly allocated to one of the conditions upon signing up for one of the experimental sessions. Each session had been randomly assigned an experimental condition using an online random number generator.

Following written informed consent, participants were asked to indicate their initial general level of distress with same 11-point scale used in Studies 1 and 2. They then completed the DASS-21 and the Self-Efficacy Scales. They were then seated in front of a laptop computer and told they would be presented with a series of video clips on the screen. The manipulation of controllability and the yoking procedure were similar to that used in Study 2. Participants in the controllability condition (C+) could press the space bar to stop the segment they were watching. Participants in the no-control condition (C-) were required to watch the segment until the program terminated it and moved on to the next one (for a full description of the instructions see Appendix 9). At the end of each segment, participants had to rate how distressing they found the segment they just watched on a scale from 0 (*Not at all distressing*) to 9 (*Extremely distressing*). The scale appeared on the screen and participants had to press the number key corresponding to their answer. After participants saw all 10 segments of the video, they were asked to indicate again their general level of distress and asked the manipulation check question. Participants were then administered the FIT followed by the MEPS.

Scoring

FIT. Audio-recorded responses on the FIT were coded for specificity and content. Following Williams et al. (1996), specific responses were given a score of 3,

intermediate responses a score of 2, general responses a score of 1, and omissions a score of 0. Responses were considered specific when the event described a specific time, a location and people involved where appropriate (e.g. *"Going to my girlfriend's parents' house for their wedding anniversary and helping them out"*). In an intermediate response, one or two of these elements were present but not all (e.g. *"Helping out at my cousin's primary school soon"*). A response was coded as general if it did not include any specific details (e.g. *"Going paintballing soon"*). Content of the responses was also coded for level of mastery in the event described on a scale from 0 (no mastery, i.e. no attempt to control the environment) to 3 (full mastery, i.e. full effective control of outcomes). Total scores for the two indices were calculated by summing the scores across all cue words. A second independent rater blind to experimental condition and the hypotheses of the study coded 20% of memory responses for specificity and content. The mean inter-rater reliability coefficients were r = .68 and r = .70, respectively.

MEPS. The recorded responses on the MEPS were coded for number of means generated and overall effectiveness of the solution. The number of means referred to the number of discrete steps taken by the protagonist to reach the desired outcome. If the outcome was not reached, the number of means was scored as 0 (Platt & Spivack, 1975a). Overall effectiveness of the solution was scored on a 5-point Likert scale (1 = *not at all effective*, 5 = *very effective*). A solution was considered effective if it maximised the positive and minimised the negative consequences for the protagonist (Marx et al., 1992). Total scores for the two indices were obtained by summing the scores from the four situations. A second independent rater coded 20% of the responses for both number of means and effectiveness. The mean inter-rater reliability coefficients were r = .47 and r = .72, respectively.

Results

Participant characteristics

Table 3.1 presents participants' characteristics. Planned t-tests revealed that participants in the controllability and no-controllability conditions did not differ in terms of age, scores on the three scales of the DASS-21 and self-efficacy scores, $p > .05$. However, the proportion of females in the no-controllability condition was significantly higher than in the controllability condition ($\chi 2 = 5.13$, $p < .05$).

Manipulation check

Independent sample t-test revealed that the perception of control over the duration of the videos was significantly different between conditions, $t(37) = 9.80$, $p < .001$. Participants in C+ reported perceiving more control over the termination of the video ($M = 8.60$, $SD = 1.87$) than participants in C- ($M = 1.79$, $SD = 2.44$), indicating that the manipulation of controllability was effective.

Levels of distress and ratings of videos

Means and standard deviations of the levels of distress at baseline and after the stressful task are presented in Table 3.1. A mixed models 2 (Condition) x 2 (Time of Ratings) ANOVA of levels of distress indicated a significant main effect for Time of Ratings, $F(1,37) = 118.21$, $p < .001$, indicating that the levels of distress significantly increased after seeing the videos. A significant main effect for Condition was also found, $F(1,37) = 11.32$, $p < .01$, with participants in C+ being overall less distressed than those in C-. No significant interaction between condition and time of ratings was found, $F(1,37) = 0.75$, $p = .393$.

An independent sample t-test showed that participants in C- rated the video segments ($M = 5.24$, $SD = 1.31$) as more distressing than participants in C+ ($M = 3.75$, $SD = 1.99$), $t(37) = -2.74$, $p < .01$.

Table 3.1

Participant characteristics and levels of distress according to experimental group

	Controllability Condition ***n*** **= 20**	**No-Controllability Condition n = 19**
Number of females	10 (*50.0%)*	16 (*84.2%*)
Age	19.1 (1.74)	20.05 (3.99)
DASS-21		
Anxiety Scale	7.20 (4.79)	9.68 (9.27)
Depression Scale	8.70 (7.90)	8.74 (8.90)
Stress Scale	10.20 (5.91)	12.53 (10.17)
NGSE	28.80 (4.84)	29.421 (3.79)
DIS_1	0.30 (.80)	2.21 (2.35)
DIS_2	5.30 (2.52)	6.47 (1.68)

Note: Values indicate means with standard deviation in parentheses. DASS = Depression Anxiety Stress Scales; NGSE = New General Self-Efficacy Scale. DIS_1 = Baseline level of distress; DIS_2 = Level of distress after the videos.

Future imaginings

Table 3.2 presents the mean specificity and mastery scores of the future events generated in response to positive and negative cue words for the two conditions. A mixed models 2 (Condition) x 2 (Cue Valence) ANOVA on specificity scores indicated a main effect for Valence, $F(1, 37) = 8.42$, $p < .01$. Overall, participants recalled more specific memories in response to positive cue words than in response to negative cue words. No significant main effect of Condition, $F(1, 37) = 3.24$, $p = .08$, or significant Valence x Condition interaction was found, $F(1, 37) = .28$, $p = .60$. The main effect of Condition, $F(1,37) = 3.24$, $p = .08$, was not significant but approached statistical significance. However, the effect size was small to moderate, $\eta_p^2 = .081$.

A separate 2 (Condition) x 2 (Cue Valence) mixed models ANOVA on mastery scores indicated a significant main effect of Cue Valence, $F (1, 37) = 98.65$, $p < .001$, and a significant main effect of Condition, $F (1, 37) = 4.73$, $p < .05$. Overall, events

generated in response to positive cues involved more mastery than those in response to negative cues. Additionally, participants in C+ described future events that involved more mastery than participants in C-. There was no significant interaction between condition and cue valence regarding the levels of mastery described, F (1, 37) = .63, p = .43.

Table 3.2

Mean total specificity and mastery for future events generated

	Controllability condition n = 20	**No-Controllability Condition n = 19**
Specificity		
Positive cues	12.85 (1.73)	11.32 (2.60)
Negative cues	11.40 (3.12)	10.32 (2.85)
Mastery		
Positive cues	8.80 (2.80)	7.21 (2.27)
Negative cues	4.35 (2.13)	3.42 (1.43)

Note: Standard deviations appear in parentheses

Prediction of future mastery

To examine the extent to which participants' characteristics and manipulation of controllability accounted for mastery-related content of future imaginings, a multivariable linear regression analysis was conducted. Because the mastery scores did not differ according to cue valence between the two conditions, the total mastery score was chosen as the outcome variable. Participants' DASS-21 Depression Scores and Self-Efficacy Scores were entered in Step 1, and condition was entered in Step 2.

Multicollinearity analyses conducted prior to the regression analyses indicated little evidence for problematic multicollinearity among variables, with VIF values ranging from 1.01 to 1.07 across all independent variables. Table 3.3 presents the final

model for the equation. Although the final model was not significant, $F(3,35) = .31$, $p > .05$, participants' condition emerged as a significant predictor. Lacking control over the termination of the aversive stimuli was associated with less mastery and accounted for approximately 12% of the variance in mastery scores, $F\ (1, 35) = 4.74$, $p < 0.05$.

Table 3.3

Summary of multivariate linear regression model predicting mastery future imaginings

Outcome	Variables	*B*	SE *B*	β	*t*	*p*
Mastery scores	DASS-21 Depression	-.04	.07	-.09	-.55	.58
	NGSE	.08	.14	.94	.57	.57
	Condition	-2.57	1.18	-.34	-2.18	.04

Note: DASS-21 = Depression Anxiety Stress Scales; NGSE = New General Self-Efficacy Scale. Step 1 $R^2 = 0.02$, $\Delta R^2 = 0.02$; Step 2 $R^2 = 0.13$, $\Delta R^2 = 0.12$

Problem-solving

Table 3.4 presents the mean of the total number of means and of the overall effectiveness of the solutions generated on the MEPS for each of the condition. Independent sample t-tests conducted revealed that participants did not significantly differ in terms of the total number of means generated, $t\ (37) = .26$, $p = .79$. However, there was a significant difference in the overall effectiveness of the solutions imagined, $t\ (31.46) = 2.01$, $p < .05$. Participants in C- generated solutions that were less effective than those generated by participants in C+.

Table 3.4

Mean total scores for MEPS means and effectiveness

	Controllability condition **n = 20**	**No-Controllability Condition** **n = 19**
Means	18.20 (5.63)	17.68 (6.54)
Effectiveness	13.80 (2.61)	11.58 (3.85)

Note: Standard deviations appear in parentheses

To examine the relative contribution of experimental condition and mastery of future imaginings to effectiveness scores, a multivariate regression analysis was conducted, predicting the score of total overall effectiveness on the MEPS. Experimental condition was entered in Step 1 and mastery score on the FIT was entered in Step 2. This order of entry allowed to examine firstly the relative contribution of perception of control on effectiveness of problem solutions, and then to examine whether imagining the future as involving more personal mastery also contribute to the generation of more effective solutions when faced with every day problematic situations. Results of the final model are displayed in Table 3.5.

The analyses showed that experimental condition accounted for 11% of the variance in effectiveness scores, F (1, 37) = 4.49, $p < .05$, with less control associated with less effective solutions. However, this contribution became only marginally significant when mastery scores on the FIT were added. Moreover, mastery scores did not add significantly to the explained variance in effectiveness scores.

Table 3.5

Summary of multivariate linear regression model predicting solution effectiveness

Outcome	Variables	*B*	SE *B*	β	*t*	*p*
Solution	Condition	-2.23	1.13	-.33	.1.98	.06
Effectiveness	FIT Mastery	-.003	.15	-.003	-.02	.98

Note: FIT = Future Imagining Task. Step 1 R^2 = .11, ΔR^2 = .11; Step 2 R^2 = .00, ΔR^2 = .00

Discussion

The present study examined the impact of manipulating the degree of control over aversive stimuli on subsequent future imaginings and SPS abilities in a non-clinical population. Several findings emerged. Firstly, consistent with past research experimentally manipulating controllability (e.g. Glass et al., 1969), participants in the no-controllability condition rated the videos as being more distressing than participants in the controllability condition.

Secondly, participants imagined more specific events in response to positive cue words than to negative cue words. This is consistent with past research suggesting that non-clinical individuals exhibit a positive bias when picturing their future (e.g. Berntsen & Bohn, 2010) and that overall positive cues lead to imagine more specific future events (e.g. Dickson & Bates, 2006). However, contrary to the hypothesis, the degree of specificity of the events generated did not differ between participants who could terminate the negative stimuli and those who could not. This lack of significant findings might have been due to the task and the instructions used. Participants were specifically asked to imagine specific future events and given several examples of acceptable and non-acceptable answers. As the sample was taken from a non-clinical population, a ceiling effect might have occurred.

An important finding of this study was that the content of the events imagined differed between conditions. Results showed that when participants believed they had no control over the aversive stimuli, they imagined future events that used less mastery descriptions than participants who could terminate the aversive stimuli. These findings can be explained within the context of the Self Memory System model of autobiographical memory (Conway & Pleydell-Pearce, 2000) which suggests that the retrieval of autobiographical memories is influenced by an individual's current sense of self (i.e. working self). The working self guides the retrieval of memories and the construction of future expectations by activating the autobiographical knowledge consistent with the representation of one's current and future goals. The generation of future events then results from the flexible recombination of details from past experiences that are consistent with the individual's active self-identity and current goals (Schacter & Addis, 2007). In the present study, it is possible that the manipulation of controllability led to changes in the working self which subsequently resulted in the activation of different autobiographical knowledge in accordance with the current sense of self. Participants in the controllability condition for example would be more likely to construct future events by relying on past experiences of successfully controlling their environment.

The hypothesis concerning problem-solving abilities was partially supported. Contrary to what was expected, participants did not differ in the total number of means generated on the MEPS across conditions. This lack of findings might again reflect a ceiling effect. The number of means generated provides a quantitative index of problem-solving abilities which might not be sensitive enough to detect differences in a non-clinical population. Moreover, past research suggests that quantitative scores do not adequately distinguish between different aspects of problem-solving abilities (Marx et

al., 1992). Finally, it should be noted that the inter-rater reliability for the coding of the number of means generated on the MEPS was low, casting a doubt on the useability of this index of problem-solving and rendering any interpretation difficult. Although participants generated the same number of means regardless of their experimental group, consistent with the prediction, those who did not have control over the negative stimulus produced solutions that were less effective than those who had control. This extends findings that lower levels of perceived control are associated with less attempts to solve problems which increase the risk to develop psychopathology (Ross & Mirowsky, 1989).

This study also examined whether future imagining would predict problem-solving abilities but only experimental condition emerged as a significant predictor of the effectiveness of the solutions. This is somewhat surprising as past research suggests that problem solving depends in part on future imagining ability (Brown et al., 2012). However, it is possible that problem-solving relies more on the ability of the individuals to retrieve specific autobiographical memories as suggested by a vast body of research (e.g. Evans et al., 1992; Marx et al., 1992).

We acknowledge that this study had some limitations. First, the difference in gender between conditions might have contributed to some of the findings. Although one study found no effect of gender on problem-solving effectiveness (Goddard, Dritschel, & Burton, 1998), the influence of gender differences in the ability to generate future events and to solve problems is understudied. Moreover, there is evidence that women access their autobiographical knowledge more often and in more specific details than men (Pillemer, Wink, DiDonato, & Sanborn, 2003; Sehulster, 1995). As future imagining and problem solving abilities have been shown to rely heavily on autobiographical memory, the fact that the no-controllability condition was largely

composed of women might have impacted the present results. For example, the tendency for women to be more specific in their memory retrieval might have led them to generate specific future events. As the no-controllability contained a larger proportion of women than the controllability condition, this might have cancelled the effect of the experimental manipulation. This may explain the lack of significant differences between the conditions with regards to the specificity of the future events imagined. Another limitation of this study comes from the fact that the FIT and the MEPS were not counterbalanced. This was a methodological flaw that was not taken into account when the experiment was designed. It is possible that presenting the FIT prior to the MEPS might have contributed to the significant findings regarding problem solving abilities. Although future imagining mastery did not significantly predict the overall effectiveness of the solutions, it is possible that imagining future events activated part of the autobiographical memory knowledge that was subsequently used to generate solutions on the MEPS. As such, the study would have benefitted from presenting these two tasks in a counterbalanced order.

Despite these limitations, this study demonstrated that leading participants to believe they have no control over aversive stimuli led them to imagine less mastery in their future and to generate less effective solutions to everyday problems. This might contribute to the maintenance of elevated levels of distress in these individuals. This thesis now turns to examine whether manipulating controllability also impacts distress tolerance and behavioral avoidance.

Chapter 4: Controllability, Distress Tolerance and Behavioral Avoidance

General Introduction

Chapters 2 and 3 showed that perceiving an aversive stimulation as uncontrollable impacts cognitive processes that have been shown to contribute to maintaining distress in disorders such as depression and PTSD. The previous studies also confirmed previous findings that being exposed to uncontrollable negative events leads to negative emotional states. The question remains as to whether diminished perceived control also has an effect on the way individuals cope with subsequent capacity to cope with negative emotional states.

Literature suggests that individuals suffering from various emotional disorders, including PTSD and depression, exhibit a lower tolerance to distress (e.g. Berenz et al., 2012; Ellis et al., 2012). These populations experience difficulties coping with negative physical and emotional states leading them to avoid engaging with situations that are likely to induce such discomfort, a phenomenon known as behavioural avoidance. Behavioural avoidance encompasses various strategies aimed at controlling, reducing or altering negative internal experiences (e.g. memories, bodily sensations, thoughts, flashbacks) (Hayes et al., 2004). Although these strategies temporarily alleviate distress, they play a key role in the development and maintenance of emotional disorders such as PTSD and depression. Accordingly, research shows that behavioural avoidance resulting from impoverished distress tolerance is associated with increased posttraumatic stress and depression symptomatology (e.g. Dulin & Passmore, 2010). Low distress tolerance and avoidance behaviours are particularly prominent in trauma-related pathologies with individuals constantly trying to avoid reminders of the traumatic event. Thus diminished distress tolerance has been suggested to be a risk factor of these disorders (Vujanovic et al., 2011).

Research also suggests that trauma-related disturbances are more likely to develop in individuals who perceived the traumatic event as being outside of their control (Foa et al., 1992). Further evidence for the role of control on the ability to cope with negative states comes from the literature on coping self-efficacy which shows that individuals who believe having more control over the consequences of a traumatic event exhibit lower reactions to subsequent distressing situations and better behavioural management (Benight & Bandura, 2004; Benight et al., 1999). Interestingly, these studies also show that levels and predictors of coping self-efficacy change over time (Solomon, Benbenishty, & Mikulincer, 1991). It is possible that how controllable the traumatic event was perceived plays a role in this evolution of coping self-efficacy.

There is also some evidence that the appraisal of a traumatic event as uncontrollable is associated with an increased reliance on avoidant coping strategies (Clarke, 2006). Similarly, higher levels of religiosity, which is suggested to provide individuals with an indirect sense of control (Koenig, 2009), have been associated with less avoidance behaviours in populations exposed to terrorist attacks (Korn & Zukerman, 2011).

Together, these studies suggest that the degree to which a traumatic event is experienced as controllable plays a role in the ability to tolerate further distress and the use of behavioural avoidance. The present chapter sought to extend these findings by examining the impact of lack of perceived control on subsequent tolerance to physical (Study 4), cognitive (Study 5) and emotional (Study 6) distress. To do so, the degree of control over aversive stimuli was experimentally manipulated and distress tolerance was indexed by measuring the participants' behavioural avoidance tendencies when exposed to a subsequent distressing task.

Study 4: The Effect of Controllability on Tolerance to Subsequent Physical Distress

Introduction

As outlined above, psychopathologies that are likely to develop as a result of experiencing aversive events as uncontrollable are marked by low distress tolerance. Yet there is a lack of causal evidence on the effect of stressor uncontrollability on subsequent distress tolerance. Low distress tolerance leads to a tendency to rely on behavioural avoidance strategies. Thus measuring behavioural avoidance when faced with a stressful task is a relevant index of the ability of individuals to tolerate distress. One means to assess this response is by the cold water pressor test (CPT). The CPT requires individuals to immerse their forearm in ice cold water. This task has been suggested to validly measure an individual's tolerance to physical discomfort and unwanted bodily sensations (Leyro, Zvolensky, & Bernstein, 2010). This task has also been shown to be sensitive to experimental manipulation. For example, it has been shown that the tolerance to the task is reduced after exposure to a previous stressor (e.g. Willoughby et al., 2002).

Previous research has outlined the role of controllability over a painful stimulus on the ability to tolerate that stimulus (Arntz & Schmidt, 1989) but few studies have examined the role of perceived control over a previous stressor on subsequent tolerance to painful stress. A study by Feldner and Hekmat (2001) found that participants with lower levels of perceived control over anxiety–related events were faster to terminate the CPT than participants who felt more in control. However, the levels of perceived control were assessed by a scale and preclude any causality conclusions.

Accordingly, the present study aimed to examine the impact of experimentally manipulating controllability over a stressor on subsequent distress tolerance on the CPT.

Literature suggests the existence of a relationship between performance on the CPT and pre-existing levels of negative distress. Studies of manipulating controllability in humans also found that experiencing a stressor as uncontrollable leads to more distress (e.g. Geer et al., 1970). Thus, it was hypothesised that participants who had no control over a stressor would be faster to remove their forearms from the ice cold water than the participants who had control. It was further hypothesised that the CPT will induce more distress in participants exposed to the uncontrollable stressor.

Method

Participants

This Study used Sample A which is described in further detail in Study 1 (p. 31, see also Table 1.1) Forty undergraduate psychology took part in the research in return for course credit (30 females, mean age = 19.68, *SD* = 2.23). Participants were randomly allocated to one of two experimental conditions. The two conditions did not significantly differ in terms of key demographic characteristics or baseline measures (see Table 2.1).

Materials

The ***Depression Anxiety Stress Scales – Short Form*** (DASS-21; Lovibond & Lovibond, 1995) and the ***New General Self-Efficacy Scale*** (NGSE; Chen et al., 2001) were administered. These measures are described in detail Study 1 (see also Appendices 2 and 3).

Aversive stimuli. A slideshow of 30 pictures (15 neutral and 15 negative) from the IAPS (Lang et al., 2008) was used, as described in Study 1 (p. 32, see also Appendix 4).

Cold-Pressor Task (CPT). In the CPT, participants were required to immerse their forearm in a bucket of ice-cold water (0-4ºC) for as long as they could. The time

taken by the individuals to terminate the task by removing their forearm from the water was recorded and used as an index of their distress tolerance. If the participants had not removed their forearm within 3 minutes, the task was terminated by the experimenter. The CPT has been successfully used in the past as a laboratory stressor and has been suggested to a be reliable measure of distress tolerance and consequently of behavioural avoidance (Burns et al., 2004).

Procedure

Participants were randomly allocated to one of the conditions upon signing up for one of the experimental sessions. Each session had been randomly assigned an experimental condition using an online random number generator.

Following written informed consent, participants indicated their initial general level of distress by using the same 11-point scale described in Study 1 (0 = *not distressed at all*, 10 = *extremely distressed*). They were then administered the DASS-21 and the NGSE. Participants were then seated in front of a laptop computer and told they would be presented with a series of pictures, some of which might be distressing. The manipulation of controllability was the same as the one used in Study 1 (p. 33, see also Appendix 4), with participants led to believe that they could (controllability condition, C+) or could not (no-controllability condition, C-) press the space bar to move on to the next picture. After viewing all the pictures, participants were again asked to rate their level of distress on the 11-point scale. They were then administered the CPT following which they again indicated their level of distress. Finally, participants were thanked and debriefed as to the general aim of the study.

Results

Participant characteristics

As described in Study 1 (Ch. 2), participants did not differ in terms of baseline measures, age and gender (see Table 2.1).

Levels of distress and ratings of pictures

The means, standard deviations and analysis of the level of distress during the picture slideshow and of the pictures ratings of are presented in Study 1 (Ch. 2) (see Table 2.2). All participants increased distress following the viewing of the pictures, $F(1,38) = 55.91$, $p < .001$, but this occurred comparably for participants in C- and C+ conditions. Participants in C- rated the negative pictures as more distressing than participants in C+, $t(38) = -2.28$, $p < .05$.

The means and standard deviations of the levels of distress prior and after the CPT are presented in Table 4.1. A 2 (Time of Rating) x 2 (Condition) mixed models ANOVA revealed no significant main effects of Condition, $F(1,38) = 1.35$, $p = .25$, or Time of Rating, $F(1,38) = 2.19$, $p = .15$, and no significant interaction, $F(1,38) = .09$, $p = .77$.

Cold-Pressor Task Performance

The means and standard deviations of the time taken by participants in each condition to remove their forearm from the cold water are presented in Table 4.1. An independent sample t-test yielded no significant differences between the groups, $t(38) = -.14$, $p = .89$.

Table 4.1

Levels of distress and performance on the Cold-Pressor Task

	Controllability condition n = 20	**No-Controllability condition n = 20**
DIS_1	4.35 (2.60)	5.25 (2.34)
DIS_2	3.95 (2.26)	4.65 (2.50)
Time to remove forearm *(sec)*	75 (61.57)	77.80 (63.99)

Note: Values indicate means with standard deviation in parentheses. DIS_1 = Level of distress prior to cold-pressor task; DIS_2 = Level of distress after the cold-pressor task.

Summary of findings

Study 4 aimed to examine the impact of experimentally manipulating perceived control over an aversive stimulus on subsequent ability to tolerate physical distress. Contrary to the hypothesis, experiencing a stressor as uncontrollable did not impact participants' performance on the CPT. Participants spent the same amount of time with their forearm in ice cold water regardless of their experimental condition. Further, the manipulation of controllability did not affect differentially the level of distress induced by the CPT. It should be noted that the CPT did not increase distress in any of the participants. The means of the levels of distress suggested that participants felt less distressed after the CPT than they did prior to the task in both conditions.

Study 5: The Effect of Controllability on Tolerance to Subsequent Cognitive Distress

Introduction

Study 4 did not find evidence of the role of stressor controllability on subsequent distress tolerance. However, the lack of significant findings might have been due to the

task chosen to assess distress tolerance as the CPT did not significantly increase distress in any participants.

Using a painful task to induce distress is only one of the methods used in the literature. Other studies examining distress tolerance have relied on the use of difficult cognitive tasks that have been shown to reliably increase stress in participants, such as the PASAT-C (Lejuez et al., 2003). The PASAT-C indexes persistence on a difficult cognitive task, and thus premature termination of the task reflects lowered tolerance to feelings of frustration. As such the PASAT-C captures a different aspect of distress tolerance than the CPT (Leyro et al., 2010). In this task, individuals are sequentially presented with numbers and required to continually sum the two most recently presented digits and to give their answer prior to the presentation of the next digit. The time between digit presentation increases across the different levels of the task. During the third and final level, participants are given the option to quit the task whenever they want to. The time taken to terminate the task is suggested to reflect behavioural avoidance tendencies and thus to index distress tolerance. The PASAT-C has been shown to elicit stress and negative affect in participants (Tombaugh, 2006). It has been widely used as a measure of distress tolerance and of the ability to persist on a difficult task in various clinical populations, including trauma exposed individuals (e.g. Tull et al., 2013).

The aim of the current study was to examine the impact of manipulating controllability over aversive stimuli on subsequent cognitive distress tolerance. Early human studies manipulating control have shown that lacking control has been associated with less persistence on a subsequently cognitive frustrating task (e.g. Glass et al., 1969). Accordingly, it was hypothesized that participants who thought they had no control over the termination of the aversive stimuli would be faster to terminate the

PASAT-C than participants who thought they had control. It was also hypothesized that in participants with no control, a greater increase in anxiety and distress levels will be observed.

Method

Participants

This study used Sample B, which is described in further details in Study 2 (p. 40, see also Table 1.1). The sample comprised 32 undergraduate students (18 females, mean age = 19.38 years, *SD* = 1.91) who participated in the study in return for course credit. Participants were randomly allocated to one of the two experimental conditions. There were no significant differences on the demographic characteristics or baseline measures between the two conditions (see Table 2.5).

Materials

The ***Depression Anxiety Stress Scales – Short Form*** (DASS-21; Lovibond & Lovibond, 1995) and the ***New General Self-Efficacy Scale*** (NGSE; Chen et al., 2001) were administered. These measures are described in detail Study 1 (see also Appendices 2 and 3).

Aversive stimuli. The same eight videos as used in Study 2 were used and are described in more detail in Study 2 (p. 40, see also Appendix 7).

Manipulation Check. To check whether the manipulation of controllability was effective, participants were asked the same question described in Study 2 (p. 41) and gave their answer on the same 11-point Likert scale (0 = *I had no control at all*, 10 = *I had full control*).

Modified Computer Version of the Paced Auditory Serial Addition Task (PASAT-C; Lejuez et al., 2003). The PASAT-C was used to assess distress tolerance. In this modified computer version of the standard PASAT, participants were presented

with a series of digits on a computer screen and asked to add the two most recently presented digits. A keypad with numbers ranging from 1 to 20 was also pictured on the screen and participants answered by clicking on the correct number. After providing their answer, participants had to ignore the sum and add the newly presented digit to the previous one. If they did not answer or gave a wrong answer, a loud bursting noise was delivered through a pair of headphones. Participants were asked to get the highest score possible and could keep track of their score in a box in the right hand corner of the screen. The task consisted of 3 levels of increasing difficulty which varied in interstimulus interval (ISI) duration and total trial duration. Level 1 lasted for 3 minutes with an ISI of 3 seconds. ISI decreased to 2 seconds for level 2 and 1 second for level 3 while the total duration increased to 5 minutes and up to 10 minutes, respectively. A one minute break was given between each level. During level 3, participants were given the option to terminate the task early by clicking on a box on the screen labelled "Quit Task". Although participants were encouraged to get the highest score possible at the start of the task, they were also informed that when they decided to terminate the task during level 3 was entirely up to them. The time taken to quit level 3 was recorded and used as a measure of the participants' distress tolerance level and behavioural avoidance tendency. Following the description of the PASAT-C by Lejuez et al. (2003), a self-rating scale, ranging from 0-100 and asking participants to indicate their level of anxiety, was presented on the screen prior to level 1 and prior to level 3.

The PASAT-C has been shown to induce stress and anxiety in participants and has been extensively used as a measure of distress tolerance and behavioural avoidance in clinical and non-clinical population (e.g. Ellis, Fischer, & Beevers, 2010)

Procedure

Participants were randomly allocated to one of the conditions upon signing up for one of the experimental sessions. Each session had been randomly assigned an experimental condition using an online random number generator.

Following written informed consent, participants indicated their initial general level of distress by using the same 11-point scale described in Study 1 (0 = *not at all distressed*, 10 = *extremely distressed*) and asked to complete the DASS-21 and the NGSE. Participants were then told that they were about to watch a series of distressing videos. Using the same instructions as in Study 2 (pp. 41-42, see also Appendix 7), controllability was manipulated by telling participants that they could (controllability condition, C+) or could not (no-controllability condition, C-) stop the video if they find it too aversive. The same yoking procedure as in Study 2 (p. 42) was used to ensure all participants were exposed to each video for the same duration. Following the task, participants were asked the manipulation check question and indicated their level of distress. Instructions about the PASAT-C were then given and right before starting the task, the level of distress was again assessed. Participants completed the PASAT-C following which they indicated one last time their general level of distress. Finally, participants were debriefed and thanked.

Results

Participants characteristics

As described in Study 2 (Ch. 2), participants did not differ in terms of baseline measures, age and gender (see Table 2.5).

Manipulation check

Independent sample t-tests were conducted to examine whether the manipulation of controllability was effective. The results of the analysis are presented in Study 2 (pp.

43-44) and indicated that participants in C- perceived less control over the termination of the videos than participants in C+.

Levels of distress for the video task and ratings of videos

The means, standard deviations and analysis of the level of distress before and after the video task and of the video ratings are presented in Study 2 (see Table 2.6). The video task significantly increased distress in all participants and this increase was significantly larger for participants in C- than in C+, $F(1,30) = 4.40$, $p < .05$. However, participants in C- did not rate the videos as more distressing than participants in C+.

PASAT-C

Table 4.2 presents the means and standard deviations on the different indices of the performance and reaction to the PASAT-C. To examine whether the experimental manipulation affected the time taken to quit level 3, an independent sample t-test was conducted. No significant difference was observed between the two experimental conditions, $t(30) = .59$, $p = .56$.

Table 4.2

Means and standard deviations of the PASAT-C indices

	Controllability condition n = 16	**No-Controllability condition n = 16**
Time to quit PASAT-C *(sec)*	187.06 (251.28)	138.13 (213.39)
DIS_1	1.87 (1.93)	2.81 (2.32)
DIS_2	3.56 (2.39)	5.56 (2.16)
ANX_1	17.69 (23.72)	21.63 (23.19)
ANX_2	27.69 (29.32)	47 (28.55)

Note: Values indicate means with standard deviation in parentheses. DIS_1 = Level of distress prior to the PASAT-C; DIS_2 = Level of distress after the PASAT-C; ANX_1 = Anxiety rating prior to Level 1 of the PASAT-C; ANX_2 = Anxiety rating prior to Level 3 of the PASAT-C

A 2 (Time of Rating) x 2 (Condition) mixed models ANOVA of levels of distress revealed a significant main effect of Condition, $F(1,30) = 4.08$, $p < .05$ and a significant main effect of Time of Rating, $F(1,30) = 61.83$, $p < .001$. Overall, the PASAT-C significantly increased distress in all participants, and participants in C- were more distressed overall than participants in C+. The interaction was not significant but approached statistical significance, $F(1,30) = 3.54$, $p = .07$. Independent sample t-tests showed that although the levels of distress were not significantly different between the two conditions prior to the start of the PASAT-C, the level of distress after completion of the task was significantly higher in C- than in C+, $t(30) = -2.48$, $p < .05$.

Finally, a 2 (Time of Rating) x 2 (Condition) mixed models ANOVA of anxiety ratings revealed a significant main effect of Time of Rating, $F(1,30) = 32.78$, $p < .001$, and a significant interaction, $F(1,30) = 6.19$, $p < .05$. The PASAT-C significantly increased anxiety levels in all participants but the increase was significantly larger for participants in C- than in C+. No significant main effect of Condition was observed.

Prediction of Anxiety Increase

To examine the relative contribution of participants' characteristics and experimental condition to increase in anxiety generated by the PASAT-C, a multivariate linear regression was conducted with anxiety increase (computed as the difference between anxiety prior to the start of Level 3 and anxiety prior to the start of Level 1) as an outcome variable. DASS-21 Anxiety Scores and Self-Efficacy Scores were entered in Step 1, and condition was entered in Step 2.

Multicollinearity analyses conducted prior to the regression analyses indicated little evidence for problematic multicollinearity among variables, with VIF values ranging from 1.00 to 1.02 across all independent variables. Table 4.3 presents the final model for the equation. DASS-21 Anxiety and Self-Efficacy Scores accounted for

20.3% of the variance. When condition was added, an additional 16.4% of the variance in anxiety increase was predicted, F (1,28) = 7.25, $p < .05$, with less controllability associated with a larger increase in anxiety. In the final model, only DASS Anxiety scores and uncontrollability emerged as significant predictors of the variation in anxiety increase.

Table 4.3

Summary of multivariate linear regression model predicting anxiety increase on the PASAT-C

Outcome	Variables	*B*	SE *B*	β	*t*	*p*
Anxiety	DASS-21 Anxiety	1.12	.40	.42	2.80	.009
Increase	NGSE	-.32	.58	-.08	-.54	.590
	Condition	15.07	5.60	.41	2.69	.012

Note: DASS-21 = Depression Anxiety Stress Scales; NGSE = New General Self-Efficacy Scale. Step 1 $R^2 = .20$, $\Delta R^2 = .20$; Step 2 $R^2 = .37$, $\Delta R^2 = .16$

Summary of results

Study 5 aimed to examine the impact of manipulating perceived control over aversive stimuli on subsequent cognitive distress tolerance. Contrary to the hypothesis, participants in the no-controllability condition did not terminate the PASAT-C earlier than participants in the controllability condition, suggesting that participants kept persisting on the cognitive frustrating task regardless of their condition. However, experiencing a previous stressor as uncontrollable led participants to report higher increase in anxiety levels during the task. Moreover, linear regression analysis showed that over and above individual difference factors, controllability emerged as a significant independent predictor of the anxiety increase produced by the PASAT-C.

Finally, partially confirming the hypothesis, the PASAT-C significantly increased distress in participants and there was a trend for participants in the no-controllability condition to report higher levels of distress after the PASAT-C than did the participants who could control the duration of the aversive stimuli.

Study 6: The Effect of Controllability on Tolerance to Subsequent Emotional Distress

Introduction

Study 5 found mixed results regarding the impact of stressor uncontrollability on tolerance for cognitive distress. One final aspect of distress tolerance that requires attention is the ability to withstand and stay engaged with emotional stimuli that produce negative mood. The impoverished tolerance to emotional distress leads individuals to actively avoid engaging with negative stimuli. This is particularly prominent in trauma-related pathologies.

One task used to assess tolerance to emotional distress consists of presenting participants with negative stimuli, such as aversive pictures, and to monitor their disengagement from these stimuli by measuring the time taken to terminate contact with the stimuli (Cooper et al., 2013). The aim of the current study was to examine the impact of perceived control over a stressor on the ability to tolerate subsequent emotional distress. One previous study used a similar design and showed that participants with no perceived control displayed more avoidance of the negative pictures (Bryant et al., 2014). Accordingly, it was hypothesised that participants in the no-controllability condition would terminate the display of the negative pictures earlier than participants in the controllability condition. It was further hypothesised that the

picture viewing task will lead to more distress in participants with no-controllability and to a more negative rating of the aversive images.

Method

Participants

This study used Sample D (see Table 1.1), which consisted of 29 undergraduate psychology who took part in the research in return for course credit (13 females, mean age = 19.28 years, *SD* = 2.03). Participants were randomly allocated to one of the experimental conditions.

Materials

The ***Depression Anxiety Stress Scales – Short Form*** (DASS-21; Lovibond & Lovibond, 1995) and the ***New General Self-Efficacy Scale*** (NGSE; Chen et al., 2001) were administered. These measures are described in detail Study 1 (see also Appendices 2 and 3).

Aversive stimuli. Participants were connected to an electric shock stimulator and presented with a slideshow of two different geometrical figures of two different colours (red circle, green circle, red triangle, green triangle). They were informed that the red circle could signal that an electric shock would follow whereas the triangles and green circle were safety signals indicating no shock. Each figure was displayed for a total of two seconds and a blank screen followed for four seconds. A fixation cross displayed for three seconds preceded the display of a new figure. In total, 12 safety signals (i.e. red and green triangles and green circle) and six red circles were presented. In reality, no shock was ever delivered. The task was programmed with Inquisit (V 4.0.4.0) and was presented to the participants on a 23.5 inch screen of a desktop computer. Threatening participants of receiving electrical shock has previously been used in

research and been shown to reliably induce stress in participants (e.g. Bryant et al., 2014).

Manipulation Check. To check whether the manipulation of controllability was effective, participants were asked how much they thought being able to prevent the shocks from happening was under their control and had to indicate their answer on an 11-point Likert scale (0 = *Not under my control at all*, 10 = *Fully under my control*).

Behavioural Avoidance task. To assess participants' ability to withstand negative emotions, participants were exposed to a slideshow of ten negative and ten neutral pictures taken from the IAPS (Lang et al., 2008) (see Appendix 14). The negative pictures selected represented various types of negative events (e.g. death, mutilated bodies) that scored high on arousal. Participants were told that they could move on to the next picture at any time they wanted by pressing '*enter'* on the keyboard. The time spent looking at each negative picture was used as an index of distress tolerance (i.e. an index of behavioural avoidance). The task was presented on a desktop computer using Inquisit (V 4.0.4.0). The program recorded the latency to press enter. This method has been used as a valid measure of distress tolerance of negative emotional states (Cooper et al., 2013).

Procedure

Participants were randomly allocated to one of the conditions upon signing up for one of the experimental sessions. Each session had been randomly assigned an experimental condition using an online random number generator.

Following written informed consent, participants indicated their initial general level of distress by using the same 11-point scale described in Study 1 (0 = *not at all distressed*, 10 = *extremely distressed*). They were then administered the DASS-21 and the NGSE. An electrode delivering electric shock was then placed on the second finger

of their dominant hand. An individual calibration procedure took place for each participants, with actual shocks being delivered to the finger. Participants were told that the shocks should be unpleasant but not painful and were asked to set an acceptable intensity of the shock. Although no shock was actually delivered during the task, the calibration took place so that participants would not get suspicious and realised that the generator delivered actual shocks. Once the calibration was done, participants were told that they were going to see red and green triangles and circles and that red circles might predict that a shock would be delivered. They were informed that the shock would happen after the circle disappeared from the screen and that not every red circle would be follow by a shock but that they had no way of knowing which of the red circles would announce a shock. They were also instructed that the shocks could be delivered at the beginning, at the end or throughout the task. Controllability was manipulated by telling participants in the controllability condition (C+) that they could press the space bar when they were seeing the red circles to prevent the shock from happening. Participants in the no-controllability (C-) were told that they could not do anything to prevent the shocks from happening (see Appendix 13 for full instructions). After the task ended, participants were again asked to rate their level of distress on the 11-point scale and were asked the manipulation check question. They were then administered the secondary stressing task following which they again indicated their level of distress. Finally, participants were thanked and debriefed as to the general aim of the study.

Results

Participant characteristics

Participant characteristics are presented in Table 4.4. Independent sample t-tests showed no significant differences between the two conditions in terms of demographic

variables and baseline measures, $p > .05$. A chi-square on gender also revealed that the sex-ratio did not differ between the two groups.

Manipulation Check

An independent sample t-test showed that the manipulation of controllability was effective. Participants in C+ reported feeling significantly more in control over the prevention of the shocks ($M = 6.73$, $SD = 2.74$) than participants in C- ($M = 1.07$, $SD = 2.13$), $t(27) = 6.18$, $p < .001$.

Table 4.4

Participant characteristics and levels of distress according to experimental group

	Controllability Condition *n* = 15	**No-Controllability Condition *n* = 14**
Number of females	6 (*40.0%)*	7 (*50.0%*)
Age	19.47 (2.03)	19.07 (2.01)
DASS-21		
Anxiety Scale	5.87 (4.24)	6.14 (5.74)
Depression Scale	10.40 (9.89)	6.00 (4.96)
Stress Scale	10.40 (7.83)	8.43 (6.38)
NGSE	29.67 (4.86)	29.36 (4.34)
DIS_1	3.00 (3.01)	2.00 (1.80)
DIS_2	2.20 (2.11)	2.71 (1.94)
DIS_3	3.40 (2.38)	3.57 (2.03)

Note: Values indicate means with standard deviation in parentheses. DASS = Depression Anxiety Stress Scales; NGSE = New General Self-Efficacy Scale. DIS_1 = Baseline level of distress; DIS_2 = Level of distress after threat of shock; DIS_3 = Level of distress after behavioural avoidance task

Levels of distress

The means and standard deviations for the ratings of distress at baseline (DIS_1), after the threat of shock (DIS_2) and after the behavioural avoidance task (DIS_3) is

presented in Table 4.4 and the distress levels across the experiment are illustrated in Figure 4.1.

A 3 (Time of Rating) x 2 (Condition) mixed models ANOVA yielded a significant main effect of Time of Rating, $F(2,54) = 8.34$, $p < .001$, and a significant Time x Condition interaction, $F(2,54) = 3.88$, $p < .05$. No significant main effect of Condition was found. A contrast analysis indicated that between Time 1 and Time 2, only the Time x Condition interaction was significant, $F(1,27) = 15.32$, $p < .001$. Follow-up analysis showed that after threat of shocks, distress significantly increased in participants in C-, $t(13) = -3.24$, $p < .01$, but significantly decreased for participants in C+, $t(14) = 2.57$, $p < .05$.

Contrasts also indicated that between Time 2 and Time 3, only a main effect of Time of Rating was significant $F(1, 27) = 11.16$, $p < .01$, indicating that the behavioural avoidance task led to an increase in distress for all participants, regardless of their experimental condition. The interaction between condition and time of rating was not significant, indicating that the manipulation of controllability did not alter the ratings of distress after, relative to before the behavioural avoidance task, $F(1,27) = .31$, $p = .58$.

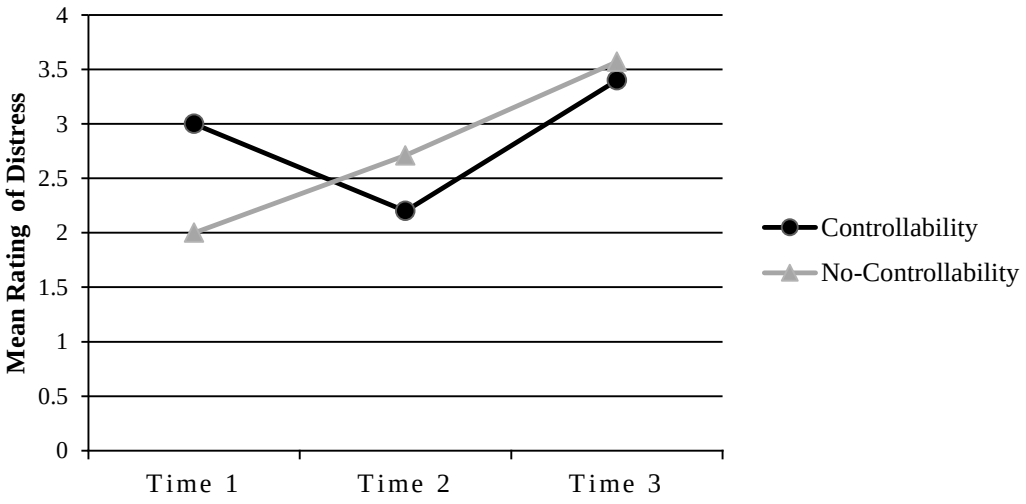

Figure 4.1. Evolution of mean ratings of distress level at baseline (Time 1), after threat of shock (Time 2) and after the behavioural avoidance task (Time 3) for each experimental group.

Behavioural avoidance task

The means and standard deviations of the time spent viewing negative and neutral pictures as well as the ratings of these pictures is presented in Table 4.5.

Viewing times

A 2 (Valence) x 2 (Condition) mixed models ANOVA of viewing time revealed a significant main effect of Valence, $F(1, 27) = 16.33$, $p < .001$, indicating that overall participants spent more time watching the negative pictures than the neutral pictures. There was also a significant main effect of Condition, $F(1,27) = 12.29$, $p < .01$, with participants in C- spending less time viewing both neutral and negative pictures than participants in C+, suggesting that participants who were led to believe they could not prevent the shocks from happening were more avoidant overall. However, the Valence x Condition interaction was not significant, $F(1,27) = .06$, $p = .80$, indicating that manipulation of controllability did not significantly alter the viewing time of negative

relative to neutral pictures. That is, participants in C- spent less time viewing all pictures, both negative and neutral.

Table 4.5

Mean time spent viewing pictures and mean ratings of the pictures in the behavioural avoidance task

		Controllability condition n = 15	No-Controllability condition n = 14
Viewing time (ms)			
	Neutral picture	3286.74 (999.53)	1960.80 (793.76)
	Negative picture	4372.16 (1842.27)	2919.38 (1133.64)
Rating			
	Neutral picture	.52 (.64)	.71 (.92)
	Negative picture	4.66 (2.09)	5.30 (2.25)

Note: Values indicate means with standard deviation in parentheses

Picture ratings

A 2 (Valence) x 2 (Condition) of picture ratings revealed a significant main effect of Valence only, $F(1,27) = 168.41$, $p < .001$. Participants, regardless of their experimental condition, rated the negative pictures as more distressing than the neutral ones. However, participants in C- rated all the pictures as equally distressing as participants in C+, $F(1,27) = .69$, $p = .41$. The interaction between condition and valence was non-significant, indicating that the experimental manipulation did not alter the ratings of negative relative to neutral pictures, $F(1,27) = .44$, $p = .51$.

Predictors of negative pictures viewing time

To further explore the factors that may have impacted the time participants spent viewing negative pictures, a multivariate linear regression was undertaken. We note that the interaction between condition and valence was not significant. However, we had a

specific hypothesis that lack of control should be impacting on negative rather than neutral pictures. Thus it was a theory driven prediction that the factors may impact on valence differentially and regression analysis were conducted accordingly. The DASS-21 Anxiety and the Self-Efficacy scores were entered in Step 1, and Condition in Step 2. The VIF values were acceptable across all variables. Anxiety and Self-Efficacy scores did not significantly account for any of the variance in viewing time, $F(2,26) = 2.72$, $p = .08$. The addition of experimental condition significantly increased the predicted variance by 18%, $F(1,25) = 6.85$, $p < .05$.

In the final model, self-efficacy scores and condition emerged as significant predictors of negative pictures viewing time, with higher self-efficacy associated with longer viewing times and less perceived control associated with shorter viewing times. The final model for the equation is presented in Table 4.6.

Table 4.6

Summary of multivariate linear regression model predicting negative pictures viewing time

Outcome	Variables	*B*	SE *B*	β	*t*	*p*
Negative	DASS-21 Anxiety	-37.05	55.13	-.11	-.67	.51
pictures	NGSE	141.43	59.85	.38	2.36	.03
viewing time	Condition	-1398.77	534.39	-.42	-2.62	.01

Note: DASS-21 = Depression Anxiety Stress Scales; NGSE = New General Self-Efficacy Scale. Step 1 $R^2 = .17$, $\Delta R^2 = .17$; Step 2 $R^2 = .35$, $\Delta R^2 = .18$

General Discussion

This chapter aimed to examine whether manipulating controllability over an aversive situation impacted tolerance to different types of subsequent distress. The

studies yielded mixed results, with levels of control differentially affecting tolerance to physical, cognitive and emotional distress.

In Study 4, no significant effect of stressor controllability on the ability to tolerate a subsequent painful stimulus was found. Contrary to the hypothesis, participants who were led to believe they had no control over the initial stressor left their forearm in ice cold water for a similar duration as participants who thought they had control over the initial stressor. This goes against previous findings that individuals who perceive less control over anxiety-related events are likely to terminate the CPT earlier than individuals who perceive more control (Feldner & Hekmat, 2001). Several reasons might explain the current result. Firstly, the CPT might not have been sufficiently distressing enough to motivate participants to avoid persisting in the task in order to avoid the negative emotion associated with it. Indeed, the data showed that all participants reported similar levels of distress prior to and after the CPT. Moreover, following some previous studies(e.g. Smeets, Otgaar, Candel, & Wolf, 2008), participants were asked to remove their arms from the cold water after a maximum time of 3 minutes. However, in some studies, the time limit is set at 5 minutes (e.g. Willoughby et al., 2002). Thus, it is possible that a ceiling effect occurred in our study and that differences between groups would have emerged if a longer time limit had been used. Alternately, the nature of the initial stressor might have been responsible for the lack of significant findings. It is possible that if the distressing task over which controllability was manipulated had been of a physical nature (e.g. electric stimulation), a difference between the two experimental conditions would have emerged. Indeed, past research has shown that lacking control over a physically uncomfortable stressor decreases the ability to tolerate this stressor (Arntz & Schmidt, 1989). This could then extend to decrease the tolerance of a secondary physically uncomfortable task. Future

research would benefit from examining this proposition. Finally, the CPT, although widely used as a measure of distress tolerance, is also a task that induces pain. No measure was included to control for pre-existing levels of pain tolerance which might have confounded the present findings. It should also be noted that one limitation of the study was the lack of inclusion of a manipulation check to ensure that the manipulation of controllability was effective. Thus, it cannot be certain that during the first stressing task, participants in the no-controllability condition did feel less in control than participants in the controllability condition. The fact that the CPT did not lead to an increase in distress for any of the participants is surprising as this task has extensively been used as a way to induce stress in a laboratory setting. One difference between past research and the present study is that studies using the CPT as an index of distress tolerance tend to not assess the distress levels before and after the task; as such past studies do not allow to evaluate the evolution of distress levels when the task is used to measure distress tolerance (e.g. Burns et al., 2004; Willoughby et al., 2002). The studies which have shown an increase in the levels of distress after the task are those which use the CPT as a laboratory stressor, requiring participants to leave their hand in the water for a period specified (e.g. 3 minutes) prior to the start of the task (e.g. Cahill, Gorski, & Le, 2003). It could also be that participants did not leave their hands in the cold water for a period long enough to induce distress. Moreover, avoidance strategies (e.g. avoiding thoughts or places associated with an aversive event, misuse of alcohol) have been shown to provide short-term relief of distress (e.g. Leyro et al., 2010). Thus the lack of increase in distress levels might have resulted from the use of avoidance.

Finally, instructing participants to remove their hands whenever they wanted to might have given them a sense of control over the task. Past research has shown that when individuals believe they have control over a painful stimulus, they experience it as

less painful (e.g. Muller & Netter, 2000). This could have led the participants to evaluate the task as less painful and thus less distressing.

Study 5 found that participants who appraised an aversive situation as uncontrollable were subsequently more distressed and experienced more anxiety during a cognitively frustrating task suggesting that reduced perceptions of control might impair the ability to regulate negative emotions. Moreover, it was found that the increase in anxiety was not a simple reflection of baseline anxiety level as the experimental manipulation independently predicted some of the variation in anxiety levels. However, this increase in adverse emotionality did not translate to higher avoidance tendencies as participants persisted on the PASAT-C for equal duration regardless of their condition. Although this may suggest that perceived control does not impact behavioral avoidance of distress brought upon by cognitive frustration, other explanations might be considered. One factor that might have influenced the results with regards to the persistence on the task is the population itself. Participants were all university students and a desirability bias might have occurred. Exposing them to a cognitively challenging task may have activated a desire to achieve at a high standard and this may have motivated them to persist on the task for longer duration. Alternatively, the lack of difference in quitting time might reflect a tendency to terminate the task earlier in all participants because it was too difficult. Despite the lack of difference in task persistence between the conditions, the main finding emerging from Study 5 is that experiencing an initial stressor as uncontrollable led to higher anxiety and distress in response to a second aversive situation.

An opposite pattern of results emerged in Study 6. While participants in the no-controllability condition did not experience higher levels of distress as a result of viewing negative threatening pictures compared to participants in the controllability

condition, they exhibited more behavioural avoidance tendencies. This provides preliminary evidence that experiencing a stressor as uncontrollable might reduce the ability to tolerate further emotional distress leading to a reliance on maladaptive behavioural strategies aimed at avoiding staying in contact with aversive situations. This is in line with studies showing that individuals who experienced a traumatic event as uncontrollable also report using more avoidant coping strategies (Korn & Zukerman, 2011) and that impoverished perceived control over a laboratory stressor lead to reduced distress tolerance (Bryant et al., 2014). The findings of Study 6 must be interpreted with caution as the behavioural avoidance observed in participants exposed to the uncontrollable stressor was not specific to the negative pictures. Participants were also faster to stop watching the neutral pictures. However, it should be noted that in clinical populations, avoidance strategies can be generalized to a wide range of situations that are not limited to the immediate source of threat (Smith & Bryant, 2000). As neutral pictures were randomly inserted among the negative ones, it is possible that participants in the no-controllability condition were motivated to avoid the task as a whole. The fact that the picture viewing task did not induce more distress in participants who did not have control over the first stressor is somewhat surprising. However, avoidance is a strategy known to reduce distress in the short-term. Thus the lack of difference in the levels of distress after the task might have resulted from the use of avoidance. Finally it should be noted that self-efficacy has been suggested to be influence the ability of people to persist in a task when faced with adversity (Bandura, 2001). Accordingly, self-efficacy scores were found to significantly predict the time participants spent viewing the negative pictures, with higher self-efficacy associated with longer viewing times. However, the manipulation of controllability was shown to

predict viewing times beyond the effect of self-efficacy suggesting that avoidance did not simply result from lower self-efficacy levels in participants.

The findings from this series of studies present a somewhat mixed picture of the effect of stressor controllability on subsequent distress tolerance and the interpretation of the results must be considered with precautions. Nevertheless, this chapter provides some preliminary evidence that experiencing a distressing stimulus as uncontrollable impairs the ability to cope with further distress which might put a person at risk of developing trauma-related pathologies.

Chapter 5: Lack of Control, Loss of Control and Hypervigilance

Study 7: The Effect of Lack and Loss of Control on Attentional and Interpretation Bias towards Threat

Introduction

Trauma-related pathologies are characterized by a constant state of hypervigilance towards threat which is suggested to play a key role in the maintenance and potentially etiology of the disorders (e.g. Ehlers & Clark, 2000). This leads individuals to allocate their attentional resources towards the monitoring of their environment in order to facilitate the detection of potential threats (e.g. Eysenck et al., 2007; Kimble et al., 2014). Accordingly, numerous studies have shown that individuals with PTSD exhibit an attentional bias towards threat (Buckley et al., 2000). This pattern results in an enhanced detection of threat, as well as difficulties in disengaging from the threatening stimulus once it has been detected (Bryant et al., 1995). This effect has been demonstrated using different experimental paradigms, the most common one being the Emotional Stroop Task. In the Emotional Stroop, participants are presented with threatening and neutral words and asked to name the color in which the word is written. Longer latencies to name the color of trauma-related words compared to neutral words purportedly measure the selective allocation of attentional resources to the meaning of the threatening word. Indeed, when administered the Emotional Stroop, individuals with PTSD take longer to color name trauma-related words compared to neutral words (e.g. Foa, Feske, Murdock, Kozak, & McCarthy, 1991; McNally, Kaspi, Riemann, & Zeitlin, 1990).

Hypervigilance in anxiety disorders and PTSD results in, and is maintained by, an interpretation bias towards threat which leads to appraise ambiguous situations as threatening and dangerous. This provides individuals with evidence that a threat is

present even there is none, increasing anxiety and arousal which in turn enhances attentional bias towards threat (Chemtob et al., 1988). Accordingly, research has found that individuals with PTSD tend to expect more threatening outcomes when presented with ambiguous scenarios (Kimble, Batterink, Marks, Ross, & Fleming, 2012). Similarly, traumatized individuals with PTSD have been shown to make more threatening interpretation of ambiguous situations (Kimble et al., 2002) and to have difficulties inhibiting the threatening meaning of homographs (Amir, Coles, & Foa, 2002).

Hypervigilance is a normal response to the experience of a traumatic event, however in some individuals it persists and eventually leads to the development of trauma-related pathologies in which perceived control of the acute stressor is thought to play a key role. Yet there is a lack of research examining the impact of depleted levels of control over an aversive situation on subsequent hypervigilant tendencies. Perceiving a traumatic event as outside of one's control could lead to the perception that the world is uncontrollable and thus more likely to be interpreted as threatening which would also enhance the monitoring of the environment for potential threats. Accordingly, the first aim of the present study was to examine whether experimentally manipulating controllability over an aversive situation impacts hypervigilance in a non-clinical population.

An additional aim to this study was to investigate the potential differential effect of losing control with no prior warning compared to not having control at all. Although some animal studies suggest that the experience of control immunizes against the adverse effect of subsequent uncontrollability (Williams & Maier, 1977), others suggest that losing control leads to more aversive consequences than never having had control (Weiss, 1971). Foa et al. (1992) proposed that these seemingly contradictory findings

might be explained by the influence of context. Losing controllability in a situation where previous control was held would have a pathogenic effect, while prior experiencing of control would be protective when the loss of control occurs in a context dissimilar to the one associated with prior controllability.

Self-reported levels of perceived control over environmental situations have been shown to predict a threatening interpretation of ambiguous information (Zvolensky et al., 2001). Similarly, the belief that one has no control over the sequelae of a trauma has been suggested to lead to the perception that the environment is more threatening (Benight & Bandura, 2004). Moreover, some studies suggest that losing control in a situation that was previously associated with perceived control leads to more adverse effects than simply lacking control (Foa et al., 1992; Mineka & Kihlstrom, 1978). Accordingly, it was hypothesized that participants who lost control over an aversive situation would exhibit an increased attentional bias towards threat, would make more threatening interpretations of ambiguous scenarios and would be more distressed than participants who never had control over the situation and participants who had full control. It was also hypothesized that participants who never had any control would show more hypervigilance (i.e. attentional and interpretation bias towards threat) and distress than participants who had full control.

Method

Participants

Sample E was used in this study (see Table 1.1). Fifty-eight undergraduate psychology students enrolled in the research in return for course credit (34 females, mean age = 20.36 years, *SD* = 5.72). Participants were randomly allocated to one of the experimental conditions.

Materials

The ***Depression Anxiety Stress Scales – Short Form*** (DASS-21; Lovibond & Lovibond, 1995) and the ***New General Self-Efficacy Scale*** (NGSE; Chen et al., 2001) were administered. These measures are described in detail Study 1 (see also Appendices 2 and 3).

Revised National Adult Reading Test (NART-R; Nelson & Willison, 1991). To ensure that the participants had an appropriate level of English and thus could understand the words on the Emotional Stroop, the NART-R was used. In this task, participants are required to read out loud a list of 50 words with an irregular pronunciation. The words were presented in a black font on a white background, on a 23.5 inch computer screen. A cut-off score of 10 was used as an exclusion criteria from the study. However, none of the participants scored less than 10 on the task.

Aversive stimuli. Participants were exposed to a task programmed with Inquisit (V 4.0.4.0) in which a series of aversive tones was delivered through a set of headphones. The tone used was produced with the NCH Tone Generator Software (V 3.12, NCH Swift Sound, Australia). It was a mono, square wave tone, of 1000 Hertz delivered equally across both left and right channels at a constant volume of 81 dB. The tone duration varied from 5 to 10 seconds and the intertrial interval ranged from 2 to 18 seconds. Two blocks of 5 minutes were used, each comprised of 15 tones. Halfway through each block, two scales appeared successively on the screen. One was asking participants to rate how distressed they were feeling on a scale from 0 to 9 (0 = *not at all distressed*, 9 = *extremely* distressed). The second one asked participants to rate how much they believed the termination of the tones was under their control on a scale from 0 to 9 (0 = *not under my control at all*, 9 = *fully under my control*). Participants

indicated their answers by pressing the corresponding number key on the keyboard. The order of presentation of the scales was counterbalanced across the two blocks.

Manipulation Check. To check whether the manipulation of controllability was effective, participants were asked to rate how much control they thought having over the termination of the tone across the task and had to indicate their answer on a 10-point Likert scale (0 = *no control at all*, 9 = *full control*).

Emotional Stoop task. To assess attentional bias towards threat, an Emotional Stroop task was used. Sixteen threatening (e.g. "*harm*", "*danger*") and 16 neutral (e.g. "*speak*", "*asked*") words were used (see Appendix 17). Negative and neutral words were matched for frequency of use and length. The task was programmed in Inquisit (V 4.0.4.0). The words were presented on a desktop computer with a 23.5 inch screen, in uppercase letters (Arial, 37 pts, bold), in either red, green, yellow or blue colour against a black background. The order of presentation of the words and the colours was randomised. The inter-trial interval between each word was 300 milliseconds. The word remained on the screen until a vocal answer was detected by the computer through a standard microphone connected to the computer. Participant were instructed to ignore the meaning of the word and to name the colour of the word as quickly and accurately as possible. Participants' responses and responses latencies were digitally recorded. Each word was presented twice in each colour, yielding a total of 128 trials.

Prior to the beginning of the task, participants received 10 practice trials in which four neutral words were used.

Interpretation Bias. The interpretation bias task was adapted from cognitive bias modification paradigms (Mathews & Mackintosh, 2000). Participants were presented with a series of ten ambiguous scenarios taken from a previous study of interpretation bias (Lothmann et al., 2011) (see Appendix 18). Each scenario was

preceded with a title and participants were asked to carefully read both the title and the scenario and to imagine that the situation was happening to them. After each scenario, participants were asked to rate how well they understood the scenario they just read. After they read all ten scenarios, participants were presented with four statements that had a similar meaning to the original situation but had a different wording. Two of the statements depicted a positive or negative interpretation of the original scenario (targets). The two remaining statements were related to the emotional valence of the situation but contained details that were not included in the original scenario (foils). The four statements were presented sequentially and were accompanied by the title of the original situation. Participants were asked to rate how similar each statement was to the scenario on a 4-point scale (1 = *not at all similar*, 4 = *very similar*).

Procedure

Participants were randomly allocated to one of the conditions upon signing up for one of the experimental sessions. Each session had been randomly assigned an experimental condition using an online random number generator.

Following written informed consent, participants first indicated their initial general level of distress by using the same 10-point scale as the one used during the tone task. They were then administered the NART. If their score was more than 10 on the NART they were invited to continue with the experiment. They subsequently completed the DASS-21 and the NGSE. They were then exposed to the aversive tones task. To manipulate controllability, participants received different instructions depending on the experimental group they had been assigned to. Participants in the controllability condition (C+) and the loss of controllability condition (C+/-) were given the same set of instructions and informed that if the tones were too aversive, they could press the space bar to stop them. However, participants in the C+/- condition lost their

control over the termination of the tones halfway through the task (i.e. at the start of block 2) without any instructions about the altered conditions. Participants in the no-controllability (C-) were told that they could not do anything to stop the tones and had to keep listening to them until the program terminated them (see Appendix 16 for full instructions). To ensure that participants were exposed to tones of equal duration, the yoking procedure was as follows. The time taken by each participant in C+ and C+/- to press the space bar during the first block of the experiment was recorded and averaged. The duration of each tone for the yoked participant in C- was then reduced accordingly. For the second block of the task, the time taken by each participant in C+ to stop each of the tone was recorded and assigned to the duration of the tones for one yoked participant in C+/- and one yoked participant in C-.

After the task, participants were asked to rate their level of distress on the 10-point scale and were asked the manipulation check question. They were then administered the Emotional Stroop and the interpretation bias task. Finally, participants were thanked and debriefed as to the general aim of the study.

Emotional Stroop Task data analysis

Recorded responses were scored for accuracy and error trials were removed (1.2%). Additionally, trials with response times (RT) of less than 300 ms and more than 1500 ms were removed to eliminate premature responses and abnormally long RT as these are usually caused by a defect in the vocal detection program. This removed a further 2.2% of the data. RT for the remaining trials were then averaged separately for threatening and neutral words.

Results

Participant characteristics

Participant characteristics are presented in Table 5.1. One way ANOVAs revealed that the three experimental group did not significantly differ in terms of demographic variables and baseline measures ($p > .05$). A chi-square revealed that the sex ratio did not differ between the groups.

Table 5.1

Participant characteristics according to experimental group

	Controllability Condition	**Loss of Controllability Condition**	**No-Controllability Condition**
	***n* = 20**	***n* = 18**	***n* = 20**
Number of females	13 (*65%*)	10 (*55.6%*)	11 (*55%*)
Age	21.00 (8.00)	18.83 (.79)	21.10 (5.52)
NART	28.45 (6.13)	26.50 (5.79)	29.05 (5.35)
DASS-21			
Anxiety Scale	4.40 (3.28)	4.78 (4.45)	7.90 (7.35)
Depression Scale	6.80 (9.48)	3.89 (3.60)	9.60 (8.60)
Stress Scale	12.00 (7.37)	9.11 (5.87)	12.00 (8.68)
NGSE	28.95 (5.35)	29.06 (4.19)	31.15 (4.23)

Note: Values indicate means with standard deviation in parentheses. NART= National Adult Reading Test; DASS = Depression Anxiety Stress Scales; NGSE = New General Self-Efficacy Scale.

Manipulation checks

The mean ratings of the level of perceived control over the termination of the tones made by each experimental group at the end of the task (overall manipulation check) and during the task (loss of controllability check) are presented in Table 5.2.

Overall Manipulation Check

A one-way ANOVA showed that the perception of control was significantly different between groups, $F(2,55) = 55.65$, $p < .001$. Post-hoc comparisons revealed that participants in C+/- reported feeling significantly more in control overall during the task than participants in C- ($p < .001$) but significantly less in control overall than participants in C+ ($p < .001$). Additionally, participants in C+ felt more in control overall than participants in C- ($p < .001$).

Table 5.2

Mean ratings of control according to experimental group

	Controllability Condition	**Loss of Controllability Condition**	**No-Controllability Condition**
	***n* = 20**	***n* = 18**	***n* = 20**
Control overall	6.85 (2.13)	4.22 (1.66)	1.00 (1.38)
Control T_1	6.25 (2.20)	7.61 (1.61)	1.30 (1.17)
Control T_2	7.00 (2.38)	3.83 (2.62)	.95 (1.15)

Note: Values indicate means with standard deviation in parentheses. Control overall = Ratings of levels of Perceived control overall during the task; Control T_1 = Ratings given during the first part of the tone task; Control T_2 = Ratings given during the second part of the tone task.

Loss of Controllability Manipulation Check

A mixed models 2 (Time of Rating) x 3 (Condition) ANOVA of control ratings during the task revealed a main effect of Time of Rating, $F(1,55) = 17.90$, $p < .001$. Overall, the ratings of control were lower at Time 2 than at Time 1. A significant main effect of Condition, $F(2,55) = 63.44$, $p < .001$ was also found, showing that across the task, participants in C- felt less in control than participants in C+ ($p < .001$) and participants in C +/- ($p < .001$). Finally, a significant Time x Condition Interaction was observed, $F(2,55) = 25.44$, $p < .001$. Specifically, ratings of control decreased significantly at Time 2 relative to Time 1 in the C+/- condition only ($p < .05$).

Overall, these analyses show that participants who lost control during the task reported lower levels of perceived control at Time 2 compared to Time 1, whereas the ratings of participants who had control the whole time and of those who never had control did not differ between Time 1 and Time 2.

Levels of distress

Figure 5.1 illustrates the distress levels reported by participants in each condition before, during and after the tone task. A 4 (Time of Ratings) x 3 (Condition) mixed models ANOVA on mean ratings of distress yielded a significant main effect of Time of Rating, $F(3,165) = 67.99$, $p < .001$. Participants reported significantly higher levels of distress during the first part of the task than at baseline, $F(1,55) = 113.65$, $p < .001$. The levels of distress for all participants were not significantly different between the first part and the second part of the task, $F(1,55) = .00$, $p = .99$, but they significantly decreased between the second part of the task and after the task, $F(1,55) = 46.90$, $p < .001$. Finally, the levels of distress were significantly higher after the task than at baseline for all participants, $F(1,55) = 39.88$, $p < .001$.

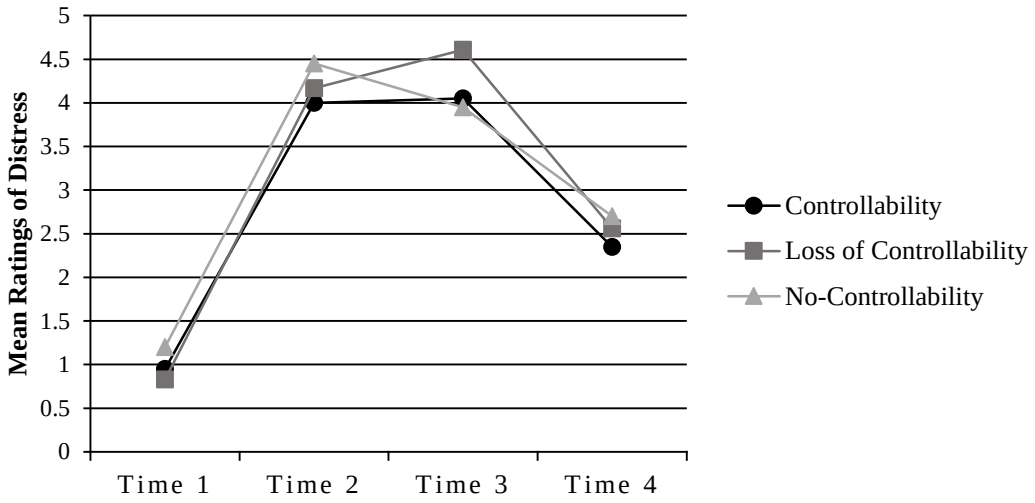

Figure 5.1. Evolution of mean ratings of distress level at baseline (Time 1), during the first part of the tone task (Time 2), during the second part of the tone task (Time 3) and after the task (Time 4) for each experimental group.

Emotional Stroop task

Table 5.3 presents the mean reaction times to threatening and neutral words for participants in each experimental condition. A 2 (Word Type) x 3 (Condition) mixed models ANOVA on reaction times did not yield any significant main or interaction effect. Participants took as long to color name threatening words as they did for neutral words, regardless of whether they previously held, lacked or lost controllability over the tone task.

Table 5.3

Mean reaction times on the Emotional Stroop Task

	Controllability Condition	**Loss of Controllability Condition**	**No-Controllability Condition**
	***n* = 20**	***n* = 18**	***n* = 20**

Threatening Words (*ms*)	605.86 (77.37)	646.93 (102.45)	629.09 (78.69)
Neutral Words (*ms*)	608.38 (71.43)	639.40 (90.60)	631.34 (81.54)

Note: Values indicate means with standard deviation in parentheses.

Interpretation bias task

The mean ratings of similarity to the original ambiguous scenario given to each type of statement (negative and positive targets, negative and positive foils) by the participants are presented in Table 5.4. A multivariate ANOVA was used to analyse the similarity ratings of each type of statements. No significant differences were found between the groups on any of the statement types, suggesting that all participants, regardless of their condition, made similar interpretations of the ambiguous scenarios.

Table 5.4

Mean similarity ratings of each statement type on the interpretation bias task

	Controllability Condition ***n* = 20**	**Loss of Controllability Condition** ***n* = 18**	**No-Controllability Condition** ***n* = 20**
Targets			
Negative	2.56 (.51)	2.38 (.45)	2.68 (.58)
Positive	2.32 (.55)	2.44 (.42)	2.47 (.51)
Foils			
Negative	2.02 (.50)	1.93 (.39)	2.03 (.53)
Positive	2.17 (.56)	2.28 (.45)	2.32 (.44)

Note: Values indicate means with standard deviation in parentheses.

Discussion

Study 7 aimed to examine on one hand the impact of stressor controllability on hypervigilance, and also whether loss of controllability was more pathogenic than never having control.

Contrary to the hypothesis, the manipulation of controllability was not found to have an effect on hypervigilance. Regardless of their experimental condition, participants did not exhibit an attentional bias towards threat, evidenced by similar latencies to color name threatening words in all the groups. Participants who never had control during the task and those who lost control did not interpret ambiguous scenarios as being more threatening compared to participants who had control the whole time. This goes against previous correlational findings showing that lower levels of perceived control over anxiety-related events and over trauma consequences are associated with a tendency to appraise the environment as being more threatening (Benight & Bandura, 2004; Zvolensky et al., 2001).

Several factors might explain the present results. First, it is possible that the lack of significant findings were due to the tasks chosen to assess attentional and interpretation bias. Although the Emotional Stroop has been widely used in the literature, the task sometimes fails to identify differences in color naming latencies between experimental groups, arguably because of the marked variability in responses. For example, in a review of the literature which included peer-reviewed articles and dissertations abstracts, Kimble, Frueh, and Marks (2009) found that only 8% of the studies reviewed found an interference effect due to threatening words in PTSD samples. They concluded that a publication bias might explain the robust effect of the Emotional Stroop reported in the literature and that it might not be a reliable measure of attentional bias. Other tasks used in the literature to index attentional bias such as the

dot-probe task or the use of eye-tracking paradigms might have yielded different results. Similarly, the interpretation bias task was adapted from research on cognitive bias modification in which participants undergo an interpretive bias modification training that present similarities with the task used to subsequently assess threat-related interpretation bias. Used on its own, it is possible that it is not sensitive enough to detect differences amongst participants. Replicating the current study using a different task such as a word completion sentence task might lead to different results.

It is also possible that the words and scenarios used in the tasks were not perceived by the participants as threatening. Although the words chosen for the Emotional Stroop were evaluated as negatively valenced and arousing according to standardized norms (Bradley and Lang, 1999) and the scenarios were adapted from past research, no questions were included to check that the sample specific to this study perceived the stimuli as threatening. Alternately, it could be that the tone task was not personally relevant enough to the participants and that this reduced the effect of the experimental manipulation. It is possible that if the aversive stimulus had a specific significance to the participants, they would have experienced the loss/lack of control as more distressing. Unfortunately, no questions were included to measure the personal interest of the participants in the tone task.

Finally, it is possible that hypervigilance is not directly affected by trauma controllability but rather results from other perceived aspects of the aversive event, and/or from the individuals' pre-dispositional factors. For example, heightened trait anxiety or anxiety sensitivity have been shown to be associated with increased hypervigilance towards threat (Fox, Russo, & Dutton, 2002; McNally, Hornig, Hoffman, & Han, 2000). Participants might have differed on these trait variables which are likely to remain unaffected by the manipulation of uncontrollability.

It should also be noted that, contrary to the hypothesis, the self-reported levels of distress did not differ between participants. That is, no evidence was found for a more pathogenic effect of loss of controllability. This is inconsistent with propositions from past research that losing control in a context similar to one in which control was previously experienced leads to more negative outcomes than never having had control (Foa et al., 1992). Animal research suggests that experience of controllability should have an immunizing effect over subsequent uncontrollability (Moye, Coon, Grau, & Maier, 1981) but no evidence for this proposition was found either. The lack of differences in distress might have been due to the design of the task. Although tone duration and occurrence were varied to try and minimize habituation, it is possible that habituation did occur and that by the time the loss of control occurred, the tones were not aversive enough to produce the desired effect. It could also be that the measure of distress did not accurately index the participants' emotional stated as self-report measures can be subject to bias.

This thesis now turns to examining the impact of lacking controllability and losing controllability on a physiological index of emotional regulation response, heart rate variability.

Chapter 6: Lack of Control, Loss of Control and Emotion Regulation

Study 8: The Effect of Lack and Loss of Control on Resting Heart Rate Variability

Introduction

The previous chapters have focused on examining the impact of stressor controllability on self-reported emotional response and on some of the main psychological processes impaired in trauma-related pathology. In Chapter 5, no evidence was found for the impact of loss or lack of controllability on distress. However, the study relied on a self-report measure of distress which might be subject to bias. It is possible that this effect may be reflected more sensitively on a physiological measure. Additionally, Chapter 4 showed some preliminary evidence of the role of uncontrollability on subsequent distress tolerance which is one dimension of the larger construct of emotion regulation.

Difficulties in emotion regulation are regarded as a core aspect in many emotional disorders, including those that develop following a traumatic event. Emotion regulation skills involve the use of extrinsic and intrinsic processes that aim to modulate the experiential, behavioural and physiological responses to an emotional situation (Gross, 1998). Effective emotion regulation relies on the ability to correctly identify, appraise and modify an emotional experience (Gratz & Roemer, 2004). Individuals with low emotion regulation skills have difficulties in one or more of these areas, failing to regulate their emotional experiences. This leads to the use of maladaptive regulatory strategies that are implemented rigidly and unspecific to a particular context in an attempt to produce the desired emotional outcome. These strategies lead to long-term negative consequences and contribute to maintaining emotion regulation deficits (Werner & Gross, 2010).

Deficits in emotion regulation skills have been associated with poor mental health (Gross & Muñoz, 1995) and have been observed in individuals affected by trauma-related pathology. For example, deficits in emotion regulation have been found in individuals suffering from PTSD (Ehring & Quack, 2010; Kulkarni et al., 2013) and depression (Berking et al., 2014). Neuroimaging studies suggest that PTSD might result from dysfunctional emotion regulation systems more so than in other anxiety disorders (Etkin & Wager, 2007). Impaired emotion regulation skills have also been associated with posttraumatic symptoms severity in non-clinical population exposed to traumatic events (O'Bryan, McLeish, Kraemer, & Fleming, 2014) and have been shown to contribute to functional impairment in survivors of childhood sexual abuse seeking treatment for PTSD (Cloitre, Miranda, Stovall-McClough, & Han, 2005).

Recent theories have identified cardiac vagal tone (CVC) as a physiological index of emotion regulation. CVC has been suggested to reflect the activity of the vagus nerve on the heart and as such to quantify the influence of the parasympathetic nervous system which is involved in emotion regulation (Thayer, Friedman, Borkovec, Johnsen, & Molina, 2000). The Polyvagal theory developed by Porges provides an account of the functional role of CVC, positing that the vagus nerve acts as a vagal break, inhibiting arousal and allowing for the calm behavioural states necessary to engage with the environment and social communication (Porges, 1995). The action of the vagus nerve can also quickly be withdrawn in situations requiring the mobilization of the organism, such as facing danger. Although CVC cannot be measured directly, it can be inferred by measuring HRV. Thus higher CVC, as indexed by higher HRV, reflects the dynamic regulation of autonomic reactivity that allows the individual to rapidly engage with, or withdraw from, the environment depending on the demands of the environment. This

enables an adaptive, context-specific and goal oriented regulation of emotions (Thayer, Ahs, Fredrikson, Sollers, & Wager, 2012; Thayer & Lane, 2000).

Accordingly, studies have found that higher resting levels of HRV were associated with better emotion regulation skills (Thayer & Lane, 2009) and that HRV increased during the successful application of adaptive, context-appropriate emotion regulation strategies (e.g. Melzig, Weike, Hamm, & Thayer, 2009; Smith et al., 2011). Lower HRV has been observed in individuals with PTSD (e.g. Hauschildt et al., 2011) and depression (e.g. Kemp et al., 2012). Studies have also found that re-experiencing the trauma during script-driven imagery decreased HRV (Hauschildt et al., 2011) and that lower levels of HRV assessed in the days following a trauma predicted severity of subsequent posttraumatic stress (Shaikh al arab et al., 2012).

Together these results highlight the critical role of emotion regulation deficits, as reflected by lower HRV, in trauma-related pathology. Some research suggests that difficulties in emotion regulation might not be a pre-existing attribute of individuals suffering from these disorders but rather are fuelled by the experience of pathology and in turn contribute to maintaining the disorders (Kulkarni et al., 2013). It is possible that experiencing a lack or loss of controllability over the traumatic event is one factor responsible for the impairment of emotion regulation skills, which would in turn contribute to the development of psychopathology.

Despite the key role given to emotion regulation deficits in psychopathologies where stressor uncontrollability is thought to be critical, no research has specifically examined the impact of lacking or losing control over an aversive situation on subsequent emotion regulation response. Preliminary evidence for a relationship between stressor controllability and emotion regulation comes from the suggestion that effective emotion regulation skills help reduce feelings of helplessness in individuals by

allowing them to effectively cope with the consequences of a problematic situation, contributing to restoring a sense of control (Radkovsky et al., 2014).

Accordingly, the aim of the present study was to examine the impact of lack and loss of stressor controllability on emotion regulation, as assessed by HRV, during the recovery period from a stressing task. It was hypothesised that participants who lost control during the task would exhibit a larger decrease in HRV while recovering from a stressing task than participants who had control the whole time and those who never had control. It was also predicted that the decrease in HRV would be larger for individuals who never had control than for those who had control the whole time.

Method

Participants

This Study used Sample E which is described in further details in Study 7 (p. 95, see also Table 1.1). Fifty-eight undergraduate psychology students took part in the research in return for course credit (34 females, mean age = 20.36, *SD* = 5.72). Participants were randomly allocated to one of the experimental conditions.

Materials

The ***Depression Anxiety Stress Scales – Short Form*** (DASS-21; Lovibond & Lovibond, 1995) and the ***New General Self-Efficacy Scale*** (NGSE; Chen et al., 2001) were administered. These measures are described in detail in Study 1 (see also Appendices 2 and 3).

Aversive stimuli. The same series of 30 loud tones (mono, square wave, 1000 Hz) described in Study 7 (pp. 96-97) were delivered equally across both left and right channels through a set of headphones at a constant volume of 81 dB.

Psychophysiological Apparatus and Recording. Electrocardiograms signals (ECG) were obtained via three disposable electrodes placed in a triangular configuration

(below the collarbone and back of the neck). The ECG were recorded digitally with a biological amplifier (Bio Amp ML135; ADInstruments Australia) connected to a data acquisition system (Powerlab ML880; ADInstruments Australia). The apparatus was connected to a desktop computer operating with Windows 7. The data was recorded at a sampling rate of 1000 Hz and the low pass filter was set at 50Hz during the recording. The data was stored securely on the hard drive.

Some studies have argued for the need to monitor breathing during measurement to control for respiration frequency and use this as a covariate in subsequent statistical analyses (Saul, Berger, Chen, & Cohen, 1989). However, Houtveen, Rietveld, and de Geus (2002) suggested that respiration might affect changes in HRV under condition of intense breathing (e.g. exercise) but that during activities that do not lead to variation in respiration (i.e. resting period and laboratory stress tasks), HRV is an accurate index of CVC (and emotion regulation) without controlling for respiration. Thus, breathing was not monitored during recording.

Manipulation Check. To verify that the controllability manipulation was effective, the same question as the one used in Study 7 (p. 97) was asked at the end of the task.

Procedure

Participants were randomly allocated to one of the conditions upon signing up for one of the experimental sessions. Each session had been randomly assigned an experimental condition using an online random number generator.

A schematic illustration of the procedure is presented in Figure 6.1. Following written informed consent, participants indicated their initial general level of distress by using the same 10-point scale described in Study 7 (0 = *not at all distressed*, 9 = *extremely distressed*). Participants were then seated in front of a desktop computer and

connected to the physiological apparatus. They were then administered the DASS-21 and the NGSE, allowing them to get acclimatised to the physiological setting. They were then told they would be hearing a series of loud unpleasant tones through a pair of headphones while their heart rate would be recorded. They were instructed to sit as still as possible for the duration of the task so as to obtain accurate and clear physiological data. The manipulation of controllability was the same as the one used in Study 7 (pp. 98-99, see also Appendix 16), with participants led to believe that they could (controllability condition, C+ and loss of controllability condition, C+/-) or could not (no-controllability condition, C-) press the space bar to terminate each tone. Unbeknown to the participants in the loss of controllability condition, during the second part of the task, pressing the space bar did not have any effect on the tone duration. The same yoking procedure as the one used in Study 7 (p. 99) was used to ensure all participants were exposed to tones of the same duration.

After the instructions were given, heart rate was recorded during a resting period to establish a baseline measurement of HRV as HRV varies considerably from one person to the other (Jennings, Kamarck, Stewart, Eddy, & Johnson, 1992). Consequently, the aversive tone task started (2 blocks of 5 minutes). This was followed by another resting period allowing to assess HRV during recovery and thus the changes in emotion regulation brought about by the aversive stimulus during the recovery period. Heart rate was continuously recorded throughout the tone task and the two resting periods. In line with previous recommendations, the recording time of each period was set to 5 minutes (Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, 1996). At the end of the second resting period, electrodes were removed and participants were asked to indicate their level of distress on the 10 point scale. They were then asked the manipulation

check question. Finally, participants were thanked and debriefed as to the general aim of the study.

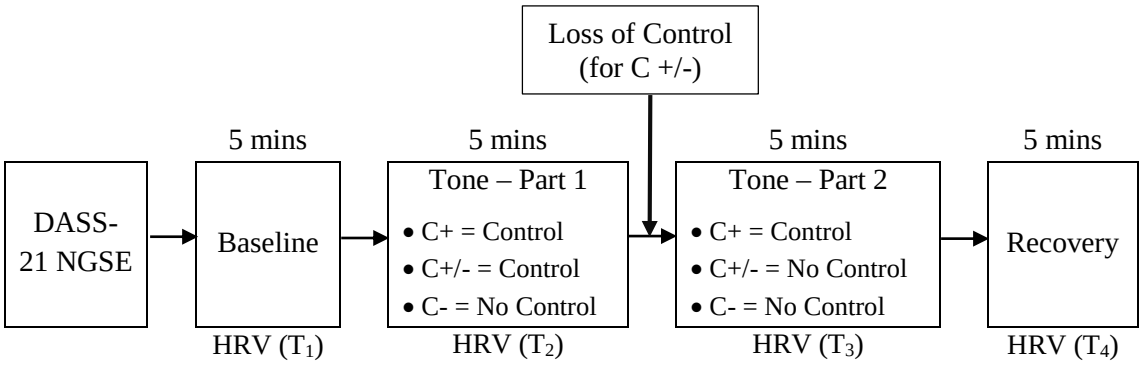

Figure 6.1. Procedure summary

Physiological Data Analysis

The digitally recorded heart rate data was analysed using the HRV module of the Labchart software (V 7; ADInstruments). The data was manually corrected for artifacts. The data from two participants from the controllability condition were excluded because of excessive noise in the recording. The analyses were performed on the data from the remaining 56 participants. One frequency domain (High Frequency power, HF) and one time domain parameters of HRV were derived for each of the four 5-minute periods (i.e. baseline, first part of the tone task, second part of the tone task and recovery). HF was chosen over low frequency power (LF) as some research argues that LF reflects sympathetic and not parasympathetic activity, or that it is a measure of both parasympathetic and sympathetic activity (Eckberg, 1997). Conversely, HF is argued to assess the influence of the parasympathetic branch on HRV and thus is a widely accepted measure of the flexibility of CVC (e.g. Levy, 1990). The absolute HF was derived from the power spectral analysis of the RR intervals of the high frequency band (0.15-0.40 Hz) computed by Lomb Periodogram using Labchart software.

The time domain parameter computed was the square root of the mean squared difference of successive RR intervals (RMSSD). RMSSD has been shown to provide an estimate of short term high-frequency variations in heart rate. Thus it is commonly used as a measure of the parasympathetic activity on HRV (i.e. CVC) (Porges & Byrne, 1992) with some studies arguing that it is less sensitive to variations in breathing and thus is a better index of CVC than spectral analysis (Penttilä et al., 2001). RMSSD has been shown to be highly correlated to HF (Berntson, Lozano, & Chen, 2005) and more so than other time domain measures such as the standard deviation of all normal RR intervals (SDNN; Kleiger et al., 1991).

Both HF and RMSSD were transformed into standardised Z-scores to reduce the skewness of their distribution.

Results

Participants characteristics

As described in Study 7 (Ch. 5), participants did not differ in terms of baseline measures, age and gender (see Table 5.1).

Manipulation checks

The mean ratings of the level of controllability perceived overall (overall manipulation check) and during the task (loss of controllability check) are presented in Study 7 (see Table 5.2). The analysis showed that the experimental manipulation was effective, with participants in the loss of controllability condition reporting significantly lower levels of perceived control than participants in the controllability condition but higher levels than participants in the no-controllability condition. The analysis also showed that during the task, a significant decrease in the ratings of controllability between time 1 and time 2 was only observed in the loss of controllability condition (see Study 7, pp. 100-101).

Levels of distress

A 4 (Time of Ratings) x 3 (Condition) mixed models ANOVA of self-reported distress found a significant main effect for Time of Rating was found with distress significantly increasing between baseline and the first part of the task, remaining the same between the first and second part of the task and significantly decreasing between the second part of the task and after the task. The task overall also significantly increased distress in all participants (see Study 7, pp. 101-102; see also Figure 5.1).

Heart rate variability

Time domain parameter (RMSSD)

The mean of the untransformed RMSSD measure during the four periods for the three experimental groups are presented in Figure 6.2. A 4 (Time) x 3 (Condition) mixed models ANOVA was conducted on standardized RMSSD and yielded a significant Time x Condition interaction, $F(6,159) = 2.18$, $p < .05$. No significant main effect of Time or of Condition was found, $p > .05$. To further analyse this interaction, and in line with the aim of the experiment to examine the impact of controllability on HRV during recovery from a stressor, three separate 2 (Time, baseline vs recovery) x 2 (Condition) mixed models ANOVAs were conducted comparing the different experimental groups.

Controllability vs Loss of Controllability

The ANOVA showed no significant main effect of Time or of Condition, $p > .05$. However, a significant Time x Condition Interaction was found, $F(1,34) = 5.44$, $p < .05$, indicating that RMSSD changed differently in the Controllability and the loss of Controllability Condition. Paired Sample t-tests revealed that RMSSD significantly decreased from baseline to recovery in the Loss of Controllability condition, $t(17) =$

2.77, $p < .05$. In the Controllability condition, RMSSD during recovery was not significantly different from RMSSD during baseline, $t(17) = -1.00$, $p = .33$.

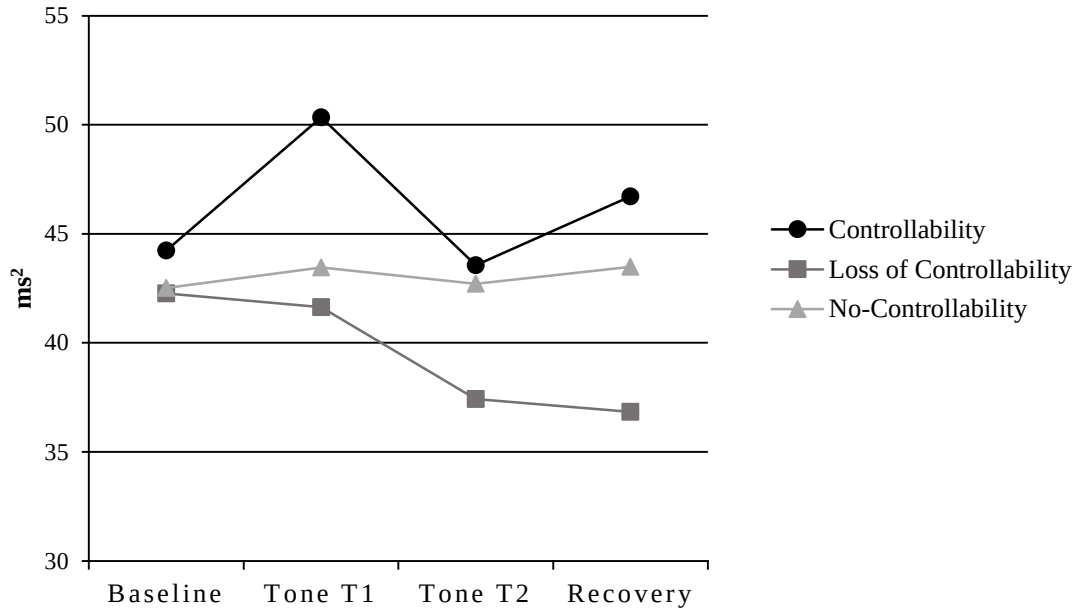

Figure 6.2. Mean RMSSD during each recording period by experimental condition.

Controllability vs No-Controllability

No significant main effect of Time, $F(1,36) = 1.17$, $p = .29$, or of Condition, $F(1,36) = .11$, $p = .74$, was found. The Time x Condition interaction was also not significant, $F(1,36) = .19$, $p = .67$. This indicates that HRV levels remained identical from baseline to recovery for the Controllability and the No-Controllability condition.

Loss of Controllability vs No-Controllability

The ANOVA did not find a significant main effect of Time or of Condition. However, it yielded a marginally significant Time x Condition interaction, $F(1,36) = 3.93$, $p = .055$. Condition had a differential impact on the evolution of RMSSD from baseline to recovery. Subsequent paired sample t-tests showed that while RMSSD stayed did not differ between baseline and recovery in the No-Controllability condition,

$t(19) = -.49$, $p = .63$, it significantly decreased in the Loss of Controllability Condition, $t(17) = 2.77$, $p < .05$. Together, these analyses show that a significant decrease in RMSSD occurred only in the Loss of Controllability condition indicating that the manipulation of Controllability had an impact on HRV during recovery from a stressor.

Frequency domain parameter (HF)

The mean of the untransformed HF measure during the four recording periods for the three experimental groups are presented in Figure 6.3.

A 4 (Time) x 3 (Condition) mixed models ANOVA on standardized HF yielded a significant Time x Condition interaction, $F(6,159) = 2.27$, $p < .05$. To identify the differences between the groups and in line with the hypothesis of the study, the analysis was broken down in three separate 2 (Time, baseline vs recovery) x 2 (Condition) mixed models ANOVAs allowing to contrast each of the experimental group.

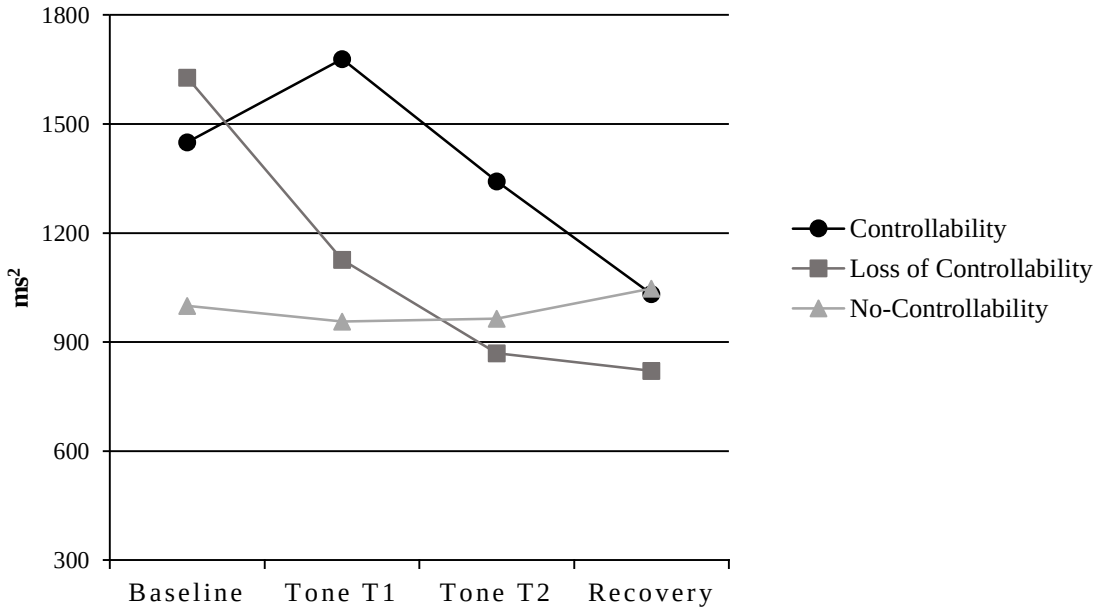

Figure 6.3. Mean HF during each recording period by experimental condition.

Controllability vs Loss of Controllability.

No significant main or interactive effects emerged from the ANOVA, $p > .05$, indicating that HF levels were not significantly different during recovery relative to baseline and that loss of controllability did not significantly alter the evolution of HF.

Controllability vs No-Controllability

Similar to the previous analysis, the 2 (Time, baseline vs recovery) x 2 (Condition, Controllability vs No-Controllability) mixed models ANOVA yielded no significant main or interaction effect, $p > .05$. The change in HF from baseline to recovery was not significantly different for the No-Controllability condition compared to the Controllability Condition.

Loss of Controllability vs No-Controllability

The ANOVA comparing the changes in HF from baseline to recovery between the Loss of Controllability and the No-Controllability conditions did not yield a significant main effect of Time or of Condition, $p > .05$. However, a significant Time x Condition interaction was found, $F(1,36) = 5.08$, $p < .05$, indicating that Condition had a differential impact on changing HF from baseline to recovery. Specifically, while HF increased in the No-Controllability condition, it decreased in the Loss of Controllability condition. Subsequent paired sample t-tests showed that the increase in the No-Controllability condition and the decrease in the Loss of Controllability condition were not statistically significant, $p > .05$. The interaction effect nevertheless indicates that relative to the no-Controllability condition, participants in the Loss of Controllability had lower levels of HF during recovery ($p < .05$).

Discussion

The present study aimed to examine the impact of having, losing and lacking controllability over a stressor on emotion regulation ability, indexed by HRV, while

recovering from the stressor. The hypotheses were partially supported. Time domain analyses of HRV showed that, as predicted, participants who lost controllability during the stressing task exhibited a larger decrease in HRV during recovery compared to participants who had control and those who never had control. However, contrary to the hypothesis, HRV was not significantly impacted in the lack of controllability condition relative to the controllability condition. Frequency domain analyses of HRV only yielded a larger decrease in HRV in the loss of Controllability condition compared to the lack of controllability condition, partially supporting the hypothesis.

The different findings emerging from the analysis of the two indices of HRV might be explained by the fact that RMSSD and HF reflect two types of analysis of HRV. Although literature has shown that RMSSD and HF highly correlate with each other and reliably index the dynamic influence of the parasympathetic nervous system (e.g. Berntson, Lozano, & Chen, 2005; Task Force, 1996) , other factors can differentially affect these measures. For example, frequency domain measures such as HF have been suggested to be more sensitive to variations in breathing, making time domain measures such as RMSSD a more valid index of vagal tone (Penttilä et al., 2001).

Despite the seemingly contradictory patterns emerging from the RMSSD and HF analysis of HRV, the important finding from this study lies in the fact that losing controllability led to a larger decrease in HRV relative to having or never having control. This suggests that when individuals perceive losing control during an aversive situation, they have more difficulties regulating their emotional arousal while recovering from this stressor which will impact on their ability to regulate their emotions. Deficits in emotion regulation have been shown to lead to poor psychological outcomes (Werner & Gross, 2010) and put the person at risk of developing

psychopathology (Kulkarni et al., 2013). Moreover, past research has found that lower HRV is associated with a delayed recovery from a psychological stressor (Weber et al., 2010). Thus the perception that control was lost over a traumatic event might slow down the recovery from a traumatic event, contributing to the maintenance of negative emotionality and eventually putting the individual at risk of developing trauma-related pathology.

The present findings can be explained within the framework of the neurovisceral integration model of HRV (Thayer & Lane, 2000), which suggests that HRV is controlled by different brain regions via the vagus nerve. The vmPFC has been proposed to be one of these regions via its role in perception and appraisal of threat (Thayer et al., 2012). Animal studies have highlighted the critical role of the vmPFC in the detection of control and in mediating the effect of stressor controllability on subsequent impairments. Thus it might be that losing control over a stressor impacts HRV via its effect on the vmPFC.

The fact that participants in the No-Controllability condition did not exhibit emotion regulation difficulties during recovery, as evidenced by the lack of difference in HRV during recovery relative to baseline, is somewhat surprising. One possible explanation for this finding is that participants in the No-Controllability condition apparently were characterized by lower HRV relative to other conditions at the outset of the experiment. Although not statistically significant, Figure 6.2 demonstrates that there was a tendency for No-Controllability to have lower HRV at baseline than those in the other conditions, and this may have impacted their vagal response to the stressor.

The present study was not without limitations. The fact that the same tone was presented several times over an extended period of time might have led to habituation in participants. Although the length of the tone task was necessary to obtain reliable

recording of heart rate, the use of tones of different frequencies might have been useful. Additionally, the present study did not assess smoking, sleep history, caffeine use and other potential covariates that are known to affect heart rate. This could have impacted on the HRV indexes analysed. It should also be noted that this study did not index other indicators of emotion regulation that would complement our physiological measure and reflect other aspects of emotion regulation. Thus there is no way to verify that the significant changes in HRV reflect impoverished emotion regulation rather than being the physiological arousal brought upon by the physically challenging task.

The conclusions from this study must also be considered tentatively, particularly considering the inconsistency between the time-domain and frequency domain analysis. Nevertheless, this study provides preliminary evidence for the pathogenic role of losing control on the ability to flexibly regulate autonomic arousal during the recovery period from a stressor, indicating difficulties in managing emotional responding. This provides support for the suggestion that loss of controllability is more debilitating than never having control in contexts that were previously associated with controllability (Foa et al., 1992; Mineka & Kihlstrom, 1978).

Chapter 7: General Discussion

Summary of Results

This thesis investigated the impact of perceived control over aversive stimuli on cognitive functions that are relevant to trauma-related psychopathologies. Studies 1 and 2 examined the proposition that lack of perceived control would impair subsequent AMS. Both studies found that participants led to believe they could not control the termination of aversive stimuli subsequently recalled less specific and more categoric memories than participants who believed they had control during the initial task. Study 2 also explored whether the overgeneral retrieval found in participants who believed they had no control was due to a limited amount of executive resources available at the time of retrieval. The results showed that to retrieve more specific memories, participants perceiving having no control over the stressing task also needed more time to complete a secondary cognitively demanding task, providing preliminary evidence for the role of executive resources in the relationship between stressor uncontrollability and autobiographical memory retrieval.

Study 3 built upon this examination of autobiographical memory impairment by investigating the impact of lack of controllability on future imagining and problem-solving abilities. Contrary to the study's hypothesis, participants who did not have control did not imagine fewer specific future events. However, the content of the imagined events differed between participants. Those who did not have control over the aversive stimuli subsequently generated events with content characterized by themes of less mastery. In line with predictions, the study also found that participants who had control demonstrated better problem-solving effectiveness on a social problem-solving task.

Studies 4 to 6 then turned to investigate whether stressor controllability would impact distress tolerance by measuring the behavioural avoidance tendencies of participants when they were exposed to various distressing tasks. Contrary to Study 4's hypothesis, participants who did not have control did not exhibit a diminished tolerance to distress induced by a physically uncomfortable task. Study 5 used a cognitively distressing task to assess behavioural avoidance tendencies. The results only partially supported the hypotheses. Although participants did not differ in the time taken to quit the task, those who did not have prior control subsequently reported a greater increase in their anxiety levels during the secondary distressing task. Finally, Study 6 found that participants who did not have control were subsequently faster to terminate a secondary emotionally distressing task providing support for the hypothesis that lack of controllability leads to a diminished tolerance for further distress.

Study 7 was designed to examine the impact of lack and loss of controllability over a stressor on hypervigilance, assessed by attentional and interpretation bias towards threat. Contrary to the predictions, lack and loss of controllability were not found to impact the participants' allocation of their attention towards threatening stimuli or their interpretation of ambiguous scenarios.

Finally, Study 8 explored the impact of lack and loss of controllability on a physiological index of emotion regulation, HRV. Contrary to the hypothesis, participants who did not have control during the task did not evidence reduced heart variability during the recovery period. However, participants who lost control showed a lower HRV while recovering from the task, demonstrating impaired emotion regulation abilities in the aftermath of a stressing situation.

The final chapter of this thesis now discusses these findings in relation to prevailing models of the different cognitive processes examined in this program of

research, acknowledges methodological considerations, provides an integrative account of the findings and suggests some suggestions for future directions.

Controllability and Autobiographical Memory Specificity

Studies 1 and 2 provided evidence that experimentally manipulating perception of control over a distressing stimulus impacted autobiographical memory retrieval, with participants who thought they had no control retrieving more categoric and less specific memories. Interestingly, in both Studies 1 and 2, categoric memories were significantly predicted by the manipulation of controllability but no significant predictors of specific memories emerged in these studies. This suggests that lack of controllability leads to an increase in categorical recall rather than impacting specific recall. The fact that AMS is impaired in trauma-related pathologies, such as depression and PTSD, has been well established in the literature (e.g. McNally et al., 1995; Williams & Dritschel, 1992) but few studies have attempted to clarify why some people exposed to a traumatic event exhibit an impaired AMS retrieval. The results from this program of research indicate that the degree of control an individual perceived having during the trauma is one possible factor responsible for these deficits in these conditions. The results from this program of research suggest that one possible factor responsible for these deficits in these conditions could be the degree of control an individual perceived holding during a stressful situation. This is however only speculative and a replication of the present findings in clinical samples is required before any firm conclusions can be drawn.

One of the mechanisms posited by the Carfax model to account for OGM is diminished executive control (Williams et al., 2007). This has been supported by a series of experimental studies (Dalgleish et al., 2007; Neshat-Doost et al., 2008). This thesis explored this potential mechanism by administering a cognitively demanding task concomitantly with the AMT (Study 2). Unexpectedly, no difference was found

between participants in their performance on the task. It is acknowledged that the dual task might have not been cognitively demanding enough and that a ceiling effect may have occurred. Goddard et al. (1998) have shown that increasing the difficulty of the dual task had a significant effect on AMS. Future research that would use a more cognitively demanding dual task is warranted to clarify these findings. Despite the lack of significant difference in performance between the participants, correlational analyses provided preliminary evidence that executive resources available to the participants who had no control were limited. Indeed, the more specific memories they retrieved, the longer they took to produce a correct answer on the dual task. No such pattern was found for the participants who had control, suggesting that a specific retrieval was more cognitively demanding for individuals who previously lacked control. This raises the possibility that believing one lacks control limits the amount of executive resources available for the individual to voluntarily retrieve a specific memory.

We acknowledge that degrees of perceived control may impact autobiographical memory via other mechanisms. The Carfax model, and experimental evidence (e.g. Watkins & Teasdale, 2001; Watkins, Teasdale, & Williams, 2000), suggests that impaired autobiographical memory might be due to rumination. There is also some evidence that inducing LH in participants can elicit ruminative thoughts (Bodner & Mikulincer, 1998). It is possible that after perceiving the lack of control of a distressing event, participants engaged in rumination, repetitively focusing on the possible causes and consequences, as a way to cope with the situation which then interrupts the search for a specific memory at a general level. Similarly, the Carfax model suggests that functional avoidance of unwanted memories can lead to overgeneral retrieval. Hermans et al. (2008) suggest that non-clinical individuals exhibit the functional avoidance mechanism only in certain situations, which may be elicited following lacking control

over aversive stimuli. Consistent with this suggestion, Debeer et al. (2012) showed that in individuals with avoidant coping style, categoric retrieval increased following an acute stressor. The results from Study 6 showed that participants who lacked control over an aversive situation were subsequently more likely to avoid engaging with a secondary distressing task. Therefore, it is possible that when individuals are faced with an uncontrollable situation, they experience a distress that prompts avoidance of memories, and leads to more overgeneral retrieval. Further research is warranted to explore how rumination and avoidance may moderate the relationship between perceived lack of control and overgeneral retrieval.

Controllability and Future Oriented Thinking

Impaired AMS has been shown to lead to difficulties in future-oriented thinking. More specifically, categoric retrieval has been found to be associated with deficits in imagining specific future events (e.g. Williams et al., 1996) and problem solving (e.g. Marx et al., 1992). As lack of controllability was found to impair autobiographical memory retrieval, this thesis examined whether lack of controllability over a stressor would also impact these two future-oriented cognitive functions. Study 3 found that the manipulation of controllability did not impact on the specificity of the future events generated by the participants. This was unexpected but could be due to the presentation of the instructions on the FIT, which might have led to a ceiling effect. Past research on autobiographical memory has shown that the AMT may not be sensitive enough to detect deficits in AMS in non-clinical individuals and that the use of minimal instructions (i.e. not instructing to retrieve specific memories) might be more appropriate in this population (Debeer, Hermans, & Raes, 2009). As imagining future events and retrieving autobiographical memories have been shown to rely on a similar

process (D'Argembeau & Mathy, 2011), the same recommendations might apply to the FIT.

The main finding from Study 3 regarding future imagining was that the content of the events generated was different between the conditions. Participants who perceived having no control over the aversive situation subsequently imagined future events that used less mastery descriptions. This is consistent with the Self Memory System model of autobiographical memory (Conway & Pleydell-Pearce, 2000) which proposes that the retrieval of autobiographical memories is influenced by an individual's current sense of self (i.e. working self). The working self guides the retrieval of memories and the construction of future expectations by activating the autobiographical knowledge consistent with the representation of one's current and future goals. It is possible that after individuals perceived having control over the negative situation they were exposed to, they might have been more likely to retrieve past experiences of successfully controlling their environment or to ignore those in which they failed to do so and subsequently constructed future events fitting with this current perception of their self. Thus, when individuals experience a traumatic event and perceived it as controllable, this process might protect them in the aftermath of the trauma by allowing them to imagine being in control of their future. Conversely, if the individuals perceived the event as uncontrollable, this might activate representations of the current self as lacking personal mastery which would then lead to the expectation that what will happen in their future will not be under their control. This could explain the association between future imagining deficit and helplessness found in clinical populations (MacLeod et al., 2005) and put the individual at risk of developing future psychopathology. We recognize that other factors might explain these findings. Self-efficacy has been shown to influence future imaginings and changes in the working self

(Brown et al., 2012). Although regression analysis showed that baseline levels of self-efficacy did not significantly predict the variation in mastery scores, it is possible that the manipulation of controllability contributed to increase or decrease self-efficacy in participants. As changes in self-efficacy were not measured in this study, it is not possible to rule out the potential effect of this variable.

Study 3 also investigated the impact of controllability on problem solving performance. Participants generated similar number of means regardless of their experimental conditions but those who experienced impoverished control produced solutions that were less effective overall. This suggests that appraising a stressor as uncontrollable leads to difficulties in effectively solving problems. In the long-term, this could lead to reduced persistence to actively solve problems and contribute to the development of a sense of helplessness. This is consistent with past research showing that lower perceived control is associated with less attempts to solve problems (Ross & Mirowsky, 1989). The findings are also in accordance with literature on coping, suggesting that perceiving a stressor as controllable leads to the use of more problem-focused coping strategies as opposed to emotion-focused strategies which are maladaptive and less effective (Endler et al., 2000). However, there is a broad literature highlighting the complexity of coping strategies employed in response to stressors of varying controllability. For example, emotion-focused coping has been shown to be more beneficial in the face of some uncontrollable stressors such as cancer (e.g. Stanton et al., 2000). Future experimental studies could investigate different coping strategies employed after being exposed to different levels of controllability following a stressor.

The fact that depleted levels of control lead to a less effective resolution of social problems might result from various mechanisms. Past research suggests that problem solving depends in part on future imagining ability (Brown et al., 2012). The

present thesis does not support this suggestion as only controllability emerged as a significant predictor of solution effectiveness. This might be explained by the lack of difference in the specificity of the future events generated by the participants. Future research should examine the relationship between lack of controllability, problem solving and future imagining using less directive instructions for the FIT. It is also possible that problem-solving relies more on the ability of the individuals to retrieve specific autobiographical memories, as suggested by a vast body of research (e.g. Evans et al., 1992; Marx et al., 1992). As such, the different mechanisms responsible for OGM are also likely to be responsible for the deficit in problem-solving. For example, Goddard et al. (1996) suggested that the processes involved in problem solving (e.g. problem definition, generations of various solutions, deciding on a solution) require sufficient cognitive resources. Lack of perceived control has been shown to impair performance on cognitive task relying on executive resources (e.g. Cemalcilar et al., 2003). Study 2 also found preliminary evidence that lacking control over a negative situation limits the amount of executive resources available to the individual. Together, this suggests that lack of controllability could impair the problem solving process via its impact on executive resources. Finally, it is also possible that in line with the Self-Memory Model (Conway & Pleydell-Pearce, 2000), perceiving an aversive event as uncontrollable influences the working self and increases the recollection of past experience in which the individual failed to control his or her environment to maintain a sense of coherence in self-identity. This could in turn impact problem solving by impairing the generation of effective solutions. Future research is necessary to uncover the mechanisms that lead individuals who experienced an aversive event as uncontrollable to subsequently generate less effective solutions.

Controllability and Distress Tolerance

Previous research has identified low distress tolerance as a risk factor for developing trauma-related pathologies (Vujanovic et al., 2011). This thesis used different tasks to examine whether experimentally manipulating controllability over a stressor would subsequently affect the tolerance to a secondary distressing situation. Overall, the results from the different studies painted a somewhat mixed picture. The seemingly contradictory findings might, however, be explained by the different methodological procedures employed to assess distress tolerance and the resultant avoidance tendencies. Specifically, different aversive stimuli eliciting distress (e.g. cold water, distressing images) may lead to distinct responses because of factors other than degree of perceived control.

In Study 4, we found that participants who had no control over a negative situation were not subsequently faster to terminate a physically distressing task (CPT). Although the CPT has been demonstrated to be a reliable measure of distress tolerance (e.g. Burns et al., 2004), it is also widely used to elicit pain (Birnie, Petter, Boerner, Noel, & Chambers, 2012). Past research has shown that when individuals believe they have control over a painful stimulus, they experience it as less painful and are better able to tolerate it (e.g. Arntz & Schmidt, 1989; Muller & Netter, 2000). In our study, participants were instructed to remove their forearm when they felt excessively uncomfortable. This may have given them a sense of control over the task, thus reducing the aversive nature of the painful stimulus. Alternately, animal studies have shown that exposing rats to inescapable shocks leads to the development of analgesia (e.g. Moye et al., 1981). Similarly, human studies have found that experiencing a laboratory stressor as uncontrollable led to subsequent stress-induced analgesia (Bandura, Cioffi, Taylor, & Brouillard, 1988; McCown, Galina, Johnson, DeSimone, &

Posa, 1993). It is possible that depleting perceived control in participants might have induced analgesia which in turn blunted the adverse effect of the CPT and reduced the between-group differences in term of distress tolerance.

In Study 5 however, we found evidence that stressor uncontrollability impacts the reaction to a secondary distressing task. Study 5 showed that impoverished control led to a more negative reaction to a secondary stressor. Participants who did not have control reported larger increase in their level of anxiety and distress after completing a cognitively frustrating task (PASAT-C). However, this did not lead to a greater avoidance of the task which seems to indicate that tolerance to this increased distress was not diminished. Although these results appear contrary to our original prediction, they could be explained by taking into account the task used. Another study employed both the PASAT-C and the Mirror Tracing Persistence Task (MTPT) to index distress tolerance in dysphoric and non-dysphoric university students (Ellis et al., 2010). Whereas a difference was observed on the MTPT, no such difference was seen on the PASAT-C, suggesting that the PASAT-C might not be a sensitive enough measure to detect differences in distress tolerance in non-clinical samples.

The finding that control manipulation influenced the response to a secondary stressor were extended in Study 6 in which we demonstrated that experiencing an initial stressor as uncontrollable reduced the ability to tolerate subsequent distress. Participants who lacked control were more likely to avoid staying in contact with a secondary emotionally arousing task. These findings are in accordance with previous research showing that manipulating perceived control led to greater behavioural avoidance during a distressing task (Bryant et al., 2014).

Together, the results from Studies 5 and 6 shed some light on the mechanisms at play during the aftermath of an uncontrollable event. Our findings suggest that

perceiving an aversive event as uncontrollable leads to experiencing subsequent stressors as more distressing and anxiety provoking, and further, impairs the tolerance for this increased negative arousal. This potentially motivates the use of maladaptive avoidance strategies. This cascade may provide an explanation for the findings that individuals who experienced a trauma as uncontrollable are subsequently more likely to use avoidant coping strategies (Clarke, 2006). Avoiding potentially distressing situations could reduce their adverse effects at first, as was suggested by our findings in Study 6 that participants who lacked control did not exhibit increased levels of distress, but eventually maintain psychopathology through negative reinforcement. This is speculative at this point and deserves targeted attention in future research.

An alternative account of the present findings comes from animal research. Studies have found evidence for the immunising effect of experiencing a stressor as controllable (e.g. Baratta et al., 2007). It is possible that participants in the controllability condition were protected against the adverse effects of the secondary stressor as a result of feeling in control during the first task. Thus the present findings could have resulted from lower emotional arousal and increased distress tolerance in the participants who felt in control during the first task rather than an increase of these levels in the no-controllability condition, or from a combination of both. The present studies did not include a control group to examine this possibility, precluding any possible conclusions. Therefore future research is required to elucidate this proposition.

Controllability and Hypervigilance

Hypervigilance towards threat is a hallmark of PTSD, and involves preferentially allocating attention towards threatening stimuli and also interpreting ambiguous situations as more threatening (Ehlers & Clark, 2000). Contrary to our expectation, Study 7 found no evidence that manipulating controllability impacted

hypervigilance. Participants who lacked or lost control did not exhibit an attentional bias towards threatening words on an Emotional Stroop nor did they make elevated threat-oriented interpretations of ambiguous social scenarios. The present findings contrast with correlational evidence that higher levels of perceived control are associated with more threatening interpretations of ambiguous information (Zvolensky et al., 2001). A distinction between Zvolensky and colleagues' study and ours is that it relied on a self-reported measure of perceived control over environmental stressors. This difference in methodology precludes any direct comparison between studies.

Research has shown that following an acute stressor, hypervigilance can be an adaptive response as it promotes survival (van Marle, Hermans, Qin, & Fernández, 2009). Yet in some individuals, this state does not subside over time. The findings from this program of research, as well as prior research, have shown that perceiving an aversive situation as uncontrollable leads to increased levels of anxiety and distress. Increased anxiety has been shown to fuel hypervigilance (Dalgleish, Moradi, et al., 2001). Thus, it is possible that stressor uncontrollability contributes to the maintenance of hypervigilant states. Lacking control is generally perceived by individuals as a threat to the self (Shapiro et al., 1996). Thus experiencing a stressor as uncontrollable might extend to perceiving one's environment as unsafe, leading individuals to interpret it as more threatening and increasing their tendencies to preferentially detect threat. Therefore, it is possible that the lack of an association between manipulated controllability and hypervigilance in our study may be a result of methodological issues rather than reflecting the absence of a relationship between control and subsequent hypervigilance. It is possible that the tasks used to measure hypervigilance or the stimuli used in the tasks were not threatening enough. Having said that, the possibility that hypervigilance is not directly affected by stressor controllability should be

considered. Further experiments using different tasks need to be conducted to clarify the role of stressor uncontrollability on attentional and interpretation bias towards threat.

Controllability and Physiological Reactions to a Stressor

The final aim of this thesis was to examine the differential effect of lacking and losing control on a core physiological index of emotion regulation during the recovery from a stressor (Study 8). The main finding to emerge from Study 8 was that participants who lost control during the aversive task without prior warning exhibited decreased HRV while recovering from the task. This is the first study, to our knowledge, to demonstrate that experimentally removing control impairs emotion regulation, as reflected by HRV. It should be noted that this was only found via a time-domain analysis of HRV and not via frequency domain analysis, although this might have resulted from the influence of other factors (e.g. breathing) on each type of measure analysis. Unexpectedly, HRV in participants who lacked control from the beginning of the task remained unaffected. It is unclear why such findings emerged as past research has found evidence that lacking control was associated with increased physiological arousal (e.g. Glass et al., 1969). However, these studies relied on skin conductance to measure physiological arousal whereas in our study we focused on HRV. The relative small sample size might have also limited the ability to detect between group differences. Future research should aim to further investigate this relationship using bigger sample sizes and including both measures of HRV and skin conductance.

According to Thayer and Lane's neurovisceral integration model of HRV, the vmPFC is one of the brain structures responsible for regulating heart rate via its effect on the vagus nerve (Thayer et al., 2012; Thayer & Lane, 2000). In rodents, the vmPFC has been identified as the critical brain region responsible for the effect of

controllability on subsequent behaviours (Amat et al., 2005; Christianson et al., 2009). It is possible that control deprivation may lead to a reduced activation of the vmPFC leading to the autonomic system acting as if the organism was under a constant state of threat which would lower HRV. As HRV has been shown to reflect emotion regulation (Appelhans & Luecken, 2006), this would then impair subsequent capacity to calm the arousal system.

Previous research found that deficits in emotion regulation skills lead to the appraisal of an aversive situation as more uncontrollable whereas effective emotion regulation strategies help to restore a sense of control by allowing the individual to adaptively cope with the problematic situation (Radkovsky et al., 2014). The present findings extend on this research by showing that the reciprocal effect also exists, and that experiencing a loss of control over a negative event contributes to impaired emotion regulation abilities. It is possible that individuals who appraise a traumatic event as suddenly depleting their control levels will then exhibit difficulties in regulating their emotions, which in turn will contribute to maintaining a feeling of helplessness and may put them at risk of developing psychopathology. This deficit in emotion regulation is also likely to impact on other dimensions related to emotion regulation, such as the reduced distress tolerance and increased negative reactivity to a secondary stressor (that we observed in Studies 5 and 6).

The other main finding to emerge from Study 8 was that loss of control was critical in impacting HRV as opposed to lacking control. The animal literature suggests that the experience of control has an immunizing effect on subsequently lacking control (e.g. Amat et al., 2010; Williams & Maier, 1977). These propositions are not mutually exclusive and can be explained by the influence of the context in which the loss of control occurs (Mineka, Cook, & Miller, 1984; Mineka & Kihlstrom, 1978). Our

findings suggest that losing control in a context similar to one in which controllability was previously experienced has a more debilitating effect on subsequent functioning. Few studies have actually focused on the impact of losing controllability, and our results suggest that this is an important line of investigation to pursue.

Methodological Considerations

Actual and perceived control

The experiments in this thesis manipulated both perceived and actual control. In Studies 1, 4 and 6 perceived control was manipulated. Although participants in the control condition were instructed that they could terminate (Studies 1 and 4) or prevent (Study 6) the aversive stimulus by pressing a key, their actions did not actually influence the aversive stimulus. This design was used because past human research outlines the importance of perceived control. This thesis was also interested in examining the effect of actual control and accordingly in Studies 2, 3, 5, 7 and 8, we chose to manipulate actual control. This manipulation both allowed investigation of the impact of actually having control and also minimised perceptions that their actions (which they believed had control) actually had no effect over outcomes. It should be noted that few participants who had control over the aversive stimulus actually chose to implement their control, which is in line with what had been observed in previous studies manipulating actual control (Glass et al., 1969). Yet, these participants reported perceiving greater levels of control than those in the no control condition, suggesting that the perception of control does not rely on factual feedback that one's actions are in fact determining outcomes.

We recognise that the use of these two different types of control is a methodological consideration that must be taken into account when interpreting the findings of this thesis. It should be noted that Studies 1 and 2 yielded similar effects of

perceived and actual control on autobiographical memory suggesting that manipulating actual or perceived control might be equivalent, consistent with what has been suggested by past research (e.g. Endler et al., 2000). This suggests that actually having control and perceiving control may involve comparable mechanisms, however future research is required to more fully disentangle the overlapping and distinct mechanisms underpinning actual and perceived control.

Manipulation of control

This program of research used a simple instrumental design to manipulate control, in which an aversive stimulus could be controlled by the simple action of pressing a key on the keyboard. The manipulation was reinforced by the use of instructions which were designed to specifically induce the belief in participants that they did or did not have control. This simple approach was adopted to minimise other potentially confounding factors and to isolate the effect of varying level of (perceived) control as the only difference between conditions. Overall, this manipulation seemed to be effective as manipulation checks showed that the levels of control perceived by the participants corresponded to the condition they had been assigned to.

Nevertheless, some limitations to this experimental manipulation must be acknowledged. The manipulation of a sense of control by very explicit instructions might reflect different mechanisms than real life situation as participants were explicitly informed that they had or did not have control. Variable paradigms have been used to manipulate control, such as exposing individuals to uncontrollable situations with no mention that they cannot influence the outcome (e.g. Cemalcilar et al., 2003) or instructions that led them to believe that they could act on the situation when in reality they could not (e.g. Henderson et al., 2012). In these types of paradigms, it is likely that participants gradually come to the realisation that they have no control. This could be

more reflective of the perception that one is losing control rather than lacking control. The findings from Study 8 suggests that loss and lack of control have differential effects. Thus depending on the kind of experimental manipulation used, different findings might emerge.

The fact that the current literature on the effect of control consists of a variety of experimental manipulations presents a challenge in the interpretation of findings and of the understanding of the mechanisms at play. It is possible that generalizing findings from one paradigm to other forms of manipulating control may be limited. It is therefore important to carefully consider the benefits and limitations of the different experimental designs currently available to manipulate control when designing future studies and interpreting them within the existing literature.

Finally, the duration of the effect of manipulating perceived control is currently unknown in humans. Although animals paradigms using a 24-hour delay between manipulation and testing have been found to be effective (Maier & Watkins, 1998), there is no consensus in humans as to how long the effect of the manipulation will persist. Thus it may be that some of the null findings in this thesis might have resulted from the fact that the effect of the manipulation did not extend to the administration of the dependent variable. Further research should attempt to manipulate this delay to uncover the optimal time course of controllability manipulation on subsequent measurement.

Sampling issues

This program of research used analogue samples of undergraduate students who were relatively young. Further, there was a predominance of female participants. The relatively young age of the samples might limit the generalisation of the present findings. The generalisation of the findings might also be limited by the relatively

imbalanced gender ratio. Studies suggest that gender influences responses to emotionally arousing tasks (Andreano & Cahill, 2009) and that sex hormones mediate the effect of stress on various variables (Toufexis, Myers, & Davis, 2006). Further, women have been shown to retrieve autobiographical memories in more specific details than men (Pillemer et al., 2003). Future research would benefit from including more male participants.

Additionally, undergraduate students may not be representative of the general population in terms of education levels. This might have impacted performance on certain tasks. A related contextual issue in all studies of undergraduate psychology students is the possibility that demand characteristics strongly influence response. As all studies involved students participating in psychological research, it is likely that participants were attuned to experimental cues in relation to both the control manipulation and the desired responses on the dependent variables. This issue is a perennial problem in all psychological studies, and raises the value of conducting real-simulating or non-experimental studies to index the potential impact of demand characteristics on the current findings (Orne, 1969).

The relatively small sample sizes should also be taken into account. The sample sizes were not determined on the basis of power analysis because of the absence of prior studies using comparable manipulation with the dependent variables studied in this thesis. The sample sizes used in the different experiments were adopted because they were representative of the sample sizes used in prior experimental studies that have assessed the cognitive constructs studied there (e.g. autobiographical memory, future imagining). This might have masked some differences between the groups, especially for measures that involve high between-subject variability, such as the Emotional

Stroop or HRV. Future research should aim to recruit more participants to increase the power of detecting differences between the conditions.

It should also be noted that, although participants were screened for depression and anxiety through the use of the DASS-21 at the start of each study, no comprehensive assessment of previous psychopathology was conducted. Thus it is possible that some participants might have had experienced trauma, head injury or psychopathology in the past. This could have impacted the findings of this program of research. Future studies should ensure that these potential covariates are taken into account by including a comprehensive evaluation of psychopathology history.

Finally, the studies relied on the use of non-clinical analogue samples to study psychological processes that are relevant to disorders characterised by loss of control, such as depression and PTSD. This approach was adopted because it is important at this stage to delineate the impact of perceived control without confounding features of psychopathology. The limitation of this approach is that it does not allow one to generalise to clinical phenomena. Future research could usefully extend these findings into clinical populations to determine if these patterns exist in clinical populations, conduct longitudinal research to determine if they are risk factors for developing these conditions, and also to assess the extent to which impairments in controllability may persist after symptom resolution.

Integrative Account

This thesis advances our understanding of the effect of stressor uncontrollability in the context of trauma-related pathologies. Although lack of control has been suggested to play a key role in the development and maintenance of these disorders, there has been a lack of experimental studies examining the causal mechanisms underlying this role. This thesis provides evidence that impoverished control over

analogue aversive situations impacts a range of cognitive and physiological variables that are impaired in trauma-related pathologies. First, this program of research suggests that one of the mechanism explaining why stressor uncontrollability puts an individual at risk of developing psychopathology is via its impact on autobiographical knowledge. We found experimental evidence that stressor uncontrollability impaired AMS and that this could be brought upon by a reduction of executive resources available. This effect extends to future-oriented cognitive processes relying on autobiographical memory. Indeed, we found that lack of control led participants to imagine the future in which they lack control and to exhibit problem solving abilities. Together, these findings suggest that experiencing a stressor as uncontrollable contributes to distress and helplessness in the aftermath of an uncontrollable experience by impairing the ability to recall specific past experiences and importantly to feel in control over the future. These feelings are also likely to be reinforced by the decreased ability to effectively solve interpersonal problematic situations. This increase in distress might then be aggravated by a reduced ability to tolerate the negative effect of further stressor, which motivates the use of behavioural avoidance strategies. Indeed, we found preliminary experimental evidence that lack of control led to diminished distress tolerance as evidenced by the avoidance of a secondary aversive situation, as well as an increased anxious reaction to the situation. However, the present thesis suggests that uncontrollability might only impact tolerance to certain types of distress as no effect was found on tolerance to physical distress. Nevertheless, diminished control affected tolerance to distress brought upon by an emotional task which is likely to be a valid analogue of real life stressors. The use of avoidance motivated by this impaired tolerance would then only temporarily alleviate the negative emotions eventually leading to the maintenance of psychopathology via negative reinforcement.

In terms of physiological response, our findings showed that *loss* of control led to reduced HRV during the recovery from a stressor. High HRV allows an individual to quickly and flexibly adapt to the environment and to appropriately regulate emotional arousal. Impaired emotion regulation is likely to maintain the individual in a state of constant vigilance and hinder the ability to engage in a range of activities that are essential to recover from a trauma. This can also explain why tolerance to distress is reduced. This finding is the first to our knowledge to provide experimental evidence for the pathogenic role of losing control at a physiological level. It is likely that when individuals are exposed to a trauma, they actually feel like they are losing control over an environment in which they previously felt being in control. Therefore, future studies examining the effect of stressor controllability should pay particular attention to the impact of losing control as opposed to simply lacking control.

The findings from this thesis can also be considered from various theoretical perspectives which are concerned with self-regulation of affect and behaviour. The fact that perceiving an event as uncontrollable seems to lead to a disruption in self-regulation might be understood from a cybernetic theory point of view. According to Carver and Scheier's model, behaviours and affect are regulated by a hierarchical system of feedback loops in which the individuals' goals are organised (e.g. Carver & Scheier, 1982, 1998). At each level of the hierarchy, the individuals compare their perception of a current condition or state to a standard value of reference. If a discrepancy occurs, they will execute a behaviour to reduce the discrepancy by modifying their current situation. In this model, negative affect, including stress, arises when this self-regulation process is not performing well. It is possible that some of the findings from our experiments resulted from a discrepancy noted by the participants between their perception that they lacked control and their standard that they should be

in control. Moreover Carver and Scheier have suggested that although negative affect can lead people to try harder to reach their goal, which would contradict the findings of the present thesis, there are some circumstances that can lead them to give up on trying to reduce the discrepancy (e.g. Carver & Scheier, 2004). This occurs when their expectancy of being successful in attaining their goals is unfavourable. It is possible that telling participants that they could not control the termination of the stressor led them to evaluate that any effort to perceive some control would be futile, which in turn led them to disengage from subsequent tasks. This could for example explain the findings that perceived control affected distress tolerance to a subsequent stressor.

The present findings can also be considered from a social cognitive theory perspective (e.g. Bandura, 1997; Bandura, 2001). As mentioned in Chapter 1, coping self-efficacy plays a key role in determining how individuals react in the aftermath of a trauma. Bandura emphasises the importance of self-efficacy beliefs in human agency and highlight the fact that people need to believe that they have some control over the environment and that they have the ability to implement this control. This has received support from various meta-analytic and empirical studies (e.g. Bandura et al., 1988; Stajkovic & Luthans, 1998). Thus, leading participants to believe that they could not control the stressing stimuli they were exposed to might have resulted in a decrease in their self-efficacy beliefs. Low levels of self-efficacy have been suggested to affect self-regulation, which might explain some of our findings such as impaired emotion regulation or increased distress. Moreover, self-efficacy beliefs also influence the ability to persevere in the face of obstacles and the amount of effort to be spent on certain challenges. Some of the variables measured in this program of research relied on the ability to persist on a task (e.g. behavioural avoidance or retrieving specific memories)

and the findings that manipulating stressor controllability impacted on these processes might have been due to the effect of the manipulation on self-efficacy levels.

One final theory that can be considered to explain our findings is the Self-Determination Theory proposed by Deci and Ryan. According to this theory, the intrinsic motivation that is necessary to an individual's health and well-being results from three universal innate needs, competence, relatedness and autonomy (Deci & Ryan, 1985; Ryan & Deci, 2000). Of particular relevance to this thesis are the competence (feeling effective and in control in the interaction with the social environment) and autonomy (perceiving oneself as the origin of one's behaviour) needs. Environmental factors can impact on these needs by prompting changes in the perception of the locus of the causality of an event (autonomy need) and in the perception of one's competence. If an event leads to the perception that the cause of an event was external and/or diminishes perceived competence, intrinsic motivation is decreased. This theory has been empirically validated in numerous studies (e.g. Vallerand & Reid, 1984). The manipulation of controllability in this study might have led participants to feel less competent over the task and less in control (i.e. the causality shifted towards an external locus). This would have resulted in a decrease in intrinsic motivation and a higher reliance on extrinsic motivation. This could explain the findings that participants with no control were more likely to be distressed by the task and also the lack of perseverance on some of the variables measured such as behavioural avoidance.

As a whole, this thesis extends the vast body of research on the role of stressor controllability and potentially sheds light on mechanisms underpinning trauma-related pathologies by providing experimental evidence for different pathways by which lack and loss of control impacts relevant cognitive, emotional, behavioural, and

physiological responses. These different effects might interact with each other and be mutually reinforcing, contributing to the maintenance of the disorders.

Future Directions

While this program of research has indicated some important evidence to strengthen the argument that control plays a key role in subsequent response to stress, there remains a need for further experimental research. First, only a limited number of variables have been examined in this program. Future studies should extend on this program of research by examining the impact of experimentally manipulating perceptions of control on other cognitive and physiological variables involved in stress-related pathologies. For example, future studies could examine how stressor controllability impacts intrusions as this variable involves attributions of control over one's memories, and has been identified as key maintaining factor of trauma-related pathology. Studies should also try and uncover the neurobiological mechanisms affected by controllability. Animal research has identified the key role of the vmPFC in the detection of control (Amat et al., 2005) and there is some evidence that this is also the case in humans (Bryant et al., 2014). Nevertheless, this remains understudied in humans and should be further explored. Answering these questions would allow for a better understanding and provide a comprehensive picture of the role of control in trauma disorders.

Animal research points to the immunizing effect of experiencing control on subsequent exposure to aversive events (e.g. Baratta et al., 2007). The designs of the present studies do not allow firm conclusions concerning this. Nevertheless, future studies should use a triadic design similar to the one used in animal research. That is, future research should include a third group only exposed to a task measuring the variable of interest without prior exposition to an initial distressing stimuli over which

control had been manipulated. This would allow to examine whether experiencing control indeed has a protective effect against the experience of subsequent stressors. Moreover, one of the findings of this program of research was that losing control was more pathogenic than never having control, which is in line with some previous literature (Mineka & Kihlstrom, 1978; Weiss, 1971). Although these two propositions might seem contradictory at first glance, it has been suggested that context might influence the effect of experiencing control (Foa et al., 1992). To our knowledge, no studies has experimentally examined this proposition. Clarifying the interaction between levels of control and context on subsequent functioning is an important issue that should be addressed in future studies.

Finally, research would benefit from examining stressor controllability using longitudinal designs. The experimental manipulation in this thesis was limited to studying the effect of controllability over a single set of aversive stimuli. Future research could extend on the findings by repeating this procedure over several days. This could also allow for a better examination of the differential effect of lacking, losing and having control discussed above. In naturalistic settings, research could also evaluate control perceptions in individuals who have just experienced a trauma and examine whether this leads to the development of psychopathology in the months following the trauma. This would allow to provide strong support for the role of controllability as a key risk factor for trauma related disorders.

Concluding comment

In closing, this program of research has experimentally demonstrated that stressor uncontrollability impacts a wide range of variables that have been known to contribute to the development and maintenance of psychopathology such as depression and PTSD. It is now crucial that experimental research is extended to other potential

variables affected in these disorders and to clinical populations to validate the ecological validity of these studies. A better understanding of the psychological variables affected by impoverished control and of the mechanisms underpinning these relationships has the potential to help better assist individuals who experienced an aversive life threatening situation.

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APPENDICES

Appendix 1. Participant information sheet and consent form (Study 1 and 4)

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT

Exposure to emotional stimuli and impact on subsequent stress.

Participant Selection and Purpose of Study

You are invited to participate in a study investigating how being exposed to emotional stimuli influences the way you respond to subsequent stress. You were selected as a possible participant in this study because voluntarily participated in a research screening at the beginning of 2011 and agreed to return to take part in this study.

Description of Study and Risks

If you decide to participate, you will first be shown images on a computer screen (neutral or negative images depicting scenes of violence or injury). You will be asked to provide subjective ratings of arousal in response to their presentation. You will then be asked to put your arm in icy cold water and to keep it in the water for as long as possible. Finally you will be asked to recall personal memories evoked by cue words.

You may find some of the images presented distressing and you may find the experience of placing your arm in cold water uncomfortable. Should this reach a level which you cannot tolerate, you should indicate to the experimenter you wish to withdraw from participation in the study.

It is not expected that you will experience any long term discomfort. Your participation in the experiment will add valuable insight into this field of research.

We cannot and do not guarantee or promise that you will receive any benefits from this study.

Confidentiality and Disclosure of Information

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to discuss or publish the results as part of the experimenter's PhD theses and potential scientific articles/professional conferences. In any publication, information will be provided in such a way that you cannot be identified.

Recompense to participants

Upon completion of the experiment, you will be awarded 1 hour credit which goes towards part of your Psychology 1course requirement.

Your consent

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

Inquiries

If you have any questions or concerns following your participation, either Laurie Monier (0415133738; l.monier@student.unsw.edu.au) or Professor Richard Bryant (9385 3640; r.bryant@unsw.edu.au) will be happy to address them.

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).
Please keep this information sheet and one copy of the Participant Consent Form. The investigator will keep the other signed copy. Both copies should be signed by you and the investigator.

THE UNIVERSITY OF NEW SOUTH WALES

Approval No 181

PARTICIPANT CONSENT FORM

Exposure to emotional stimuli and impact on subsequent stress.

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

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

....
(Please PRINT name) (Please PRINT name)

.....
Date

.....
Signature(s) of Investigator(s)

.....
Please PRINT Name

REVOCATION OF CONSENT

Exposure to emotional stimuli and impact on subsequent stress.

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

I understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales, *(other participating organisation[s] or other professional[s])*.

....
Signature Date

.....
Please PRINT Name

The section for Revocation of Consent should be forwarded to Professor Richard Bryant, School of Psychology, UNSW, Sydney, NSW, 2052. Email: r.bryant@unsw.edu.au

Appendix 2. Depression Anxiety Stress Scales – Short form (DASS-21)

DASS21	*Name:*	*Date:*			
Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you *over the past week*. There are no right or wrong answers. Do not spend too much time on any statement. *The rating scale is as follows:* 0 Did not apply to me at all 1 Applied to me to some degree, or some of the time 2 Applied to me to a considerable degree, or a good part of time 3 Applied to me very much, or most of the time					
1	I found it hard to wind down	0	1	2	3
2	I was aware of dryness of my mouth	0	1	2	3
3	I couldn't seem to experience any positive feeling at all	0	1	2	3
4	I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5	I found it difficult to work up the initiative to do things	0	1	2	3
6	I tended to over-react to situations	0	1	2	3
7	I experienced trembling (eg, in the hands)	0	1	2	3
8	I felt that I was using a lot of nervous energy	0	1	2	3
9	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10	I felt that I had nothing to look forward to	0	1	2	3
11	I found myself getting agitated	0	1	2	3
12	I found it difficult to relax	0	1	2	3
13	I felt down-hearted and blue	0	1	2	3
14	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15	I felt I was close to panic	0	1	2	3
16	I was unable to become enthusiastic about anything	0	1	2	3
17	I felt I wasn't worth much as a person	0	1	2	3
18	I felt that I was rather touchy	0	1	2	3
19	I was aware of the action of my heart in the absence of physical exertion (eg, sense of heart rate increase, heart missing a beat)	0	1	2	3
20	I felt scared without any good reason	0	1	2	3
21	I felt that life was meaningless	0	1	2	3

Appendix 3. New General Self-Efficacy Scale

Subject ID: _____

Please read each statement and decide to what extent it describes you. There are no right or wrong answers. You will probably agree with some of the statements and disagree with others. Please indicate your degree of agreement with each statement below by using the scale provided.
Please be very truthful and describe yourself as you really are, not as you would like to be.

Scale :

1 Disagree Strongly disagree
2 Disagree Moderately Disagree
3 Neither Agree nor Disagree
4 Moderately Agree
5 Strongly Agree

1. I will be able to achieve most of the goals that I have set for myself. _____
2. When facing difficult tasks, I am certain that I will accomplish them. _____
3. In general, I think that I can obtain outcomes that are important to me. _____
4. I believe I can succeed at most any endeavor to which I set my mind. _____
5. I will be able to successfully overcome many challenges. _____
6. I am confident that I can perform effectively on many different tasks. _____
7. Compared to other people, I can do most tasks very well. _____
8. Even when things are tough, I can perform quite well. _____

Appendix 4. Manipulation of controllability task (Study 1 and 4)

Instructions for the Perceived Control Condition:

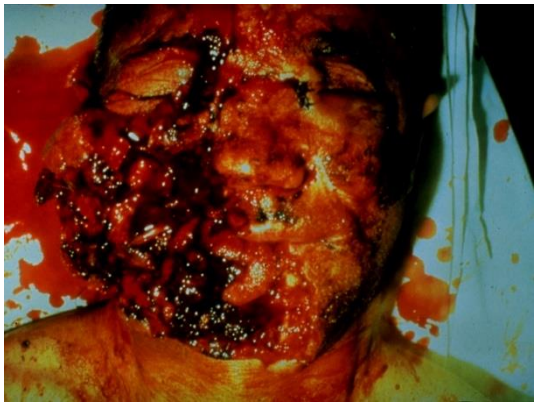
"I would like to show you some images on this screen. You will be presented with different images for a few seconds each. All you need to do is watch the computer screen as if it were a television. It is important that you try not to look away from the screen. Now, if you find some of the images are too distressing, you can press this key to indicate that you no longer wish to look at it. Nevertheless, the picture might not go straight away as the program might need a while to proceed to the following picture. But it is in your hands how long you have to watch these images because by pressing the key, you will start the termination process. After each picture disappeared from the screen, you will be asked to rate how distressed you were by the picture on a scale from 1 to 7 by pressing the corresponding number key"

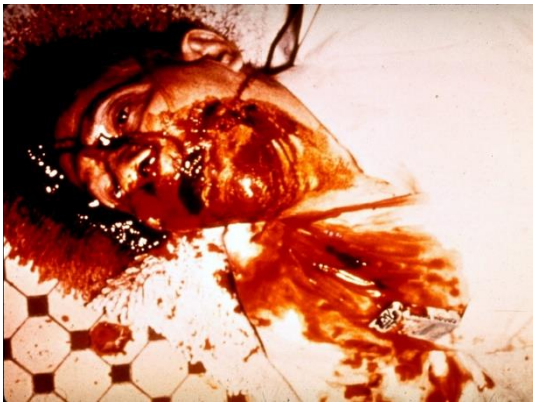
Instructions for the No-Perceived Control Condition:

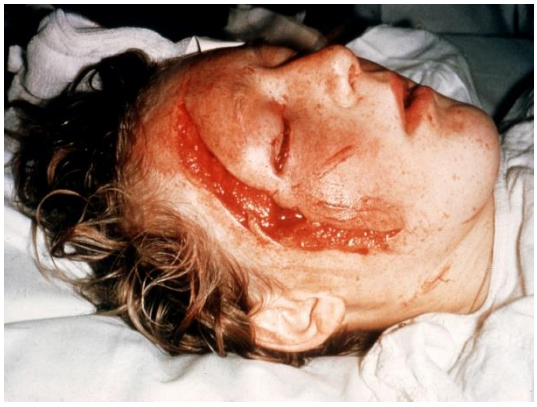
"I would like to show you some images on this screen. You will be presented with different images for a few seconds each. All you need to do is watch the computer screen as if it were a television. It is important that you try not to look away from the screen. Some of these images are distressing but you will need to watch it until the program terminates it. After each picture disappeared from the screen, you will be asked to rate how distressed you were by the picture on a scale from 1 to 7 by pressing the corresponding number key"

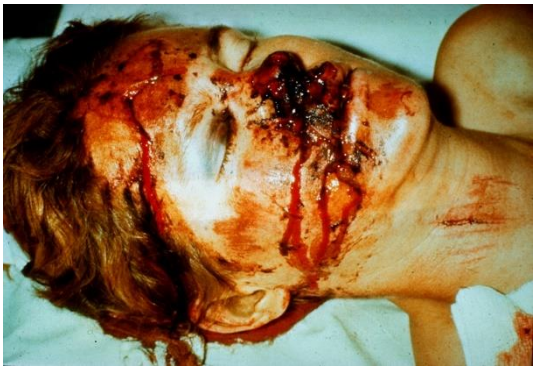
Example of Neutral Images:

Example of Negative Images:









Appendix 5. Autobiographical Memory Test

Instructions:

"I am going to read to you some words. For each word I want you to think of a specific event that you have experienced, and that is related to that word. A specific event is a single event that lasted less than a day, and occurred at a particular time and place. The event could have happened at any point in your life. It might be an important event, or trivial event. For example, if the word I give you is "movies" don't just say "every Friday I go to the movies". Rather, your description should be of a specific event such as "last Friday I went to the movies and spilt popcorn everywhere". It is important that you try to retrieve a different specific memory or event for each word I say rather than repeating the same event. I'll give you 30 seconds to think of an event for each word. You can tell your memory as soon as it comes to your mind but you will have 30 seconds maximum to recall an event."

Word List:

Positive	Happy
	Safe
	Successful
	Brave
	Special
Negative	Angry
	Tense
	Hurt
	Fear
	Clumsy

Appendix 6. Participant information sheet and consent form (Study 2 and 5)

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT

Impact of emotional stimulus processing on memory & arithmetic performance

Participant Selection and Purpose of Study

You are invited to participate in a study looking at the impact of processing emotional information on cognitive performance. More specifically, we hope to learn how it impacts your autobiographical memory and arithmetic performance. You were selected as a possible participant in this study because you voluntarily participated in a research screening at the beginning of 2012 and agreed to return to take part in this study.

Description of Study and Risks

If you decide to participate, you will first be shown a series of short movies depicting scenes of surgery. Following that, you will be asked to recall some personal memories while performing a reaction time task. While you are describing your memories, you will be audio recorded. Finally, you will be asked to perform arithmetic operations.

The videos you will be shown depict a variety of scenes of either surgical procedures or violence. These are mainly taken from medical educational sources or films you may have seen. You may find some of the images presented distressing, however this should be short-lived. If you ever feel you are overly distressed by the study, you can contact Professor Richard Bryant on the number below. Also, you can indicate to the experimenter if you wish to withdraw from the study at any time.

We cannot and do not guarantee or promise that you will receive any benefits from this study.

Confidentiality and Disclosure of Information

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to discuss or publish the results as part of the experimenter's PhD theses and potential scientific articles/professional conferences. In any publication, information will be provided in such a way that you cannot be identified.

Recompense to participants

Upon completion of the experiment, you will be awarded 1 hour of credit which goes towards part of your Psychology 1B course requirement.

Your consent

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

Inquiries

If you have any questions or concerns following your participation, either Laurie Monier (0415133738; l.monier@student.unsw.edu.au) or Professor Richard Bryant (9385 3640; r.bryant@unsw.edu.au) will be happy to address them.

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).
Please keep this information sheet and one copy of the Participant Consent Form. The investigator will keep the other signed copy. Both copies should be signed by you and the investigator.

THE UNIVERSITY OF NEW SOUTH WALES

Approval No 203

PARTICIPANT CONSENT FORM

Impact of emotional stimulus processing on memory and arithmetic performance

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

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

....
(Please PRINT name) (Please PRINT name)

.....
Date

.....
Signature(s) of Investigator(s)

.....
Please PRINT Name

REVOCATION OF CONSENT

Impact of emotional stimulus processing on memory and arithmetic performance

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

I understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales, *(other participating organisation[s] or other professional[s])*.

....
Signature Date

.....
Please PRINT Name

The section for Revocation of Consent should be forwarded to Professor Richard Bryant, School of Psychology, UNSW, Sydney, NSW, 2052. Email: r.bryant@unsw.edu.au

Appendix 7. Manipulation of controllability task (Study 2 and 5)

Instructions for the Controllability Condition

"I would like to show you some videos on this screen. You will be presented with different videos. All you need to do is watch the computer screen as if it were a television. It is important that you try not to look away from the screen and you watch carefully each video. Now, if you find the video is too distressing, you can press the space bar to indicate that you no longer wish to watch it. This will stop the video. So it is in your hands how long you have to watch the movies for. But really try and watch each video till the end. After the video stops, you will be asked to rate how distressed you were by it on a scale from 1 to 7 by pressing the corresponding number key. Between each video, there will be a blank screen to allow the program to load the next video. Just keep looking at the screen until the next video comes up. Try to not distract yourself."

Instructions for the No-Controllability Condition

"I would like to show you some videos on this screen. You will be presented with different videos. All you need to do is watch the computer screen as if it were a television. It is important that you try not to look away from the screen and you watch carefully each video. Now, you may find the videos are distressing, but you have to keep watching it until it stops. After the video stops, you will be asked to rate how distressed you were by it on a scale from 1 to 7 by pressing the corresponding number key. Between each video, there will be a blank screen to allow the program to load the next video. Just keep looking at the screen until the next video comes up. Try to not distract yourself."

Description of the videos used:

Video 1: The video depicts a medical investigator cracking open a dead body's skull
Video 2: The video depicts cannibals eating human organs
Video 3: The video depicts a monk immolating himself
Video 4: The video depicts a surgical amputation of a foot

Video 5: The video depicts a surgical mastectomy

Video 6: The video depicts the stabbing of a male

Video 7: The video depicts a scene of dental surgery

Video 8: The video depicts humans killing and dismembering a turtle

Appendix 8. Participant information sheet and consent form (Study 3)

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT

(*Impact of emotional stimulus processing on future imagining and problem solving*)

Participant Selection and Purpose of Study

You are invited to participate in a study looking at the impact of processing emotional information on cognitive performance. More specifically, we hope to learn how it impacts your ability to imagine future events and problems. You were selected as a possible participant in this study because you voluntarily participated in a research screening at the beginning of 2013 and agreed to return to take part in this study.

Description of Study and Risks

If you decide to participate, you will first be shown a series of short movies depicting the scene of a car crash. Following that, you will be asked to imagine and describe events that could take place in the future. Finally, you will be presented with the beginning and the end of a series of problems and will be asked to provide a step by step strategy you would use to achieve the outcome presented to you.

The videos you will be shown depict a variety of scenes from a car crash. You may find some of the images presented distressing, however this should be short-lived. If you ever feel you are overly distressed by the study, you can contact Professor Richard Bryant on the number below. Also, you can indicate to the experimenter if you wish to withdraw from the study at any time.

We cannot and do not guarantee or promise that you will receive any benefits from this study.

Confidentiality and Disclosure of Information

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to discuss or publish the results as part of the experimenter's PhD theses and potential scientific articles/professional conferences. In any publication, information will be provided in such a way that you cannot be identified.

Recompense to participants

Upon completion of the experiment, you will be awarded 1.5 hours of credit which goes towards part of your Psychology 1A course requirement.

Your consent

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

Inquiries

If you have any questions or concerns following your participation, either Laurie Monier (0415133738; l.monier@student.unsw.edu.au) or Professor Richard Bryant (9385 3640; r.bryant@unsw.edu.au) will be happy to address them.

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au).
Please keep this information sheet and one copy of the Participant Consent Form. The investigator will keep the other signed copy. Both copies should be signed by you and the investigator.

THE UNIVERSITY OF NEW SOUTH WALES

Approval No 85

PARTICIPANT CONSENT FORM

(*Impact of emotional stimulus processing on future imagining and problem solving*)

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

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

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

……
Date

……
Signature(s) of Investigator(s)

……..
Please PRINT Name

REVOCATION OF CONSENT
(*Title of project*)

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

I understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales, *(other participating organisation[s] or other professional[s])*.

…… ……
Signature Date

……
Please PRINT Name

The section for Revocation of Consent should be forwarded to Professor Richard Bryant, School of Psychology, UNSW, Sydney, NSW, 2052. Email: r.bryant@unsw.edu.au

Appendix 9. Manipulation of controllability task (Study 3)

Instructions for the Controllability Condition

"I would like to show you some videos on this screen. We have cut a video in different segments that are going to be presented to you one after the other. All you need to do is watch the computer screen as if it were a television. It is important that you try not to look away from the screen and you watch carefully each video. Now, if you find the segment you are watching is too distressing, you can press the space bar to indicate that you no longer wish to watch it. This will stop the video. So it is in your hands how long you have to watch each segment for. Put another way, you have control in this study on watching the scenes in the video and it's up to you to stop each one when you want to. If it is too distressing, you can stop the video. After the video stops, you will be asked to rate how distressed you were by it on a scale from 0 to 9 by pressing the corresponding number key. Between each video, there will be a blank screen to allow the program to load the next segment. Just keep looking at the screen until the next video comes up. Try to not distract yourself."

Instructions for the No-Controllability Condition

"I would like to show you some videos on this screen. We have cut a video in different segments that are going to be presented to you one after the other. All you need to do is watch the computer screen as if it were a television. It is important that you try not to look away from the screen and you watch carefully each video. You may find the videos are distressing, but you have to keep watching it until it stops. How long you have to watch each segment for is not up to you. This has been decided before the experiment and there is nothing you can do but keep watching. You cannot stop the video no matter how distressing the video is for you. Put another way, you have no control in this study on how long you are watching the scenes in the video, although we recognise that they can be distressing. After the video stops, you will be asked to rate how distressed you were by it on a scale from 0 to 9 by pressing the corresponding number key. Between each video, there will be a blank screen to allow the program to load the next segment. Just keep looking at the screen until the next video comes up. Try to not distract yourself."

Description of the video (divided in 10 segments):

The video depicts emergency services attending the scene of a serious car crash on a highway. During the video, injured victims are treated on the scene and can be heard screaming. The video ends with the emergency services removing the only deceased victim from the scene, showing victim's face disfigured by the impact.

Appendix 10. Future Imagining Task

Instructions

"You are going to be presented with a number of sentences on the screen. For each sentence, I want you to try and imagine a specific event that may take place in your future and that relates to that sentence. By specific event, I mean that you need to try and think of an event as if it was something happening on a particular day. That means that you need to think about the location, the people who could be there and most importantly, yourself in that situation. It might be in the distant future or the near future. It doesn't need to be an event that you already know is going to happen, just a specific event or situation that might happen. I am asking you to imagine a specific event in the future, not something that already happened to you. You will have 45 sec maximum to think of something. When you have an event in mind just press the space bar and then describe the situation you've just imagined to me. I will record your answers if that's ok with you.

For example, take the sentence "Picture a situation in the future where you go on a boat". Telling me "A friend of mine has a boat, I might go on that" isn't specific enough. Instead you should tell me something like "I'm on a friend's boat on Sydney harbour. It's my 50th birthday." Or "This Christmas, I'm on a friend's boat with about 10 other people. We're watching the start of the Sydney to Hobart race."

Let's see another example. If the sentence was "Imagine a specific event in your future involving cooking", telling me "Cooking Dinner" isn't what I'm expecting. Rather, say something like "I'm learning how to make pasta. I will invite my sister and her boyfriend over for pasta on the long weekend."

Future events prompts

	Positive	**Negative**
"Picture a specific event or situation in your future where you will feel …"	*... happy,*	*... lonely*
	... confident	*... fear*
	... lucky	*... angry*
	... relaxed	*... pain*
	... helpful	*... regret*

Appendix 11. Scenarios for the Means-Ends Problem Solving Task

Practice scenario

Andrew was listening to people speak at a meeting about how to make things better in his community. He wanted to say something important and have the chance to be involved in decision making. The situation ends with Andrew being elected to council and presenting a speech at a meeting. Begin where Andrew wanted to have a say and be involved in decision making

Experiment scenarios

1. Christine had just moved in that day and didn't know anyone. She wanted to have friends in the neighbourhood. The situation ends with Christine having many good friends and feeling at home in the neighbourhood. Begin with Christine in her room immediately after arriving in the neighbourhood.

2. One day, Michael saw an attractive woman he had never seen before while at a party. He was immediately attracted to her. The situation ends when they get married. Begin when Michael first notices the woman at the party.

3. Jane is having problem getting alone with the manager at her job. Jane is very unhappy about this. The situation ends with Jane's manager liking her. Begin where Jane isn't getting along with her manager.

4. Peter came home after shopping and found that he had lost his watch. He was very upset about it. The situation ends with Peter finding his watch and feeling good about it. Begin where Peter found that he has lost his watch.

Appendix 12. Participant information sheet and consent form (Study 6)

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

(The impact of exposition to electrical stimulation on cognitive processing of emotional pictures)

You are invited to participate in a study looking at the impact of being exposed to mild electrical stimulation on inhibitory control, imagery and cognitive processing. More specifically, we hope to learn how mild electrical stimulation impacts your ability to process pictures. You were invited to this research study because you study psychology and are participating in return for course credit points.

If you decide to participate, you will first be exposed at times to mild electrical stimulation – this can be annoying but not harmful. This will be done by placing an electrode on your fingertip; this a painless procedure. While you are doing the task, an electrode will be placed on your middle finger to monitor your skin conductance. Then, you will be asked to look at some pictures, some of which might be distressful, and to answer some questions relating to these pictures.

You may find the electrical stimulation unpleasant and some pictures distressing. Should any part of the study become such that you do wish to continue, you can indicate to the experimenter you wish to withdraw from participation in the study, and you will still receive your credit for the study.

It is not expected that you will experience any long term discomfort. Your participation in the experiment will add valuable insight into this field of research. You will be able to learn of the study results from http://www.psy.unsw.edu.au/contacts-people/academic-staff/scientia-professor-richard-bryant

We cannot and do not guarantee or promise that you will receive any personal benefits from this study.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to discuss or publish the results in potential scientific articles/professional conferences. In any publication, information will be provided in such a way that you cannot be identified. Upon completion of the experiment, you will be awarded 1 hour of credit which goes towards part of your Psychology 1 course.

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

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

Please keep this information sheet and one copy of the Participant Consent Form. The investigator will keep the other signed copy. Both copies should be signed by you and the investigator

If you have any questions or concerns following your participation, either Laurie Monier (0415133738; l.monier@student.unsw.edu.au) or Professor Richard Bryant (9385 3640; r.bryant@unsw.edu.au) will be happy to address them.

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

(The impact of exposition to electrical stimulation on cognitive processing of emotional pictures)

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

.....	.....
Signature of Research Participant	Signature of Parent or Guardian (when relevant)
.....	.....
(Please PRINT name)	(Please PRINT name)

.....
Date

.....
Signature(s) of Investigator(s)

.....
Please PRINT Name

REVOCATION OF CONSENT OR DISCONTINUATION
(Control and Psychological Function Study)

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

I understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales, *(other participating organisation[s] or other professional[s])*.

.....	.....
Signature	Date

.....
Please PRINT Name

The section for Revocation of Consent should be forwarded to *Professor Richard Bryant, School of Psychology, University of New South Wales, Sydney, NSW, 2052. Email: r.bryant@unsw.edu.au.*

Appendix 13. Manipulation of controllability task (Study 6)

Instructions for the Controllability Condition

"In this task, you are going to see a series of shapes. The shapes will be circles and triangles that can appear in either red or green.

When you see a red triangle, a green triangle or a green circle, it means that you will NOT receive a shock. These are safety signals.

But when you see a red circle, this signals that you might receive an electric shock to your finger. The shock will occur after the circle disappears from the screen. But you have the control to prevent the shock from happening. When you see the red circle, you can press the space bar to signal that you do not want to experience the shock. It is important to be aware that the electric shock will not come straight away after you see the red circle. It will take at least four seconds to come through so you have time to press the space bar to prevent the shock.

You also need to know that the electric shock will not happen after every red circle. This is randomly determined by the program. You will never know which of the red circles will be followed by a shock. They may come right at the beginning of the series of shapes, in the middle or they may not occur until right at the end.

But remember, you always have control on preventing the shock from happening by pressing the space bar."

Instructions for the No-Controllability Condition

"In this task, you are going to be see a series of shapes. The shapes will be circles and triangles that can appear in either red or green.

When you see a red triangle, a green triangle or a green circle, it means that you will NOT receive a shock. These are safety signals.

But when you see a red circle, this signals that you might receive an electric shock to your finger. The shock will occur after the circle disappears from the screen. If the shock is delivered following that red circle, you will need to put up with the shock until it is over. Just wait and it will turn off after a short burst.

It is important to be aware that the electric shock will not come straight away after you see the red circle. It will take at least four seconds to come through.

You also need to know that the electric shock will not happen after every red circle. This is randomly determined by the program. You will never know which of the red circles will be followed by a shock. They may come right at the beginning of the series of shapes, in the middle or they may not occur until right at the end.

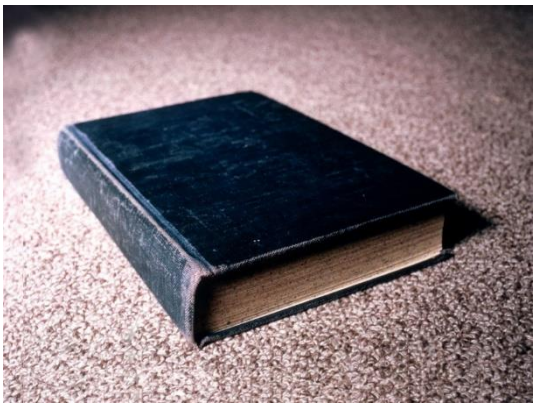
Remember, you have no control on preventing the shock from happening or knowing which red circles will be followed by an electric shock. When the shocks will happen, you need to put up with it until it is over. ”

Appendix 14. Behavioural Avoidance Task

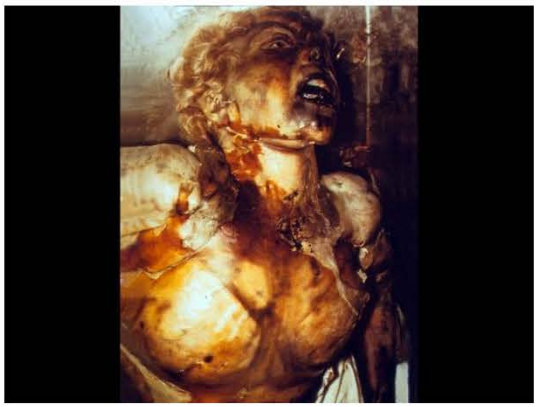
Instructions

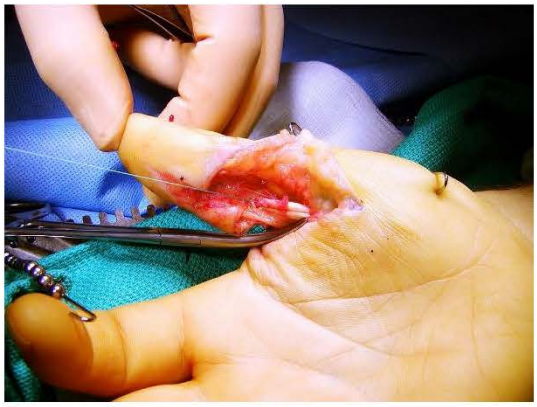
"You are going to see a series of pictures, some of which might be distressing. All you need to do is to look at the pictures and answer the question related to it afterwards. You can move to the next picture when you want by pressing enter. The picture will not disappear until you press enter. So it's up to you how long you watch each picture for. There is no set time for this task, just go at your own pace."

Example of Neutral Images



Example of Negative Images





Appendix 15. Participant information sheet and consent form (Study 7 and 8)

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

(The impact of exposition to white noise on emotion regulation and cognitive resources)

You are invited to participate in a study looking at the impact of being exposed to aversive noise on your emotion regulation and executive resources. More specifically, we hope to learn how aversive noise control impacts your heart rate, skin conductance and your cognitive resources available to complete various tasks. You were invited to this research study because you are study psychology and are participating in return for course credit points.

If you decide to participate, you will first be given a series of loud tones – these can be annoying but not harmful. You will also have psychophysiological recordings obtained, including heart rate and skin conductance which are measured by placing electrodes on your skin; this a painless procedure. You will then be asked to complete a cognitive task of naming the colour of the ink a word is written in. Then, you will have to do a task assessing different cognitive domains.

You may find the bursts of noise unpleasant. Should any part of the study become such that you do wish to continue, you can indicate to the experimenter you wish to withdraw from participation in the study, and you will still receive your credit for the study.

It is not expected that you will experience any long term discomfort. Your participation in the experiment will add valuable insight into this field of research. You will be able to learn of the study results from http://www.psy.unsw.edu.au/contacts-people/academic-staff/scientia-professor-richard-bryant

We cannot and do not guarantee or promise that you will receive any personal benefits from this study.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or except as required by law. If you give us your permission by signing this document, we plan to discuss or publish the results in potential scientific articles/professional conferences. In any publication, information will be provided in such a way that you cannot be identified. Upon completion of the experiment, you will be awarded 1 hour of credit which goes towards part of your Psychology 1 course.

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

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

Please keep this information sheet and one copy of the Participant Consent Form. The investigator will keep the other signed copy. Both copies should be signed by you and the investigator

If you have any questions or concerns following your participation, either Laurie Monier (0415133738; l.monier@student.unsw.edu.au) or Professor Richard Bryant (9385 3640; r.bryant@unsw.edu.au) will be happy to address them.

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

(The impact of exposition to white noise on emotion regulation and cognitive resources)

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

.....	.....
Signature of Research Participant	Signature of Parent or Guardian (when relevant)
.....	.....
(Please PRINT name)	(Please PRINT name)

.....
Date

.....
Signature(s) of Investigator(s)

.....
Please PRINT Name

REVOCATION OF CONSENT OR DISCONTINUATION
(The impact of exposition to white noise on emotion regulation and cognitive resources)

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

I understand that such withdrawal **WILL NOT** jeopardise any treatment or my relationship with The University of New South Wales, *(other participating organisation[s] or other professional[s])*.

.....	.....
Signature	Date

.....
Please PRINT Name

The section for Revocation of Consent should be forwarded to *Professor Richard Bryant, School of Psychology, University of New South Wales, Sydney, NSW, 2052. Email: r.bryant@unsw.edu.au.*

Appendix 16. Manipulation of controllability task (Study 7 and 8)

Instructions for the Controllability and Loss of Controllability Conditions

"You are going to hear tones of various durations at random time intervals. All you have to do is listen to the tones. If you find that the tone is too aversive to keep listening to, you can press the space bar to indicate that you no longer wish to listen to it. This will stop the tone. So it's in your hands how long you have to listen to the tone for. Put another way, you have control in this task on listening to the tone and it's up to you to stop it when you want to.

Also, at two points during the task, you will see scales ranging from 0 to 9 appearing on the screen asking you to rate how you are feeling at that point. Read the question at the top of the screen and answer using the scale provided on the screen by pressing the corresponding number key on the keyboard.

Before the task starts, you will have a 5 minute rest period. Just relax during these 5 minutes and try to stay as still as you can. Finally, after the task is over, you will have another rest period of 5 minutes."

Instructions for the No-Controllability Condition

"You are going to hear tones of various durations at random time intervals. All you have to do is listen to the tones. You may find that the tones are aversive but you have to keep listening to it until it stops. How long you have to listen to each tone for isn't up to you. This is decided by the program and there is nothing you can do but keep listening. You can't stop the tone no matter how uncomfortable it is for you. Put another way, you have no control in this task on how long you are listening to the tones although we recognise they can be aversive.

Also, at two points during the task, you will see scales ranging from 0 to 9 appearing on the screen asking you to rate how you are feeling at that point. Read the question at the top of the screen and answer using the scale provided on the screen by pressing the corresponding number key on the keyboard.

Before the task starts, you will have a 5 minute rest period. Just relax during these 5 minutes and try to stay as still as you can. Finally, after the task is over, you will have another rest period of 5 minutes."

Appendix 17. Emotional Stroop Task

Instructions:

"You are going to see words written in different colours. You need to determine whether the word that appears on the screen is yellow, green, red or blue. You need to say the color of the word appearing on the screen and not the meaning of the word. Your answers will be recorded via the microphone. Do not say anything else other the colour of the word during the task. Try to respond as quickly as you can, because you will be timed"

Stimuli

Practice words	shoe	class
	table	chocolate
Negative (threatening) words	harm	victim
	fear	tragedy
	snake	trapped
	blood	mutilate
	death	struggle
	horror	disaster
	scream	terrified
	danger	nightmare
Neutral words	swim	advice
	nose	costume
	media	diamond
	speak	revision
	asked	suitcase
	fairly	electric
	senior	positions
	faster	inspector

Appendix 18. Interpretation bias task

Intructions:

"During the first part of the task, you will be presented with a series of scenarios to read. Each will begin with a title that you will have to read carefully. Imagine each situation as happening to yourself! After you've read each scenario and its title, press the space bar to rate how well you understood the scenario. This is just a check to ensure that you understand the words that appear on the screen. The scale will be on the screen. Answer by using the corresponding number key on the keyboard.

During the second part of this task, you are going to see a series of 4 statements, one at a time, about the situations you read previously. Some statements are more similar to the situations than others and none will consist of the exact wording of the situation. There will be 4 statements for each situation. The title of the situation will be given to help you remember the right situation. You have to read each statement and indicate how similar it is to the situation. It does not matter what you have answered for other statements of the same situation. Type in "1" for not similar at all, "2" for not very similar, "3" for similar, "4" for very similar. That scale will always be at the bottom of the screen. Don't worry if you aren't sure as this is perfectly normal. Just do your best to try and pick out the statements that are the most similar and the most different in meaning to the original scenario that was paired with the title."

Stimuli:

Scenario 1: "Asking for a date"

Scenario	During a party you start to dance with someone you are interested in. You seem to get on well. When you call them the next day to ask them out, they sound a little bit nervous.
Negative Target	When you ask them out, they sound a little bit annoyed.
Positive Target	When you ask them out, they sound a little bit excited.
Negative Foil	When you ask them out, they say they already have plans that evening.
Positive Foil	When you ask them out, they say they are free that evening.

Scenario 2: "Assignment Mark"

Scenario	You had to write a long report for your psychology class. When your tutor gives you back your assignment, you are surprised because you did not get the grade that you were expecting
Negative Target	When your tutor gives back your assignment, you are surprised because you received a much lower grade than you expected.
Positive Target	When your tutor gives back your assignment, you are surprised because you received a much better grade than you expected.
Negative Foil	When your tutor gives back your assignment, you are surprised because she has left red corrections all over it.
Positive Foil	When tutor gives back your assignment, you are surprised because she has given you a credit.

Scenario 3: "Becoming a reporter"

Scenario	The university newspaper is looking for a new student reporter. You want to know what would be involved and ask for details. The professor heading the newspaper says that they are looking for someone who is qualified.
Negative Target	The professor organizing the newspaper says that you do not suit the role.
Positive Target	The professor organizing the newspaper says that you fit the role nicely.
Negative Foil	The professor organizing the newspaper says that your writing is not good enough.
Positive Foil	The professor organizing the newspaper says that you write well.

Scenario 4: "Meeting with an old friend"

Scenario	You arrange to meet up with a friend who you have not seen for a while. As you wait for them to arrive, you are sure they will think that you have changed.
Negative Target	Your friend thinks you have changed for the worse.
Positive Target	Your friend thinks you have changed for the better.
Negative Foil	Your friend thinks that the meeting is boring.
Positive Foil	Your friend thinks that it is nice to meet again.

Scenario 5: "Summer party"

Scenario	During the summer you invite some friends over for a small party at your parent's house. Ten of your friends come along. The next day you overhear them talking about the party quietly.
Negative Target	You hear your friends talking about how they were bored at the party.
Positive Target	You hear your friends talking about how they enjoyed the party.
Negative Foil	You hear your friends saying that your parents' house is crowded.
Positive Foil	You hear your friends saying that they liked your garden.

Scenario 6: "Lost basketball game"

Scenario	You join the University basketball team and are asked to play in a game. You try very hard but your team loses. Afterwards your new teammates want to discuss how you played.
Negative Target	Your teammates want to discuss how terribly you played.
Positive Target	Your teammates want to discuss how brilliantly you played.
Negative Foil	Your teammates want to discuss that you should stay on the bench the next game.
Positive Foil	Your teammates want to discuss whether you want to play in the next game as well.

Scenario 7: "The new jacket"

Scenario	You arrive at a birthday party in your new jacket. Everyone turns to look at you as you walk in and you decide that this is because of your new jacket.
Negative Target	Everybody turns to look at you as you walk in because your jacket looks awful.
Positive Target	Everybody turns to look at you as you walk in because your jacket looks smart.
Negative Foil	Everybody turns to look at you as you walk in and some people point at you and start laughing.
Positive Foil	Everybody turns to look at you as you walk in because you are looking good.

Scenario 8: "The end of semester party"

Scenario	As one of the main organizers, you are asked to give a short speech at the end-of semester party. When the time comes you get on the stage. As you speak, you notice some of the students in the audience start to laugh.
Negative Target	As you speak, students in the audience find your efforts laughable.
Positive Target	As you speak, students in the audience start to laugh approvingly.
Negative Foil	As you speak, students in the audience start to yawn.
Positive Foil	As you speak, students in the audience start to applaud your comments.

Scenario 9: "Ice skating"

Scenario	Your friends are going to ice-skate this afternoon but they have not yet asked you. You would like to go too. When you ask them whether you can join, they look surprised.
Negative Target	When you ask your friends whether you can join, they look annoyed.
Positive Target	When you ask your friends whether you can join, they look pleased.
Negative Foil	When you ask your friends whether you can join them, they say no.
Positive Foil	When you ask your friends whether you can join them, they say yes.

Scenario 10: "First housewarming party"

Scenario	You are organizing your first housewarming party at the new place you just moved into. At the party, you see some people in the corner and hear them talking.
Negative Target	You hear some people in the corner criticising the party.
Positive Target	You hear some people in the corner praising the party.
Negative Foil	The people in the corner are looking miserable.
Positive Foil	The people in the corner are looking pleased.

Statistical Summaries

Study 1

Table A1.1
T-Test summary table for experimental group differences in participants characteristics

	C+ n = 20	C- n = 20	t	df	*Sig* (2-tail)	95% CI
Age	19.75 (2.05)	19.60 (2.46)	.21	38	.835	-1.30 – 1.60
DASS – Dep	7.30 (5.52)	9.10 (7.91)	-.83	38	.409	-6.16 – 2.56
DASS – Anx	5.60 (6.24)	7.70 (7.98)	-.93	38	.360	-6.69 – 2.49
DASS – Str	10.20 (8.53)	12.20 (8.61)	-.74	38	.465	-7.49 – 3.49
NGSE	30.65 (4.51)	28.55 (3.50)	1.64	38	.108	-.48 – 4.68

Note: Standard deviations appear in parentheses. C+ = Controllability Condition; C- = No-Controllability Condition; DASS = Depression, Anxiety, Stress Scales – Short Form; NGSE = New General Self-Efficacy Scale

Table A1.2
Chi-square summary table for experimental group differences in gender

	$\chi 2$	df	*Sig* (2-tail)
Gender	.53	1	.716

Table A1.3
Analysis of variance (ANOVA) summary table for differences in levels of distress according to Experimental Condition and Time of Rating

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Time	208.013	1	208.013	55.911	.000
Time x Cond	2.112	1	2.112	.568	.456
Error(Time)	141.375	38	3.720		
Test of Between-Subjects Effects					
Intercept	406.406	1	406.406	126.547	.000
Cond	3.306	1	3.306	1.029	.317
Error	122.038	38	3.212		

Note: "Time" = Time of rating (before vs after aversive task); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A1.4
Analysis of variance (ANOVA) summary table for differences in pictures ratings according to Experimental Condition and Pictures Valence

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Val	320.534	1	320.534	531.148	.000
Val x Cond	3.472	1	3.472	5.754	.021
Error(Val)	22.932	38	.603		
Test of Between-Subjects Effects					
Intercept	396.060	1	396.060	938.714	.000
Cond	1.878	1	1.878	4.451	.042
Error	16.033	38	.422		

Note: "Val" = Pictures Valence (neutral vs negative); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A1.5
T-Test summary table for experimental group differences in pictures ratings split by pictures valence

Picture Valence	C+ n = 20	C- n = 20	t	df	*Sig* (2-tail)	95% CI
Negative	4.72 (1.27)	5.57 (1.07)	-2.284	38	.028	-1.60 – -.10
Neutral	1.14 (.30)	1.15 (.19)	-.212	38	.833	-.18 – .14

Note: Standard deviations appear in parentheses. C+ = Controllability Condition; C- = No-Controllability Condition.

Table A1.6
Analysis of variance (ANOVA) summary table for differences in specific memories according to Experimental Condition and Cue Valence

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Val	7.813	1	7.813	8.464	.006
Val x Cond	.612	1	.612	.664	.420
Error(Val)	35.075	38	.923		
Test of Between-Subjects Effects					
Intercept	918.012	1	918.012	410.526	.000
Cond	10.512	1	10.512	4.701	.036
Error	84.975	38	2.236		

Note: "Val" = Cue Valence (positive vs negative); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A1.7
Analysis of variance (ANOVA) summary table for differences in categoric memories according to Experimental Condition and Cue Valence

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Val	.450	1	.450	.932	.340
Val x Cond	.200	1	.200	.414	.524
Error(Val)	18.350	38	.483		
Test of Between-Subjects Effects					
Intercept	39.200	1	39.200	37.855	.000
Cond	8.450	1	8.450	8.160	.007
Error	39.350	38	1.036		

Note: "Val" = Cue Valence (positive vs negative); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A1.8
Hierarchical regression model summary table examining variables predicting specific memories

Model	R	R^2	Adj. R^2	SE of Estimate	R^2 Change	F Change	df1	df2	*Sig. F Change*
1	.306[a]	.094	.045	2.29508	.094	1.918	2	37	.161
2	.414[b]	.172	.103	2.22475	.078	3.376	1	36	.074

a. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score, Experimental Condition

Table A1.9
ANOVA summary table for hierarchical regression predicting specific memories

Model		SS	df	Mean Square	F	*Sig*
1	Regression	20.207	2	10.103	1.918	.161[a]
	Residual	194.893	37	5.267		
	Total	215.100	39			
2	Regression	36.917	3	12.306	2.486	.076[b]
	Residual	178.183	36	4.950		
	Total	215.100	39			

a. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score, Experimental Condition

Table A1.10
Model coefficient summary table for hierarchical regression predicting specific memories

Model		B	SE	β	t	*Sig*
1	(Constant)	4.520	3.042		1.486	.146
	DASS-21 Depression Score	-.055	.058	-.158	-.946	.350
	Self-efficacy scale score	.121	.095	.212	1.269	.212
2	(Constant)	7.659	3.408		2.247	.031
	DASS-21 Depression Score	-.050	.056	-.144	-.887	.381
	Self-efficacy scale score	.081	.095	.143	.858	.396
	Experimental Condition	-1.339	.729	-.289	-1.837	.074

Table A1.11
Hierarchical regression model summary table examining variables predicting categoric memories

Model	R	R^2	Adj. R^2	SE of Estimate	R^2 Change	F Change	df1	df2	*Sig. F Change*
1	.185[a]	.034	-.018	1.57962	0.034	.657	2	37	.524
2	.432[b]	.186	.118	1.47006	.152	6.721	1	36	.014

a. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score, Experimental Condition

Table A1.12
ANOVA summary table for hierarchical regression predicting categoric memories

Model		SS	df	Mean Square	F	*Sig*
1	Regression	3.278	2	1.639	.657	.524[a]
	Residual	92.322	37	2.495		
	Total	95.600	39			
2	Regression	17.801	3	5.934	2.746	.057[b]
	Residual	77.799	36	2.161		
	Total	95.600	39			

a. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score, Experimental Condition

Table A1.13
Model coefficient summary table for hierarchical regression predicting categoric memories

Model		B	SE	β	t	*Sig*
1	(Constant)	2.470	2.094		1.179	.246
	DASS-21 Depression Score	.026	.040	.111	.643	.524
	Self-efficacy scale score	-.043	.066	-.114	-.659	.514
2	(Constant)					
	DASS-21 Depression Score	.021	.037	.091	.567	.574
	Self-efficacy scale score	-.006	.063	-.017	-.102	.919
	Experimental Condition	1.249	.482	.404	2.592	.014

Study 2

Table A2.1
T-Test summary table for experimental group differences in participants characteristics, manipulation check and video ratings

	C+ n = 16	C- n = 16	t	df	*Sig* (2-tail)	95% CI
Age	18.88 (.81)	19.88 (2.53)	-1.508	18.023*	.149	-2.39 – .39
DASS – Dep	7.13 (6.61)	7.00 (6.01)	-.146	30	.885	-5.63 – 4.88
DASS – Anx	7.13 (7.41)	7.50 (7.14)	.056	30	.956	-4.46 – 4.71
DASS – Str	15.00 (10.78)	10.63 (6.80)	1.373	25.303*	.182	-2.18 – 10.93
NGSE	28.44 (5.90)	28.81 (3.88)	-.212	30	.833	-3.98 – 3.23
Manip Check	8.25 (2.27)	1.63 (2.00)	8.777	30	.000	5.08 – 8.17
Vid. Ratings	3.90 (1.50)	4.80 (1.44)	-1.733	30	.093	-1.96 – .16

Note: Standard deviations appear in parentheses. C+ = Controllability Condition; C- = No-Controllability Condition; DASS = Depression, Anxiety, Stress Scales – Short Form; NGSE = New General Self-Efficacy Scale; Manip Check = Manipulation Check
* Levene's test for equality of variance indicated a violation of the homogeneity of variance assumption, due to this adjustment degrees of freedom are not whole integers.

Table A2.2
Chi-square summary table for experimental group differences in gender

	$\chi 2$	df	*Sig* (2-tail)
Gender	.508	1	.476

Table A2.3
Analysis of variance (ANOVA) summary table for differences in levels of distress according to Experimental Condition and Time of Rating

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Time	272.250	1	272.250	95.526	.000
Time x Cond	12.250	1	12.250	4.298	.047
Error(Time)	85.500	30	2.850		
Test of Between-Subjects Effects					
Intercept	517.562	1	517.562	101.899	.000
Cond	18.062	1	18.062	3.556	.069
Error	152.375	30	5.079		

Note: "Time" = Time of rating (before vs after aversive task); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A2.4
Analysis of variance (ANOVA) summary table for differences in specific memories according to Experimental Condition and Cue Valence

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Val	1.891	1	1.891	1.312	.261
Val x Cond	.391	1	.391	.271	.606
Error(Val)	43.219	30	1.441		
Test of Between-Subjects Effects					
Intercept	708.891	1	708.891	374.126	.000
Cond	23.766	1	23.766	12.543	.001
Error	56.844	30	1.895		

Note: "Val" = Cue Valence (positive vs negative); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A2.5
Analysis of variance (ANOVA) summary table for differences in categoric memories according to Experimental Condition and Cue Valence

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Val	.000	1	.000	.000	1.000
Val x Cond	1.000	1	1.000	1.071	.309
Error(Val)	28.000	30	.933		
Test of Between-Subjects Effects					
Intercept	60.062	1	60.062	63.502	.000
Cond	10.562	1	10.562	11.167	.002
Error	28.375	30	.946		

Note: "Val" = Cue Valence (positive vs negative); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A2.6
T-Test summary table for experimental group differences in proportion of correct answers, latency to answer and latency to produce correct answer on the dual task

	C+ n = 16	C- n = 16	t	df	*Sig* (2-tail)	95% CI
Corr. Ans.	95.33 (6.18)	95.96 (5.72)	-.302	30	.765	-4.94 – 3.66
Tot. Lat.	950.51 (201.10)	931.01 (170.24)	.297	30	.769	-114.98 – 154.08
Corr. Lat.	931.15 (189.20)	911.70 (192.21)	.288	30	.775	-118.26 – 157.15

Note: Standard deviations appear in parentheses. C+ = Controllability Condition; C- = No-Controllability Condition; "Corr. Ans." = Proportion of correct answer; "Tot. Lat." = latency to answer; "Corr. Lat." = latency to produce correct answer

Table A2.7
Pearson Correlations between type of memories recalled and latency to produce correct answer for the Controllability condition.

	Corr. Lat	Spe M	Cat M
Corr. Lat.	–	.246	-.262
Sig (2-tailed)		.358	.327
Spe M	.246	–	-.726
Sig (2-tailed)	.358		.001
Cat M	-.262	-.726	–
Sig (2-tailed)	.327	.001	
n	16	16	16

Note: "Corr. Lat." = latency to produce correct answer; "Spe M" = Specific Memories; "Cat M" = Categoric Memories

Table A2.8
Pearson Correlations between type of memories recalled and latency to produce correct answer for the No-Controllability condition.

	Corr. Lat	Spe M	Cat M
Corr. Lat.	–	.612	-.497
Sig (2-tailed)		.012	.050
Spe M	.612	–	-.519
Sig (2-tailed)	.012		.039
Cat M	-.497	-.519	–
Sig (2-tailed)	.050	.039	
n	16	16	16

Note: "Corr. Lat." = latency to produce correct answer; "Spe M" = Specific Memories; "Cat M" = Categoric Memories

Table A2.9
Hierarchical regression model summary table examining variables predicting specific memories

Model	R	R^2	Adj. R^2	SE of Estimate	R^2 Change	F Change	df1	df2	*Sig. F Change*
1	.375[a]	.140	.081	2.18613	.140	2.367	2	29	.112
2	.482[b]	.233	.150	2.10210	.092	3.365	1	28	.077

a. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score, Experimental Condition x Latency for Correct Answer

Table A2.10
ANOVA summary table for hierarchical regression predicting specific memories

Model		SS	df	Mean Square	F	*Sig*
1	Regression	22.623	2	11.312	2.367	.112[a]
	Residual	138.596	29	4.779		
	Total	161.219	31			
2	Regression	37.491	3	12.497	2.828	.057[b]
	Residual	123.728	28	4.419		
	Total	161.219	31			

a. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score, Experimental Condition x Latency for Correct Answer

Table A2.11
Model coefficient summary table for hierarchical regression predicting specific memories

Model		B	SE	β	t	*Sig*
1	(Constant)	5.472	3.022		1.810	.081
	DASS-21 Depression Score	-.102	.074	-.279	-1.376	.179
	Self-efficacy scale score	.066	.094	.143	.708	.485
2	(Constant)	6.580	2.968		2.217	.035
	DASS-21 Depression Score	-.111	.071	-.303	-1.552	.132
	Self-efficacy scale score	.093	.091	.201	1.018	.317
	Exp Cond x Corr. Lat.	-.001	.001	-.312	-1.834	.077

Table A2.12
Hierarchical regression model summary table examining variables predicting categoric memories

Model	R	R^2	Adj. R^2	SE of Estimate	R^2 Change	F Change	df1	df2	*Sig. F Change*
1	.498[a]	.248	.196	1.42091	.248	4.786	2	29	.016
2	.610[b]	.372	.305	1.32125	.124	5.540	1	28	.026

a. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score, Experimental Condition x Latency for Correct Answer

Table A2.13
ANOVA summary table for hierarchical regression predicting categoric memories

Model		SS	df	Mean Square	F	*Sig*
1	Regression	19.325	2	9.662	4.786	.016[a]
	Residual	58.550	29	2.019		
	Total	77.875	31			
2	Regression	28.996	3	9.665	5.537	.004[b]
	Residual	48.879	28	1.746		
	Total	77.875	31			

a. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score, Experimental Condition x Latency for Correct Answer

Table A2.14
Model coefficient summary table for hierarchical regression predicting categoric memories

Model		B	SE	β	t	*Sig*
1	(Constant)	3.073	1.965		1.564	.129
	DASS-21 Depression Score	.093	.048	.367	1.940	.062
	Self-efficacy scale score	-.063	.061	-.194	-1.026	.313
2	(Constant)	2.179	1.866		1.168	.253
	DASS-21 Depression Score	.101	.045	.396	2.242	.033
	Self-efficacy scale score	-.084	.058	-.261	-1.464	.154
	Exp Cond x Corr. Lat.	.001	.000	.363	2.354	.026

Study 3

Table A3.1
T-Test summary table for experimental group differences in participants characteristics, manipulation check and video ratings

	C+ n = 20	C- n = 19	t	df	*Sig* (2-tail)	95% CI
Age	19.10 (1.74)	20.05 (3.99)	-974	37	.336	-2.93 – 1.03
DASS – Dep	8.70 (7.90)	8.74 (8.90)	-.014	37	.989	-5.49 – 5.42
DASS – Anx	7.20 (4.79)	9.68 (9.27)	-1.060	37	.296	-7.23 – 2.27
DASS – Str	10.20 (5.91)	12.53 (10.17)	-.879	37	.385	-7.69 – 3.04
NGSE	28.80 (4.84)	29.42 (3.79)	-.444	37	.659	-3.45 – 2.21
Manip Check	8.60 (1.87)	1.79 (2.44)	9.804	37	.000	5.40 – 8.22
Vid. Ratings	3.75 (1.99)	5.24 (1.31)	-2.743	37	.009	-2.59 – -.39

Note: Standard deviations appear in parentheses. C+ = Controllability Condition; C- = No-Controllability Condition; DASS = Depression, Anxiety, Stress Scales – Short Form; NGSE = New General Self-Efficacy Scale; Manip Check = Manipulation Check

Table A3.2
Chi-square summary table for experimental group differences in gender

	$\chi 2$	df	*Sig* (2-tail)
Gender	5.132	1	.023

Table A3.3
Analysis of variance (ANOVA) summary table for differences in levels of distress according to Experimental Condition and Time of Rating

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Time	418.030	1	418.030	118.212	.000
Time x Cond	2.645	1	2.645	.748	.393
Error(Time)	130.842	37	3.536		
Test of Between-Subjects Effects					
Intercept	497.017	1	497.017	242.843	.000
Cond	23.171	1	23.171	11.321	.002
Error	75.726	37	2.047		

Note: "Time" = Time of rating (before vs after aversive task); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A3.4
Analysis of variance (ANOVA) summary table for differences in future imaginings specificity according to Experimental Condition and Cue Valence

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Val	29.243	1	29.243	8.422	.006
Val x Cond	.987	1	.987	.284	.597
Error(Val)	128.475	37	3.472		
Test of Between-Subjects Effects					
Intercept	10255.709	1	10255.709	995.738	.000
Cond	33.402	1	33.402	3.243	.080
Error	381.086	37	10.300		

Note: "Val" = Cue Valence (positive vs negative); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A3.5
Analysis of variance (ANOVA) summary table for differences in mastery scores of future events imagined according to Experimental Condition and Cue Valence

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Val	330.741	1	330.741	98.646	.000
Val x Cond	2.126	1	2.126	.634	.431
Error(Val)	124.054	37	3.353		
Test of Between-Subjects Effects					
Intercept	2755.309	1	2755.309	422.164	.000
Cond	30.899	1	30.899	4.734	.036
Error	241.486	37	6.527		

Note: "Val" = Cue Valence (positive vs negative); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A3.6
Hierarchical regression model summary table examining variables predicting future mastery

Model	R	R^2	Adj. R^2	SE of Estimate	R^2 Change	F Change	df1	df2	*Sig. F Change*
1	.131[a]	.017	-.037	3.8566	.017	.314	2	36	.732
2	.367[b]	.134	.060	3.6705	.117	4.741	1	35	.036

a. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score, Experimental Condition

Table A3.7
ANOVA summary table for hierarchical regression predicting future mastery

Model		SS	df	Mean Square	F	*Sig*
1	Regression	9.341	2	4.671	.314	.732[a]
	Residual	535.428	36	14.873		
	Total	544.769	38			
2	Regression	73.221	3	24.407	1.812	.163[b]
	Residual	471.548	35	13.473		
	Total	544.769	38			

a. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Depression score, Self-efficacy scale score, Experimental Condition

Table A3.8
Model coefficient summary table for hierarchical regression predicting future mastery

Model		B	SE	β	t	*Sig*
1	(Constant)	10.608	4.610		2.301	.027
	DASS-21 Depression Score	-.045	.078	-.097	-.572	.571
	Self-efficacy scale score	.059	.150	.067	.391	.698
2	(Constant)	13.712	4.613		2.972	.005
	DASS-21 Depression Score	-.041	.074	-.090	-.555	.582
	Self-efficacy scale score	.082	.143	.094	.575	.569
	Exp Cond x Corr. Lat.	-2.568	1.179	-.343	-2.177	.036

Table A3.9
T-Test summary table for experimental group differences on the Means End Problem Solving Task

	C+ n = 20	C- n = 19	t	df	*Sig* (2-tail)	95% CI
Means	18.20 (5.63)	17.68 (6.54)	.264	37	.793	-3.44 – 4.47
Effectiveness	13.80 (2.61)	11.58 (3.85)	2.099	31.46*	.044	.06 – 4.38

Note: Standard deviations appear in parentheses. C+ = Controllability Condition; C- = No-Controllability Condition.
* Levene's test for equality of variance indicated a violation of the homogeneity of variance assumption, due to this adjustment degrees of freedom are not whole integers.

Table A3.10
Hierarchical regression model summary table examining variables predicting problem-solving effectiveness

Model	R	R^2	Adj. R^2	SE of Estimate	R^2 Change	F Change	df1	df2	*Sig. F Change*
1	.329[a]	.108	.084	3.2708	.108	4.493	1	37	.041
2	.329[b]	.108	.059	3.3159	.000	.000	1	36	.985

a. Predictors: (Constant), Experimental Condition
b. Predictors: (Constant), Experimental Condition, FIT mastery

Table A3.11
ANOVA summary table for hierarchical regression predicting problem-solving effectiveness

Model		SS	df	Mean Square	F	*Sig*
1	Regression	48.066	1	48.066	4.493	.041[a]
	Residual	395.832	37	10.698		
	Total	443.897	38			
2	Regression	48.070	2	24.035	2.186	.127[b]
	Residual	395.828	36	10.995		
	Total	443.897	38			

a. Predictors: (Constant), Experimental Condition
b. Predictors: (Constant), Experimental Condition, FIT mastery

Table A3.12
Model coefficient summary table for hierarchical regression predicting problem-solving effectiveness

Model		B	SE	β	t	*Sig*
1	(Constant)	16.021	1.644		9.745	.000
	Experimental Condition	-2.221	1.048	-.329	-2.120	.041
2	(Constant)	16.065	2.893		5.554	.000
	Experimental Condition	-2.228	1.128	-.330	-1.975	.056
	FIT mastery	-.003	.151	-.003	-.018	.985

Study 4

Table A4.1
Analysis of variance (ANOVA) summary table for differences in levels of distress according to Experimental Condition and Time of Rating

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Time	5.000	1	5.000	2.189	.147
Time x Cond	.200	1	.200	.088	.769
Error(Time)	86.800	38	2.284		
Test of Between-Subjects Effects					
Intercept	1656.200	1	1656.200	174.337	.000
Cond	12.800	1	12.800	1.347	.253
Error	361.000	38	9.500		

Note: "Time" = Time of rating (before vs after Cold-Pressor Task); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A4.2
T-Test summary table for experimental group differences in time taken to terminate the Cold-Pressor Task

	C+ n = 20	C- n = 20	t	df	*Sig* (2-tail)	95% CI
Time to terminate	75.00 (61.57)	77.80 (63.99)	-.141	38	.889	-43.00 – 37.40

Note: Standard deviations appear in parentheses. C+ = Controllability Condition; C- = No-Controllability Condition.

Study 5

Table A5.1
T-Test summary table for experimental group differences in time taken to quit Level 3 of PASAT-C

	C+ n = 16	C- n = 16	t	df	*Sig* (2-tail)	95% CI
Time to quit	187.06 (251.28)	138.13 (213.39)	.594	30	.557	-119.37 – 217.25

Note: Standard deviations appear in parentheses. C+ = Controllability Condition; C- = No-Controllability Condition.

Table A5.2
Analysis of variance (ANOVA) summary table for differences in levels of distress according to Experimental Condition and Time of Rating

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Time	78.766	1	78.766	61.827	.000
Time x Cond	4.516	1	4.516	3.545	.069
Error(Time)	38.219	30	1.274		
Test of Between-Subjects Effects					
Intercept	763.141	1	763.141	90.190	.000
Cond	34.516	1	34.516	4.079	.052
Error	253.844	30	8.461		

Note: "Time" = Time of rating (before vs after PASAT-C); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A5.3
T-Test summary table for experimental group differences in levels of distress split by time of rating

Time of Rating	C+ n = 16	C- n = 16	t	df	*Sig* (2-tail)	95% CI
Before PASAT-C	1.87 (1.93)	2.81 (2.32)	-1.245	30	.223	-2.48 – -.60
After PASAT-C	3.56 (2.39)	5.56 (2.16)	-2.482	30	.019	-3.65 – -.35

Note: Standard deviations appear in parentheses. C+ = Controllability Condition; C- = No-Controllability Condition.

Table A5.4
Analysis of variance (ANOVA) summary table for differences in levels of anxiety according to Experimental Condition and Time of Rating

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Time	5005.562	1	5005.562	32.781	.000
Time x Cond	945.562	1	945.562	6.192	.019
Error(Time)	4580.875	30	152.696		
Test of Between-Subjects Effects					
Intercept	51984.000	1	51984.000	42.097	.000
Cond	2162.250	1	2162.250	1.751	.196
Error	37045.750	30	1234.858		

Note: "Time" = Time of rating (before Level 1 of PASAT-C vs before Level 3 of PASAT-C); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A5.5
Hierarchical regression model summary table examining variables predicting anxiety increase

Model	R	R^2	Adj. R^2	SE of Estimate	R^2 Change	F Change	df1	df2	*Sig. F Change*
1	.450[a]	.203	.148	17.432	.203	3.687	2	29	.037
2	.606[b]	.367	.299	15.810	.164	7.254	1	28	.012

a. Predictors: (Constant), DASS-21 Anxiety score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Anxiety score, Self-efficacy scale score, Experimental Condition

Table A5.6
ANOVA summary table for hierarchical regression predicting anxiety increase

Model		SS	df	Mean Square	F	*Sig*
1	Regression	2240.618	2	1120.309	3.687	.037[a]
	Residual	8812.257	29	303.871		
	Total	11052.875	31			
2	Regression	4053.860	3	1351.287	5.406	.005[b]
	Residual	6999.015	28	249.965		
	Total	11052.875	31			

a. Predictors: (Constant), DASS-21 Anxiety score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Anxiety score, Self-efficacy scale score, Experimental Condition

Table A5.7
Model coefficient summary table for hierarchical regression anxiety increase

Model		B	SE	β	t	*Sig*
1	(Constant)	16.431	19.271		-.853	.401
	DASS-21 Anxiety Score	1.154	.441	.438	2.620	.014
	Self-efficacy scale score	-.251	.641	-.065	-.391	.698
2	(Constant)	-4.032	19.058		-.212	.834
	DASS-21 Anxiety Score	1.120	.400	.425	2.802	.009
	Self-efficacy scale score	-.317	.582	-.083	-.545	.590
	Experimental Condition	15.074	5.597	.406	2.693	.012

Study 6

Table A6.1
T-Test summary table for experimental group differences in participants characteristics and manipulation check

	C+ n = 15	C- n = 14	t	df	*Sig* (2-tail)	95% CI
Age	19.47 (2.03)	19.07 (2.01)	.516	27	.610	-1.18 – 1.97
DASS – Dep	10.40 (9.89)	6.00 (4.96)	1.529	20.928*	.141	-1.58 – 10.38
DASS – Anx	5.87 (4.24)	6.14 (5.74)	-.148	27	.883	-4.10 – 3.55
DASS – Str	10.40 (7.83)	8.43 (6.38)	.740	27	.466	-3.49 – 7.44
NGSE	29.67 (4.86)	29.36 (4.34)	.180	27	.858	-3.21 – 3.83
Manip Check	6.73 (2.74)	1.07 (2.13)	6.185	27	.000	3.78 – 7.54

Note: Standard deviations appear in parentheses. C+ = Controllability Condition; C- = No-Controllability Condition; DASS = Depression, Anxiety, Stress Scales – Short Form; NGSE = New General Self-Efficacy Scale; Manip Check = Manipulation Check.
* Levene's test for equality of variance indicated a violation of the homogeneity of variance assumption, due to this adjustment degrees of freedom are not whole integers.

Table A6.2
Chi-square summary table for experimental group differences in gender

	$\chi 2$	df	*Sig* (2-tail)
Gender	.293	1	.588

Table A6.3
Analysis of variance (ANOVA) summary table for differences in levels of distress according to Experimental Condition and Time of Rating

Source	Time	Type III SS	df	MS	F	*Sig*
Test of Within-Subjects Effects						
Time	–	19.614	2	9.807	8.344	.001
Time x Cond	–	9.131	2	4.566	3.885	.027
Error(Time)	–	63.467	54	1.175		
Test of Within-Subjects Contrasts						
Time	Level 1 vs Level 2	.053	1	.053	.049	.826
	Level 2 vs Level 3	30.644	1	30.644	11.164	.002
Time x Cond	Level 1 vs Level 2	16.605	1	16.605	15.324	.001
	Level 2 vs Level 3	.851	1	.851	.310	.582
Error(Time)	Level 1 vs Level 2	29.257	27	1.084		
	Level 2 vs Level 3	74.114	27	2.745		
Test of Between-Subjects Effects						
Intercept	–	229.413	1	229.413	52.372	.000
Cond	–	.079	1	.079	.018	.894
Error	–	118.273	27	4.380		

Note: "Time" = Time of rating (Time 1 vs Time 2 vs Time 3); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A6.4
Paired sample T-Test summary table for differences in levels of distress before and after threat of shock task split by experimental group

	t	df	*Sig* (2-tail)	Paired Diff Mean	Paired Diff SD	95% CI
Condition = Controllability						
Pair: Time 1 – Time 2	2.567	14	.022	.800	1.207	.13 – 1.47
Condition = No-Controllability						
Pair: Time 1 – Time 2	-3.24	13	.006	-.714	.825	-1.19 – -.24

Table A6.5
Analysis of variance (ANOVA) summary table for differences in pictures viewing times according to Experimental Condition and Picture Valence

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Val	15126988.51	1	15126988.51	16.332	.000
Val x Cond	58252.363	1	58252.363	.063	.804
Error(Val)	25007674.50	27	926210.167		
Test of Between-Subjects Effects					
Intercept	569275572.4	1	569275572.4	250.364	.000
Cond	27956404.88	1	27956404.88	12.295	.002
Error	61392354.61		2273790.912		

Note: "Val" = Picture Valence (negative vs neutral); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A6.6
Analysis of variance (ANOVA) summary table for differences in pictures ratings according to Experimental Condition and Picture Valence

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Val	275.672	1	275.672	168.410	.000
Val x Cond	.719	1	.719	.439	.513
Error(Val)	44.197	27	1.637		
Test of Between-Subjects Effects					
Intercept	453.716	1	453.716	123.640	.000
Cond	2.520	1	2.520	.687	.415
Error	99.081	27	3.670		

Note: "Val" = Picture Valence (negative vs neutral); "Cond" = Experimental Condition (Controllability vs No-Controllability)

Table A6.7
Hierarchical regression model summary table examining variables predicting negative pictures viewing times

Model	R	R^2	Adj. R^2	SE of Estimate	R^2 Change	F Change	df1	df2	*Sig. F Change*
1	.416[a]	.173	.110	1590.0780	.173	2.723	2	26	.084
2	.592[b]	.351	.273	1436.6162	.178	6.851	1	25	.015

a. Predictors: (Constant), DASS-21 Anxiety score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Anxiety score, Self-efficacy scale score, Experimental Condition

Table A6.8
ANOVA summary table for hierarchical regression predicting negative pictures viewing times

Model		SS	df	Mean Square	F	*Sig*
1	Regression	13769000.97	2	6884500.483	2.723	.084[a]
	Residual	65737047.76	26	2528347.991		
	Total	79506048.72	28			
2	Regression	27909394.02	3	9303131.339	4.508	.012[b]
	Residual	51596654.70	25	2063866.188		
	Total	79506048.72	28			

a. Predictors: (Constant), DASS-21 Anxiety score, Self-efficacy scale score
b. Predictors: (Constant), DASS-21 Anxiety score, Self-efficacy scale score, Experimental Condition

Table A6.9
Model coefficient summary table for hierarchical regression negative pictures viewing times

Model		B	SE	β	t	*Sig*
1	(Constant)	-414.544	2018.995		-.205	.839
	DASS-21 Anxiety Score	-41.041	60.997	-.120	-.673	.507
	Self-efficacy scale score	146.748	66.204	.395	2.217	.036
2	(Constant)	1792.619	2009.605		.892	.381
	DASS-21 Anxiety Score	-37.052	55.131	-.108	-.672	.508
	Self-efficacy scale score	141.428	59.849	.381	2.363	.026
	Experimental Condition	-1398.773	534.389	-.422	-2.618	.015

Study 7

Table 7.1
One way Analysis of Variance (ANOVA) summary table for experimental group differences in participants characteristics

Variable	Source	SS	df	Mean Square	F	*Sig*
Age	Between groups	61.097	2	30.548	.930	.401
	Within groups	1806.300	55	32.842		
	Total	1867.397	57			
NART	Between groups	66.445	2	33.222	.999	.375
	Within groups	1828.400	55	33.244		
	Total	1894.845	57			
DASS – Dep	Between groups	309.119	2	154.559	2.551	.087
	Within groups	3331.778	55	60.578		
	Total	3640.897	57			
DASS – Anx	Between groups	145.875	2	72.938	2.556	.087
	Within groups	1569.711	55	28.540		
	Total	1715.586	57			
DASS – Str	Between groups	103.602	2	51.801	.934	.399
	Within groups	3049.778	55	55.451		
	Total	3153.379	57			
NGSE	Between groups	60.676	2	30.338	1.411	.253
	Within groups	1182.444	55	21.499		
	Total	1243.121	57			

Note: DASS = Depression, Anxiety, Stress Scales – Short Form; NGSE = New General Self-Efficacy Scale.

Table A7.2
Chi-square summary table for experimental group differences in gender

	$\chi 2$	df	*Sig* (2-tail)
Gender	.513	2	.774

Table 7.3
One way Analysis of Variance (ANOVA) summary table for experimental group differences in overall manipulation check

Variable	Source	SS	df	Mean Square	F	*Sig*
Manip Check	Between groups	343.322	2	171.661	55.648	.000
	Within groups	169.661	55	3.085		
	Total	512.983	57			

Table 7.4
Post-Hoc multiple comparison summary table for experimental group differences in overall manipulation check

(I) Condition	(J) Condition	Mean Diff (I-J)	SE	*Sig.*	95% CI
C	CNC	2.6278	.5706	.000	1.22 – 4.04
	NC	5.8500	.5554	.000	4.48 – 7.22
CNC	C	-2.6278	.5706	.000	-4.04 – -1.22
	NC	3.2222	.5706	.000	1.81 – 4.63

Note: "C" = Controllability Condition; "CNC" = Loss of Controllability Condition; "NC" = No-Controllability Condition

Table A7.5
Analysis of variance (ANOVA) summary table for differences in Control Ratings during tone task according to Experimental Condition and Time of Rating

Source	Type III SS	df	MS	F	*Sig*
Test of Within-Subjects Effects					
Time	36.673	1	36.673	17.896	.000
Time x Cond	104.260	2	52.130	25.439	.000
Error(Time)	112.706	55	2.049		
Test of Between-Subjects Effects					
Intercept	2333.581	1	2333.581	429.294	.000
Cond	689.717	2	344.859	63.441	.000
Error	298.972	55	5.436		

Note: "Time" = Time of rating (Time 1 vs Time 2); "Cond" = Experimental Condition (Controllability vs Loss of Controllability vs No-Controllability)

Table 7.6
Post-Hoc multiple comparison summary table for experimental group differences in Control Ratings during tone task.

(I) Condition	(J) Condition	Mean Diff (I-J)	SE	*Sig.*	95% CI
C	CNC	.90	.536	.293	-.42 – 2.23
	NC	5.50	.521	.000	4.21 – 6.79
CNC	C	-.90	.536	.293	-2.23 – .42
	NC	4.60	.536	.000	3.27 – 5.92

Note: "C" = Controllability Condition; "CNC" = Loss of Controllability Condition; "NC" = No-Controllability Condition

Table A7.7
Paired sample T-Test summary table for differences in levels of distress before and after threat of shock task split by experimental group

	t	df	*Sig* (2-tail)	Paired Diff Mean	Paired Diff SD	95% CI
Condition = Controllability						
Pair: Time 1 – Time 2	-1.803	19	.087	-.750	1.860	-1.62 – .12
Condition = Loss of Controllability						
Pair: Time 1 – Time 2	5.486	17	.000	3.778	2.922	2.32 – 5.23
Condition = No-Controllability						
Pair: Time 1 – Time 2	1.789	19	.090	.350	.875	-.06 – .76

Table A7.8
Analysis of variance (ANOVA) summary table for differences in levels of distress according to Experimental Condition and Time of Rating

Source	Time	Type III SS	df	MS	F	*Sig*
Test of Within-Subjects Effects						
Time	–	413.079	3	137.693	67.989	.000
Time x Cond	–	6.771	6	1.129	.557	.764
Error(Time)	–	334.160	165	2.025		
Test of Within-Subjects Contrasts						
Time	Level 1 vs Level 2	596.579	1	596.579	113.654	.000
	Level 2 vs Level 3	.000	1	.000	.000	.993
	Level 3 vs Level 4	161.072	1	161.072	46.8999	.000
Error(Time)	Level 1 vs Level 2	288.700	55	5.249		
	Level 2 vs Level 3	140.394	55	2.553		
	Level 3 vs Level 4	188.894	55	3.434		
Test of Between-Subjects Effects						
Intercept	–	515.424	1	515.424	206.428	.000
Cond	–	.655	2	.327	.131	.877
Error	–	137.328	55	2.497		

Note: "Time" = Time of rating (Time 1 vs Time 2 vs Time 3 vs Time 4); "Cond" = Experimental Condition (Controllability vs Loss of Controllability vs No-Controllability)

Table A7.9
Analysis of variance (ANOVA) summary table for differences in Errors on the Emotional Stroop Task according to Experimental Condition and Word Valence

Source	Type III SS	df	MS	F	*Sig*
Test of Within-Subjects Effects					
Valence	1.550	1	1.550	3.034	.087
Valence x Cond	.946	2	.473	.926	.402
Error (Valence)	28.097	55	.511		
Test of Between-Subjects Effects					
Intercept	64.929	1	64.929	46.440	.000
Cond	.353	2	.176	.126	.882
Error	76.897	55	1.398		

Note: "Valence" = Word Valence (Positive vs Negative); "Cond" = Experimental Condition (Controllability vs Loss of Controllability vs No-Controllability)

Table A7.10
Analysis of variance (ANOVA) summary table for differences in Latency on the Emotional Stroop Task according to Experimental Condition and Word Valence

Source	Type III SS	df	MS	F	*Sig*
Test of Within-Subjects Effects					
Valence	24.360	1	24.360	.069	.794
Valence x Cond	610.438	2	305.219	.862	.428
Error (Valence)	19469.059	55	353.983		
Test of Between-Subjects Effects					
Intercept	45466125.20	1	45466125.20	3320.171	.000
Cond	25571.685	2	12785.842	.934	.399
Error	753165.173	55	13693.912		

Note: "Valence" = Word Valence (Positive vs Negative); "Cond" = Experimental Condition (Controllability vs Loss of Controllability vs No-Controllability)

Table A7.11
Multivariate Analysis of Variance (ANOVA) summary table for differences between experimental condition in similarity ratings for each type of statement on the Interpretation Bias task

Source	Time	Type III SS	df	MS	F	*Sig*
Corrected Model	Negative Target	.872	2	.436	1.626	.206
	Positive Target	.249	2	.124	.498	.611
	Negative Foil	.117	2	.058	.254	.776
	Positive Foil	. 256	2	.128	.536	.588
Intercept	Negative Target	373.053	1	373.053	1390.942	.000
	Positive Target	335.937	1	335.937	1343.085	.000
	Negative Foil	230.915	1	230.915	1004.532	.000
	Positive Foil	295.366	1	295.366	1235.887	.000
Condition	Negative Target	.872	2	.436	1.626	.206
	Positive Target	.249	2	.124	.498	.611
	Negative Foil	.117	2	.059	.254	.776
	Positive Foil	.256	2	.128	.536	.588
Error	Negative Target	14.751	55	.268		
	Positive Target	13.757	55	.250		
	Negative Foil	12.643	55	.230		
	Positive Foil	13.145	55	.239		
Total	Negative Target	391.240	58			
	Positive Target	350.490	58			
	Negative Foil	244.760	58			
	Positive Foil	309.280	58			
Corrected Total	Negative Target	15.623	57			
	Positive Target	14.006	57			
	Negative Foil	12.760	57			
	Positive Foil	13.401	57			

Note: Condition = Experimental Condition (Controllability vs Loss of Controllability vs No-Controllability)

Study 8

Table A8.1
Analysis of variance (ANOVA) summary table for differences in RMSSD according to Experimental Condition and Period of measurement

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Period	.007	3	.002	.034	.992
Period x Cond	.934	6	.156	2.177	.048
Error(Period)	.11.366	159	.071		
Test of Between-Subjects Effects					
Intercept	.002	1	.002	.002	.964
Cond	.701	2	.351	.351	.705
Error	52.855	53	.997		

Note: "Period" = Period of Measurement (baseline vs Tone 1 vs Tone 2 vs Recovery); "Cond" = Experimental Condition (Controllability vs Loss of Controllability vs No-Controllability). RMSSD analyses conducted on standardized z-scores.

Table A8.2
Analysis of variance (ANOVA) summary table for differences in RMSSD between baseline and recovery contrasting Controllability and Loss of Controllability Condition

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Period	.041	1	.041	.411	.526
Period x Cond	.540	1	.540	5.445	.026
Error(Period)	3.370	34	.099		
Test of Between-Subjects Effects					
Intercept	.004	1	.004	.004	.949
Cond	.558	1	.558	.523	.475
Error	36.254	34	1.066		

Note: "Period" = Period of Measurement (Baseline vs Recovery); "Cond" = Experimental Condition (Controllability vs Loss of Controllability).
RMSSD analyses conducted on standardized z-scores.

Table A8.3
Analysis of variance (ANOVA) summary table for differences in RMSSD between baseline and recovery contrasting Controllability and No-Controllability Condition

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Period	.153	1	.153	1.172	.286
Period x Cond	.024	1	.024	.186	.669
Error(Period)	4.697	36	.130		
Test of Between-Subjects Effects					
Intercept	.148	1	.148	.168	.684
Cond	.098	1	.098	.112	.740
Error	31.647	36	.879		

Note: "Period" = Period of Measurement (Baseline vs Recovery); "Cond" = Experimental Condition (Controllability vs No-Controllability).
RMSSD analyses conducted on standardized z-scores.

Table A8.4
Analysis of variance (ANOVA) summary table for differences in RMSSD between baseline and recovery contrasting Loss of Controllability and No-Controllability Condition

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Period	.132	1	.132	1.447	.237
Period x Cond	.358	1	.358	3.934	.055
Error(Period)	3.273	36	.091		
Test of Between-Subjects Effects					
Intercept	.146	1	.146	.138	.713
Cond	.205	1	.205	.193	.663
Error	38.122	36	1.059		

Note: "Period" = Period of Measurement (Baseline vs Recovery); "Cond" = Experimental Condition (Loss of Controllability vs No-Controllability).
RMSSD analyses conducted on standardized z-scores.

Table A8.5
Paired sample T-Test summary table for differences in RMSSD between baseline and recovery split by experimental group

	t	df	*Sig* (2-tail)	Paired Diff Mean	Paired Diff SD	95% CI
Condition = Controllability						
Pair: Baseline – Recovery	-1.003	17	.330	-.125579	.531016	-.39 – .14
Condition = Loss of Controllability						
Pair: Baseline – Recovery	2.768	17	.013	.220722	.338297	.05 – .39
Condition = No-Controllability						
Pair: Baseline – Recovery	-.491	19	.629	-.054060	.492014	-.28 – .18

Note: RMSSD analyses conducted on standardized z-scores.

Table A8.6
Analysis of variance (ANOVA) summary table for differences in HF according to Experimental Condition and Period of measurement

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Period	.003	3	.001	.006	.999
Period x Cond	2.218	6	.370	2.268	.040
Error(Period)	25.923	159	.163		
Test of Between-Subjects Effects					
Intercept	.001	1	.001	.001	.981
Cond	.539	2	.270	.301	.741
Error	47.426	53	.895		

Note: "Period" = Period of Measurement (baseline vs Tone 1 vs Tone 2 vs Recovery); "Cond" = Experimental Condition (Controllability vs Loss of Controllability vs No-Controllability).
HF analyses conducted on standardized z-scores.

Table A8.7
Analysis of variance (ANOVA) summary table for differences in HF between baseline and recovery contrasting Controllability and Loss of Controllability Condition

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Period	.318	1	.318	1.564	.220
Period x Cond	.337	1	.337	1.654	.207
Error(Period)	6.923	34	.204		
Test of Between-Subjects Effects					
Intercept	.030	1	.030	.029	.865
Cond	.021	1	.021	.021	.885
Error	34.578	34	1.017		

Note: "Period" = Period of Measurement (Baseline vs Recovery); "Cond" = Experimental Condition (Controllability vs Loss of Controllability).
HF analyses conducted on standardized z-scores.

Table A8.8
Analysis of variance (ANOVA) summary table for differences in HF between baseline and recovery contrasting Controllability and No-Controllability Condition

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Period	.280	1	.280	1.611	.212
Period x Cond	.263	1	.263	1.512	.227
Error(Period)	6.261	36	.174		
Test of Between-Subjects Effects					
Intercept	1.951E-5	1	1.951E-5	.000	.996
Cond	.104	1	.104	.140	.711
Error	26.815	36	.745		

Note: "Period" = Period of Measurement (Baseline vs Recovery); "Cond" = Experimental Condition (Controllability vs No-Controllability).
HF analyses conducted on standardized z-scores.

Table A8.9
Analysis of variance (ANOVA) summary table for differences in HF between baseline and recovery contrasting Loss of Controllability and No-Controllability Condition

Source	Type III SS	df	Mean Square	F	*Sig*
Test of Within-Subjects Effects					
Period	.004	1	.004	.018	.894
Period x Cond	1.228	1	1.228	5.085	.030
Error(Period)	8.696	36	.242		
Test of Between-Subjects Effects					
Intercept	.021	1	.021	.021	.885
Cond	.030	1	.030	.030	.864
Error	36.229	36	1.006		

Note: "Period" = Period of Measurement (Baseline vs Recovery); "Cond" = Experimental Condition (Loss of Controllability vs No-Controllability).
HF analyses conducted on standardized z-scores.

Table A8.10
Paired sample T-Test summary table for differences in HF between baseline and recovery split by experimental group

	t	df	*Sig* (2-tail)	Paired Diff Mean	Paired Diff SD	95% CI
Condition = Loss of Controllability						
Pair: Baseline – Recovery	1.543	17	.141	.269819	.741941	-.10 – .64
Condition = No-Controllability						
Pair: Baseline – Recovery	-1.647	19	.116	-.239430	.650264	-.54 – .06

Note: HF analyses conducted on standardized z-scores.