INVESTIGATING THE SUBJECTIVE AND OBJECTIVE DIFFERENCES IN MENTAL TIME TRAVEL IN ANXIETY

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Mental Time Travel (MTT) refers to our ability to think about the past, present and future. MTT impairments in depression, PTSD, and schizophrenia have been linked to maladaptive behaviours, including poor planning and reduced coping skills. However, research into MTT in anxiety disorders, a family of disorders characterised by the experience of catastrophic fears related to the future, remains limited. This thesis investigated differences in past and future thinking in individuals with increasing levels of anxiety.

Study 1 piloted an adapted protocol designed to address a number of methodological limitations within the literature. Study 2 investigated the protocol in a large online sample. Study 3 investigated the effect of increasing levels of anxiety on the subjective experiences (phenomenological qualities) and objective qualities (overgenerality and episodic detail) of MTT in a non-clinical university sample. A number of differences in subjective experience were identified with increasing levels of anxiety, but no differences between groups were identified for overgenerality or episodic detail. Study 4 investigated the subjective and objective differences of MTT in a transdiagnostic clinical anxiety sample compared to healthy controls. Individuals with anxiety were found to produce less episodic details when thinking about the past and the future. A number of phenomenological differences were identified in the anxiety group, including self-reported higher levels of coherence and increased importance ratings. Finally, Study 5 compared the production of MTT in a naturalistic setting to MTT produced within the laboratory in a non-clinical university sample and a transdiagnostic clinical sample.

These studies aimed to address validity concerns of testing MTT within a laboratory setting. They represent the first studies to use traditional laboratory methods in combination with mobile phone technology to compare MTT in various

settings. In addition, Study 5 represents the first study to investigate MTT in a clinical anxiety sample within a naturalistic setting. These studies highlight the qualitative differences in recollection of past episodes and the simulation of future episodes, in combination with the reported phenomenological impact these events, across varying levels of anxiety. The implications of the results of these studies on theory and treatment of anxiety disorders are explored.

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Papers in Preparation for Publication

Robuck, S.R., Richmond, J.R., Grisham, J.R. (in preparation). Mental Time Travel in Anxiety: Investigating subjective and objective differences in a clinical sample

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Posters

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Abstract

Mental Time Travel (MTT) refers to our ability to think about the past, present and future. MTT impairments in depression, PTSD, and schizophrenia are linked to maladaptive behaviours, including poor planning and reduced coping skills. There is limited research into MTT in anxiety disorders, a family of disorders characterised by the experience of catastrophic fears related to the future. This thesis investigated differences in past and future thinking in individuals with increasing levels of anxiety.

Study 1 piloted an adapted protocol designed to address a number of methodological limitations within the literature. Study 2 applied this protocol in a large online sample. Study 3 investigated the effect of increasing levels of anxiety on the subjective experiences (phenomenological qualities) and objective qualities (overgenerality and episodic detail) of MTT in a non-clinical university sample. Several differences in subjective experience were identified with increasing levels of anxiety, but no differences between groups were identified for overgenerality or episodic detail. Study 4 investigated the subjective and objective differences in MTT in a transdiagnostic clinical anxiety sample compared to healthy controls. Individuals with anxiety were found to produce less episodic details when thinking about the past and the future. Several phenomenological differences were identified in the anxiety group, including self-reported higher levels of coherence and increased reaction ratings. Finally, Study 5 compared MTT in a naturalistic setting to MTT produced within the laboratory, in a non-clinical university sample and a transdiagnostic clinical sample. These studies aimed to address validity concerns of testing MTT within a laboratory setting. They represent the first studies to use traditional laboratory methods in combination with mobile phone technology to compare MTT in various settings. These studies highlight the qualitative differences in the recollection of past episodes and the

simulation of future episodes, in combination with the reported phenomenological impact of these events, across varying levels of anxiety. The implications of the results of these studies on theory and treatment of anxiety disorders are explored.

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CHAPTER 1

General Introduction

The ability to transport ourselves mentally in time, to re-experience the past and pre-experience the future, is a functionally adaptive process that is essential for wellbeing. This process, termed Mental Time Travel (MTT) is comprised of two key elements, episodic memory and episodic future thought (Atance & O'Neill, 2001; Suddendorf & Corballis, 2007a). It is thought that the ability to remember the past is necessary to imagine possible personal futures. By imagining possible futures, we can modulate our current behaviour to avoid possible threat, reduce possible future risk, achieve our goals and improve our ability to cope (Baumgartner, Pieters, & Bagozzi, 2008; Miloyan, Pachana, & Suddendorf, 2014; Schacter et al., 2012; Suddendorf & Corballis, 1997; Suddendorf & Corballis, 2007a; Szpunar, 2010). Individual differences in MTT ability translate into individual differences in behaviour, that in turn contribute to individual differences in wellbeing and psychological distress (Gilbert & Wilson, 2007; for review see Szpunar, 2010).

Recent research has focused on understanding the connection between memory and future thinking, along with the impact of MTT impairment on behaviour (for reviews see Klein, 2013; Schacter et al., 2012; Schacter, Addis, & Buckner, 2008; Szpunar, 2010; Szpunar & Radvansky, 2016) Converging work from neuropsychology (Hassabis, Kumaran, Vann, & Maguire, 2007b; Tulving, 1985), neuroimaging (Addis, Wong, & Schacter, 2008; Benoit & Schacter, 2015; Botzung, Denkova, Ciuciu, Scheiber, & Manning, 2008; Buckner & Carroll, 2007; Hassabis, Kumaran & Maguire, 2007a; Okuda et al., 2003; Szpunar, Watson, & McDermott, 2007) and lifespan developmental studies (Busby & Suddendorf, 2005; Craik & Bialystok, 2006; Hayne, Gross, McNamee, Fitzgibbon, & Tustin, 2011; Abram, Picard, Navarro & Piolino,

2014) have demonstrated that episodic memory is integral for successful episodic future thought. Further, research investigating MTT within clinical populations has typically focused on disorders with known memory deficits, such as depression (Williams et al., 1996) and schizophrenia (D'Argembeau, Raffard, & Van der Linden, 2008). Results from these studies provide evidence of the connection between memory and future thought, with identified differences such as overgeneral thinking, observed in both remembering the past and imagining possible futures.

Overgeneral thinking, or reduction in specificity, is identified as a key characteristic of MTT impairment in clinical populations. Critically, overgeneral memory impacts future thinking abilities, resulting in reduced preparatory behaviour, depressive expectations of the future, poor planning and poor problem solving (Lyons, Henry, Rendell, Robinson, & Suddendorf, 2016; Miranda & Mennin, 2007; Strunk, Lopez, & DeRubeis, 2006). At present, few studies have investigated MTT in anxiety disorders, a family of clinical disorders specifically characterized by maladaptive future thinking with significant implications for behavioral functioning. As a result, researchers have argued that investigating MTT and how it breaks down in anxiety disorders is an essential avenue for research (Miloyan et al., 2014; Szpunar & Radvansky, 2016)

The experimental research reported here focuses on the nature of MTT in anxiety. The research explores objective and subjective differences in the experience of episodic memory and episodic future thought in both sub-clinical and clinical populations. Further, the research explores the validity of the current experimental paradigms that are used to measure MTT. The studies reported here provide an original contribution to two fields of research, namely mental time travel literature and the clinical literature of anxiety disorders.

Mental Time Travel: A Definition

Mental Time Travel (MTT) is our ability to mentally transport ourselves into the past and in the future (Atance & O'Neill, 2001). At one end of the time continuum of MTT is episodic memory, our ability to re-experience personal past events that are bound by time and place. Episodic memory is unique from other types of memory (i.e. semantic memory and procedural memory) as it enables humans to subjectively travel back in time to remember specific personal past experiences that have already happened (see Tulving, 2002). Episodic memory incorporates the sensory and perceptual qualities of the event, as well as the emotions, perceptions, and thoughts experienced at the time the event occurred (Dere, Pause, & Pietrowsky, 2010). The ability to be consciously aware of mentally moving through time is a key element of episodic memory (and episodic future thought) and arguably the quality that makes MTT a uniquely human characteristic (Suddendorf & Corballis, 1997; Tulving, 2005). Episodic memory is central to human functioning. It enables an individual to remain oriented in the present, contributes to a sense of self (Conway & Pleydell-Pearce, 2000; Fivush & Nelson, 2004) and is implicated in problem solving and goal pursuit (Raes et al., 2005; Williams et al., 2007).

Episodic future thought, our ability to simulate personally relevant events in the future, is at the other end of the MTT continuum (Atance & O'Neil, 2001). Although episodic future thought has been referred to as episodic foresight (Suddendorf, 2010), prospection (Buckner & Carroll, 2007; Suddendorf & Corballis, 2007b) and simulation (Gaesser, Sacchetti, Addis, & Schacter, 2011; Schacter & Addis, 2007; Szpunar & Schacter, 2013) within the literature, for the purpose of this thesis I will use the term episodic future thinking because the fundamental difference between episodic future thinking and other types future thinking is its connection with episodic memory.

Research has shown that on average, healthy adults think about the future approximately 59 times per day, however, only 42.5% of these thoughts relate to specific future episodes (D'Argembeau, Renaud, & Van Der Linden, 2011). Therefore, it is important to understand the defining characteristics that distinguish episodic future thinking from other kinds of future thinking.

Episodic future thinking has two phenomenological features that separate it from simple imaginings of the future (D'Argembeau & Van der Linden, 2012). First, episodic future thought includes sensory and perceptual features, such as details of the contextual setting, sights/smells, the people involved and the objects in the event. These features separate episodic future thought from other types of future thought, which may be abstract in nature and contain no sensory qualities. For instance, planning is a future-oriented process that allows us to put together components that predetermine a course of action to achieve some goal (Alexander & Stuss, 2000; Burgess, Veitch, de Lacy Costello, & Shallice, 2000). Similarly, prospective memory is a future thinking process that allows us to remember future intentions (Brandimonte, Einstein & McDaniel, 2014; Einstein, McDaniel, Marsh & West, 2008). While episodic future thought may be a sub-component in both of these future thinking processes, planning and prospection can occur in the absence of episodic future thought (Szpunar & Tulving, 2011). More specifically, both planning and prospective memory do not necessarily involve sensory or perceptual features, or involve a sense of pre-experiencing. In addition to sensory perceptual features, episodic future thought involves an element of personal relevance or goal direction that is not required for other kinds of future thinking (D'Argembeau & Mathy, 2011). For example, thinking about your next New Year's Eve would likely include specific people who would be there, a specific context of where you would be and also a goal for the evening (i.e. do you want to have a relaxed night at home or to

dance the night away at a big party?). In contrast, thinking about which candidate will win the next election is a thought about the future, that is not personally relevant nor goal oriented. These features are not unique to episodic future thought; it is possible to engage in episodic planning in which an individual thinks about the specific steps that will be required to achieve a certain goal (i.e. what do I need to cook for Saturday's dinner party), an instance which is high in both personal relevance and goal directedness, yet does not have the same sensory perceptual qualities of episodic future thought. Similarly, it is possible to engage in semantic future thoughts that are high in goal directedness but not necessarily personally relevant (i.e. What might the green space needs of my neighbourhood be in 2025?). Therefore, it is the combination of sensory-perceptual features, personal relevance and goal directedness that make episodic future thinking unique, and culminate in individual *pre*-experiencing the future event. The fact that these features are so similar to episodic memory, which suggests a strong connection between episodic memory and episodic future thinking.

Episodic memory and episodic future thought also share several phenomenological characteristics that have been highlighted in studies conceptualizing MTT. Phenomenological characteristics are the subjective perceptual and experiential qualities that participants report when remembering the past or imagining the future. Participants are asked to use a Likert scale to rate experiential qualities such as event vividness, their emotional reaction, their experience of sensory details, their experience of contextual details, the perspective from which they re-live or pre-live the event and the importance of the event to their life-story. The subjective judgments that an individual makes about their memory seem to exert similar influences on episodic future thought (Bar, 2011; D'Argembeau & Van der Linden, 2004; McDermott, Szpunar & Arnold, 2011). For example, participants tend to report that events imagined

in the near future contain more sensory and contextual details relative to those imagined in the distant future, which tend to be represented by abstract and general features. This is also true of episodic memories from the recent past relative to those in the distant past (Arnold, McDermott & Szpunar, 2011; D'Argembeau & Van der Linden, 2004; D'Argembeau & Van der Linden, 2012; Trope & Liberman, 2003). Temporal distance is believed to impact MTT because individuals spend more time thinking about their recent past and immediate future relative to events located at greater temporal distances (Spreng & Levine, 2006). The valence of an event also appears to exert similar influence on both episodic memory and episodic future thought. There is some evidence that negative past and future events provoke additional processing to enable future preparedness (for review see Baumeister, Bratslavsky, Finkenauer & Vohs, 2001; Peeters & Czapinski, 1990; Taylor, 1991). For instance, according to the Mobile-Minization hypothesis (Taylor, 1991) negative events, that is those that are potentially adverse or threatening, result in increased physiological, affective and cognitive resources for mobilization. After a negative event, a compensatory or 'off-setting' response to the initial increased arousal occurs to minimize its impact. These counter responses, which include physiological, cognitive and behavioural components, are designed to minimize the impact of the negative events and occur irrespective of whether the event has occurred in the past or is imagined as occurring in the future (Taylor, 1991). The initial mobilization phase alerts the organism to take action, whereas the minimization phase facilitates a return to functioning in a non-threatening environment. The increase in processing before and after the negative event (imagined or otherwise) compared to positive or neutral events is thought to impact how much perceptual detail about negative events is encoded and recalled, however, at present there is mixed evidence (for review see Taylor & Brown, 1988; Taylor, 1991). While

additional processing may occur for negative events, there is also a growing body of evidence that suggests a positivity bias for past and future thoughts. Positivity biases occur when people perceive past events (Walker, Skowronski, & Thompson, 2003) and future events (Berntsen & Bohn, 2010; Newby-Clark & Ross, 2003; Szpunar et al., 2012; Taylor & Brown, 1988: Walker & Skowronski, 2009) as positive more often than negative. Future positivity bias (also termed optimism bias) is the tendency to overestimate the likelihood of positive events happening, to form positively biased scenarios and to imagine positive events in more detail and at a closer time point compared to negative events (Sharot, 2011). Similarly, people tend to report more sensory details for positive events than negative events (D'Argembeau, Comberlain & Van Der Linden., 2003). Such biases are linked to several adaptive processes including increased emotional well-being and coping with stress (Schacter et al., 2012; Taylor, 1989). The competing possibilities between increased processing for negative events and an optimism biases for positive events likely impact the results of studies in which participants are asked to generate emotionally valanced events. Critically, however, it is the phenomenological symmetry between episodic memory and episodic future thought that provides evidence that they lie upon a single continuum.

Although there are a number of commonalities between episodic memory and episodic future thought, there are also several important differences that have been identified. For example, episodic future thoughts are typically less detailed (Szpunar et al., 2007) than episodic memory, but are rated as more relevant to our life story (Berntsen & Bohn, 2010) and are governed predominantly by cultural life scripts (Berntsen & Jacobson, 2008) relative to episodic memories. While the similarities in the phenomenological qualities above supports the connection between episodic memory

and episodic future thinking, the differences suggest that episodic future thought is a unique mental process.

A significant body of evidence has shown that similar neural pathways underlie episodic memory and episodic future thought. This evidence has emerged from three converging areas. First, from clinical neuropsychology, observations of amnesic individuals showed that impairments in episodic memory were similarly reflected in an inability to imagine future episodes (Tulving, 1985; Tulving, 2002; Hassabis et al., 2007b). Additionally, observations of individuals with bilateral hippocampal lesions highlighted that even when individuals retained the ability to remember the past and imagine the future, these thoughts were typically impersonal in nature making them non-episodic (Hassabis et al., 2007b; Klein, Rozendal, & Cosmides, 2002; Klein, Loftus & Kihlstrom, 2002). Second, from cognitive neuroscience, remembering past events and imagining future ones evoke similar neural activation, particularly within the prefrontal and medial temporal lobe regions (Addis, Pan, Vu, Laiser & Schacter, 2009; Addis, Wong & Schacter, 2007; for review see Benoit & Schacter, 2015; Botzung, Denkova & Manning, 2008; Buckner & Carrol, 2007; Hassabis et al., 2007a; Okuda et al., 2003; Szpunar et al., 2007). Neuroimaging research has also shown that personal relevance is key to both episodic memory and episodic future thinking (Szpunar et al., 2007). For example, regions of the medial prefrontal cortex (mPFC), posteromedial parietal cortex and the medial temporal lobes (MTLs) were uniquely activated when participants were asked to construct personal past and future episodes (i.e. thoughts about their own future), but were not activated when participants imagined a scenario that they were not personally involved in (i.e., future situations for Bill Clinton) (Szpunar et al., 2007). Third, research in lifespan development shows that episodic memory and episodic future thought are characterised by a similar trajectory of

development in early childhood (Atance, 2008; Atance & Meltzoff, 2007; Grant, Suddendorf, Busby Grant, & Suddendorf, 2010; Hayne et al., 2011; McCormack & Atance, 2011; Nigro, Brandimonte, Cicogna, & Cosenza, 2014; Richmond & Pan, 2013; Suddendorf, Nielsen, & Von Gehlen, 2011; Wang, 2008; Wang, Capous, Koh, & Hou, 2013) and decline in old age (Addis, Musicaro, Pan, & Schacter, 2010; for review see Bialystok & Craik, 2012; Gaesser et al., 2011; Terrett et al., 2015). The age-related changes in MTT ability during childhood and old age are attributed to the development and the decline of neural systems responsible for MTT (Addis, Moscovitch, Crawley, & McAndrews, 2004; Addis & Schacter, 2011; Carr & Viskontas, 2007; Gaesser, Spreng, McLelland, Addis, & Schacter, 2013; Maguire & Hassabis, 2011; Suddendorf, 2013; Suddendorf & Redshaw, 2013; Viard et al., 2011). While the pathways are similar episodic memory and episodic future thought (as evidenced from clinical neuropsychology observations of amnesic individuals and neuroimaging studies) it is important to note that there is evidence these areas to not overlap perfectly with some studies suggesting differential functioning between memory and future thinking (see Dede, Wixted, Hopkins & Squire, 2016; Squire et al., 2010). For instance, patients with hippocampal damage successfully imagined future events (Squire et al., 2010). There is also evidence that there is greater activation when imagining the future than remembering the past (see Addis, Pan, Vu, Laiser & Schacter, 2007).

Theoretical Connection of EM and EFT

In light of the similar phenomenological characteristics, common neural pathways and development trajectories outlined above, a number of theories are proposed to account for the link between episodic memory and episodic future thought. The most prominent is the Constructive Episodic Simulation Hypothesis (Schacter & Addis, 2007; Schacter,

Addis & Buckner, 2007; Schacter et al., 2007b). This theory suggests that memory for past events and simulations of future events rely on similar information and similar underlying processes. Episodic memory supports future thought construction by allowing stored event information to be retrieved and recombined into a simulated novel future event. The constructive episodic simulation hypothesis suggests that a critical function of the constructive memory system is to flexibly combine information from stored events into novel future scenarios via a relational processing network (Addis et al., 2009; Schacter et al., 2007a; Schacter et al., 2008). In support of this hypothesis, direct comparisons of past and future event construction have revealed consistently greater neural activation in the frontopolar region and the MTLs when participants are asked to imagine a future event relative to when they remember a past event (Addis et al., 2007; Conway, Pleydell-Pearce, Whitecross & Sharpe, 2003; Szpunar et al., 2007), which is taken as evidence of the relational processes required to flexibly recombine past memories into a coherent future event (Addis & Schacter, 2013; Schacter & Addis, 2011).

Two additional hypotheses have emerged to the constructive episodic simulation hypothesis. One proposed by Suddendorf and Corballis (2007) implicates executive processes (i.e. theory of mind, inhibitory control, and working memory) in episodic future thinking. One needs to be able to hold information in mind, flexibly manipulate this information and simultaneously inhibit the recall of the specific past memory when constructing episodic future thought. Research has shown that the specificity of past and future thinking is correlated with performance on tasks used as measures of executive function control, including Letter-Number sequencing and verbal fluency task (D'Argembeau, Ortoleva, Jumentier, & Van der Linden, 2010; Addis et al., 2008). While Suddendorf and Corballis highlight the role of executive function in future thinking, the

Scene Construction Hypothesis (Hassabis et al., 2007a) suggests the ability to 'scene build' as the common element between episodic memory and episodic future thought. This theory posits that individual differences in the ability to mentally generate and maintain a complex and coherent scene, are better able to account for the commonalities seen in brain activation when remembering the past and imagining the future (Hassabis et al., 2007a). These theories highlight that MTT likely recruits several complex cognitive systems to allow us to reconstruct events that have happened in the past and simulate those that might happen in the future. The aforementioned theories highlight that episodic future thought extends beyond the recombination of episodic information from the past. There is evidence from semantic dementia research that in addition to episodic details, semantic information is critical for future event construction (see Irish, Addis, Hodges & Piguet, 2012) There is also evidence to suggest that construction of past and future events relies on the general expectations (schema) of the world that an individual maintains (see Berntsen & Bohn 2010; Rubin, 2014). Further, it is suggested that the same core brain network that is activated in remembering the past and imagining the future, may be activated whenever participants are asked to 'self-projection,' including perspective taking (theory of mind) and navigation (simulation of an environment). Rather than these abilities being considered distinct, they may be interrelated (Buckner & Carroll, 2007).

Extending beyond theories that attempt to explain the underlying processes linking episodic memory and episodic future thinking, some theorists have suggested that the evolutionary purpose of episodic memory is to allow for the simulation of episodic future thoughts (Schacter & Addis, 2007; Schacter et al., 2007; Suddendorf & Busby, 2005; Suddendorf & Corballis, 2007a; Suddendorf & Redshaw, 2013). This idea has gained significant momentum in the last decade and has shifted the focus research towards episodic future thinking capacity and the implications of MTT impairment for

adaptive functioning in both clinical and non-clinical groups (for detailed reviews see Schacter et al., 2008; Suddendorf & Corballis, 2007b; Szpunar, 2010). The ability to construct temporally distant futures allows us to anticipate future needs and to imagine threat, which in turn permits us to adapt our behaviour appropriately in the present (Hanson, Atance & Paluck, 2014; Miloyan, Bulley & Suddendorf, 2015; Szpunar & Radvansky, 2015). Given that general future thinking has been linked to psychological wellbeing, including benefits for coping and affect regulation (Taylor & Schneider, 1989), problem solving (Oettingen, 1996), implementing care behaviours (Orbell, Hodgkins, & Sheeran, 1997) and achieving goals (Taylor, Pham, Rivkin & Armor, 1998), it is likely that episodic future thinking is also be related to adaptive functioning (Suddendorf & Redshaw, 2013; for review see Szpunar, 2010).

Recent empirical research has identified several adaptive benefits of episodic future thought. The construction of episodic future events has been connected to enhanced planning for future oriented tasks (Engert, Small, Wood & Singer, 2014; Pham & Taylor, 1999; Ruby, Smallwood, Engen & Singer 2013; Szpunar, Spreng & Schacter, 2014) and reductions in negative affect (Engert et al., 2014). For example, spontaneously occurring episodic future thoughts have been correlated with a reduction in negative affect, measured via subjective and objective markers of stress. These findings highlight that future thinking may be an adaptive strategy to assist individuals in managing expected future stressors (Engert et al., 2014). There is also some indication that pre-experiencing future episodic events promotes better prospective memory, that is memory to perform a specific action in the future, in both young and older adults (Brewer & Marsh, 2010; Terrett et al., 2016). While evidence from non-clinical populations has provided some support for the evolutionary proposition that

episodic memory is linked to episodic future thought for the purpose of adaptive functioning, the majority of evidence has emerged from research in clinical populations.

MTT within Clinical Populations

The extant literature includes a number of investigations of MTT in clinical populations including Alzheimer's disease (Addis, Sacchetti, Ally, Budson & Schacter, 2009), autism (Lind & Bowler, 2008), mild cognitive impairment (Gamboz et al., 2010), schizophrenia (D'Argembeau et al., 2008), depression (Williams et al., 1996) and prolonged grief (MacCallum & Bryant, 2011). Across these studies, there is a common reduction in the specificity with which clinical participants report past and future events.

The specificity of events reported in the context of MTT studies is typically measured in one of three ways. Researchers may use self-report methods, asking participants to reflect on and rate the vividness of events (see D'Argembeau & Van der Linden, 2004). Alternatively, researchers ask participants to provide short descriptions of events. These events are then objectively categorised as specific or not, depending on whether the event reported is personally relevant and occurred/will occur within a 24-hour period (see Williams et al., 1996). Alternatively, these events may be coded using an adapted protocol from autobiographical memory literature, which segments event descriptions into episodic and semantic details, using the number of episodic details provided as an index of specificity (see Levine, Svoboda, Hay, Winocur & Moscovitch, 2002; Addis et al., 2010).

The first study to demonstrate reduced specificity in a clinical sample when thinking about the past or future was in suicidally-depressed patients (Williams et al., 1996). In response to valenced word cues, Williams et al. (1996) found that suicidally

depressed patients generated fewer specific future events, as well as fewer specific past events, relative to healthy controls. In response to positive, negative or neutral cue words, participants were asked to recall personal events that happened to them in the past or imagine events that might happen in the future. Event specificity was determined using a coding protocol that categorised events as specific if they were personally relevant and occurred within a single-day. Events were categorised as intermediate (also termed categoric/intermediate) if events occurred over a period longer than 24 hours or were repeated events. Or, events were categorised as general events if they were something other than a memory/future thought. Compared to controls, suicidally depressed participants produced fewer specific memories and future events, that is, they produced fewer personally relevant events that occurred within a single-day. Depressed participants and controls exhibited comparable verbal fluency, indicating that the difference observed in past and future memory specificity was not due to a difference in cognitive processing levels between groups. Williams and colleagues suggest that the impairment may stem from depressed patients encoding limited descriptions of personal events, which in turn affects their ability to retrieve these memories when they are constructing specific future episodes. These results were replicated using the same paradigm in a sample of patients with schizophrenia (D'Argembeau et al., 2008), with the exception that the difference in specificity seen between those with schizophrenia and controls, was more pronounced for future events than past events.

Within the autobiographical memory literature, reductions in specificity observed in clinical samples are termed 'overgeneral memory'. Overgeneral memory, is the production of fewer specific events from memory in response to cue words (Williams, 2006; Williams et al., 2007). Overgeneral memory has significant consequences for psychological functioning, including delayed recovery from episodes

of affective disorders such as depression (Brittlebank, Scott, Williams & Ferrier, 1993; Dalgleish, Spinks, Yiend & Kuyken, 2001; see Sumner, Griffith & Mineka, 2010 for a meta-analysis), decreased effectiveness in problem solving (D'Zurilla & Nezu, 1980; Goddard, Dritschel & Burton, 1996; Raes et al., 2005; Evans, Williams & O'laughlin & Howells, 1992) and increased hopelessness (Evans et al., 1992). In relation to MTT, the ability to recall personally specific and detailed episodic memories is critical in the ability to generate specific episodic future thoughts that are consistent with goals and function to modify current behaviour (Conway et al., 2003; Suddendorf & Corballis, 2007; Szpunar, 2001; Williams et al., 2007).

A number of models have been proposed to explain the mechanisms underlying overgeneral memory in clinical disorders. The *self-memory model* describes autobiographical memories (and for the purpose of this thesis, episodic memories) as, "transitory dynamic mental constructions generated from an underlying knowledge base" (p.261) (Conway & Pleydell-Pearce, 2000). This model proposes that memories are stored as records of events and these records are organized in a top-down hierarchical structure with three levels. The top level consists of prolonged periods of time called *lifetime periods* (i.e. when I was a child). The next level is that of *general event* descriptions, which represent abstract conceptual summaries of events (i.e. in the summer holidays) and tend to be abstract verbal summaries of past experience. This level of representation is assumed to be the preferred or default level of access to episodic memories, with some suggestion that storage of memory at this level is the most economical, as memory is not cluttered with trivial details (Schacter & Addis, 2007; Gilbert & Wilson, 2007). The lowest level is referred to as *event-specific knowledge* (ESK) and consists of concrete sensory details of unique events including sensory and perceptually-rich visual imagery. Conway and Pleydell-Pearce suggest that

the episodic nature of these memories is part of a large 'self-memory system' that functions to promote goal-directed activities and contribute to a representation of one's self. ESKs form the specific, sensory rich, goal-directed events of MTT. The model also posits that executive function is required for successful activation or inhibition of particular ESKs during the retrieval process.

Within the self-memory model, Conway & Pleydell-Pearce's (2000) suggest that overgeneral memory occurs through a process termed *dysfacilitation* that can occur at encoding or retrieval. During encoding, dysfacilitation occurs when an event is only encoded at the abstract or categorical level, resulting in impoverished event-specific knowledge. This type of impoverished encoding may occur when the episode is inconsistent with the individual's current sense of self or goals. During retrieval, dysfacilitation occurs when an individual curtails the retrieval process prior to accessing ESKs, to only access general descriptive information. Inhibiting access to ESKs may be an avoidance strategy, as the content of ESKs contain sensory-perceptual and affective features that can elicit negative affect, which can interfere with an individual's current goals. This process of avoidance has since been termed *functional avoidance*, as it is a learnt response that helps reduce affective disturbance in the short term (Williams et al., 2007).

Extending upon the self-memory system model, the *CaR-FA-X model* (Williams, 2006; Williams et al., 2007) proposes three mechanisms –*capture and rumination* (CaR), *functional avoidance* (FA) and *impaired executive control* (X) to explain overgeneral memory, and by extension overgeneral future thought. *Capture and Rumination* is the combination of ruminative processes (repetitive and passive thinking about one's symptoms, see Nolen-Hoeksema, 1991) that captures the individual's attention and disrupts on-task processing that is required during retrieval of specific

memories. The *functional avoidance* element of the CaR-Fa-X model is consistent with the self-memory model (Conway & Pleydell-Pearce, 2000) in that both models suggest that by recollecting general descriptions individuals reduce possible changes in affect. Williams and colleagues go further to suggest that avoidance is not restricted to only negative affect but is across negative and positive affect. The fact that overgeneral thinking occurs for both positive and negative events in depression supports this idea (i.e. Dalgleish et al., 2001; Moffit, Singer, Nelligan, Carlson & Vyse, 1994). Finally, the third mechanism of the CaR-Fa-X model that is *impaired executive control* refers to a reduction in executive resources, which play an important role in the retrieval of specific memories. Executive resources are suggested to inhibit off-task and ruminative responses. A reduction in these resources limits the ability to retrieve specific memories. The CaR-Fa-X model suggests that it is the interplay of these three mechanisms results in the occurrence of overgeneral memory and the associated reduction in functioning (i.e. reduced problem solving, impaired future thinking, poor outcomes for emotional disorders). It is important to note that within the clinical samples (i.e. depression and schizophrenia) indicated above there is strong evidence of hippocampal-related memory deficits (Salmond et al., 2005; Videbech & Ravnkilde, 2004). Critically, however, the self-memory model and CaR-Fa-X models highlight that processes beyond reduced memory function (i.e. from hippocampal deficit) may contribute to overgeneral memory and subsequent overgeneral future thought. Additionally, they indicate that *how* an individual remembers the past is as important as *what* they remember (Williams et al., 2007) and by extension *how* an individual imagines the future is as important *what* they imagine.

There is much evidence to suggest that clinical samples differ in their experience of MTT in addition to exhibiting overgeneral thinking. Across varying levels of non-

clinical and clinical depression, there are differences relative to healthy controls in the subjective experience of past and future thinking. For example, depressed individuals rate negative imagined future events as *more* vivid and important than controls (Szollosi, Pajkossy & Racsmány, 2015). In contrast, when rating positive past or future events, individuals high in depression symptomology report *reduced* vividness, coherence, sensory detail, emotional intensity and bodily reaction (Anderson & Evan, 2015; Morina, Deeprose, Pusowski, Schmid & Holmes, 2011; Szollosi et al., 2015). These phenomenological qualities are in stark contrast to those of healthy individuals who report increased sensory and contextual details for positive memories (D'Argembeau, Comblain & Van der Linden, 2003; Destun & Kuiper, 1999). The phenomenological differences are important because positive future thinking plays an important role in happiness in everyday life, and is correlated with subjective well-being (MacLeod & Conway, 2005). Moreover, generating mental images of future successes can increase motivation, effort and performance (Pham & Taylor, 1999; Taylor et al., 1998). The subjective differences in MTT between healthy and clinical populations, further indicates that *how* an individual experiences memory of the past and simulations of the future may contribute to differences in adaptive functioning.

Evidence has started to link reduced behavioural functioning to deficits in MTT abilities. In schizophrenia, reduction in the ability to problem solve and achieve certain goals is correlated with impairments in future thinking ability (Lyons et al., 2015). In a new behavioural episodic foresight task, called 'Virtual Week,' patients needed to imagine future points in time to identify and resolve problems in the present that emulated real-life situations in an electronic board game format. Individuals with schizophrenia were less able to imagine specific future episodes than were healthy controls, which limited their ability to take anticipatory steps in the present to meet

future-oriented goals (Lyons et al., 2015). The research highlighted that reduction in future thinking extends to a reduction in an ability to generate and execute behaviours for future related tasks. The data supports the idea that MTT offers a selective advantage by enhancing an individual's ability to adopt strategic long-term plans to suit personally-relevant goals (Suddendorf & Corballis, 2007).

Understanding Anxiety

Anxiety disorders are the most prevalent form of psychological disturbance (Baxter, Scott, Vos & Whitford, 2013; Kessler, Chiu, Demler, & Walters, 2005). According to the Australian National Survey of Mental Health and Wellbeing, one in five Australians will suffer from an anxiety disorder within their lifetime (McEvoy, Grove & Slade, 2011). Due to its prevalence, anxiety is associated with considerable service use and economic burden, with a disproportionate number of patients with anxiety disorders seeking medical advice (Clark & Beck, 2010; Smit et al., 2006). Anxiety disorders are often chronic with relatively low remission rates and have variable relapse rates ranging from 23% to 50% after treatment (Barlow, 2002; Schuurmans et al., 2005; Yonkers, Bruce, Dyke & Keller, 2003). More research is needed to enhance our understanding of anxiety disorders and to provide new evidence-based treatment protocols. One potential avenue for research into anxiety relates to MTT, particularly given that anxiety relates to the anticipation of future threat (Beck, 1979; American Psychiatric Association, 2013).

Anxiety is a future-oriented emotional response triggered by fear (Barlow, 2002; Beck & Clark, 1997). Fear is defined as "the primitive automatic neurophysiological state of alarm involving cognitive appraisal of imminent threat or danger to the safety and security of the individual" (p 5, Clark & Beck, 2010). In contrast, anxiety is defined as "a complex cognitive, affective, physiological and behavioural response system (i.e.

threat mode) that is activated when anticipated events or circumstances are deemed to be highly aversive because they are perceived to be unpredictable, uncontrollable events that could potentially threaten the vital interests of an individual." (p. 5, Clark & Beck, 2010). While fear is the basic and automatic appraisal of danger that underlies all anxiety disorders, anxiety involves cognitive factors including perceived aversiveness, uncertainty and the inability to achieve desired outcomes (Clark & Beck, 2010; Barlow, 2002).

Importantly, the key characteristic of all anxiety disorders is problematic future thought. For instance, according to the Diagnostic and Statistical Manual (DSM-5, American Psychiatric Association, 2013) the experience of anxiety in *Generalized Anxiety Disorder* (GAD) is due to excessive and uncontrollable worry about the future. In *Panic Disorder* it is due to fear of having a panic attack in the future. *Social Anxiety Disorder* is related to the possibility of being negatively evaluated by others, being scrutinized by others, or embarrassed at a future social event that has yet to occur. Finally, *Specific Phobias* is the experience of anxiety about a future event involving a feared object or situation (i.e. spider phobias, blood-injection phobias and height phobias). Each anxiety disorder differs in the types of objects or situations that are likely to induce fear, yet all anxiety disorders involve an overestimation of danger, associated cognitive ideation and avoidance behaviours (American Psychiatric Association, 2013). Critically, the presence of an anxiety disorder or anxious symptoms that result in avoidance behaviours and dysfunctional cognitions is associated with significant reduction in well-being and social/occupational functioning (Mendlowicz & Stein, 2000; Olatunji, Cisler, & Tolin, 2007).

Evidence indicates that there is considerable overlap among the various anxiety disorders. In anxiety disorders, comorbidity or the co-occurrence of more than one

disorder in the same individual, is the norm rather than the exception (Bruce, Machan, Dyck, & Keller, 2001; Vasile et al., 1997; Yonkers, Dyck, & Keller, 2001; Yonkers, Warshaw, Massion, & Keller, 1996). In an individual with an Axis-I anxiety disorder, co-morbidity rates of a secondary anxiety disorder range between 40 to 80% (Kessler et al., 1994; Somoza, Steer, Beck & Clark, 1994). There has been a shift towards transdiagnostic research, which is designed to identify the common features across anxiety disorders, rather than the differences (Clark & Taylor, 2009; Cuthbert & Insel, 2013; Harvey, 2004; Norton, 2008). In line with this approach in this thesis I will take a transdiagnostic approach in the investigation of anxiety and MTT.

Future Thinking & Anxiety

Empirical studies have consistently demonstrated that anxious individuals in both clinical and non-clinical samples have distinctive future-oriented thought patterns. For instance, those with anxiety construct and anticipate personally-relevant threat-related events more frequently, have an increased belief in the likelihood of negative events happening, and anticipate fewer positive events than controls (MacLeod & Byrne, 1996; MacLeod, Byrne & Valentine, 1996; MacLeod, Tata, Kentish & Jacobsen, 1997; Miranda & Mennin, 2007). Moreover, there is evidence of different physiological and neural responses in anxiety disorders. For instance, when people with anxiety anticipate future negative events there is increased neural activation in the ventromedial pre-frontal cortex (vmPFC) and amygdala relative to healthy controls. The increased activation in this region has in turn been associated with exaggerated physiological responses (Miranda & Mennin, 2007; for review see Grupe & Nitschke, 2013; Nitschke et al., 2009). To cope with the increase in arousal from anticipated threat, people with anxiety disorders engage in avoidance behaviours (Borkovec, Alcaine & Behar, 2004; Cisler, Olatunji, Feldner & Forsyth, 2009; Clark & Beck, 2010; Coles & Heimberg,

2002; Craske & Barlow, 1988; Foa & Kozak, 1986). Individuals with elevated anxiety think about their personally relevant futures with increased negativity and engage in avoidance strategies, which suggests that there may be in episodic future thought relative to low levels of anxiety. Further, considering that the self-memory model and CaR-FA-X model implicate avoidance strategies in overgeneral thinking, it is likely that individuals with anxiety disorders exhibit overgeneral MTT. However, at present research investigating *how* individuals with elevated anxiety construct their future oriented thoughts and *how* they experience MTT remains limited.

Only a handful of studies have investigated episodic future thought in sub-clinical or clinical anxiety and few have compared episodic memory and episodic future thought in the same sample. For instance, two studies have investigated the phenomenological experience of MTT one in sub-clinical worriers (Finnbogadóttir & Berntsen, 2011; 2013) and one sub-clinical OCD (Zermatten, Van der Linden, D'Argembeau & Ceschi, 2008). Only one has investigated episodic future thought in a clinical GAD population (Wu, Szpunar, Goddovich, Schacter & Hoffman, 2015), and two studies have investigated overgenerality, in PTSD (Brown et al., 2013; 2014) and sub-clinical health anxiety (Sansom-Daly, Bryant, Cohn & Wakefield, 2014). The findings of these papers will be discussed below.

Studies looking at the phenomenological experience of patients with anxiety point to some differences relative to healthy controls. Surprisingly, in patients with GAD, there were no differences in phenomenological experiences relative to controls. When asked to repeatedly simulate events, controls generated additional details which those with GAD did not (Wu et al., 2015). The authors argue that the lower rate of increase in self-reported details over repeated simulations in GAD individuals compared to controls is indicative of impoverished future thinking and is likely due to a deficit in

the generation of details for future events. Studies investigating MTT in individuals with high-worry also did not find differences in phenomenological experience relative to controls (Meyer, Miller, Metzger, & Borkovec, 1990). The lack of group differences in sensory experience and emotional arousal in both Wu et al., (2015) and Finnbogadóttir & Berntsen (2011) studies is surprising, particularly as previous work has reported lower ratings of sensory, contextual and emotional experience in a study of individuals high in suppression (D'Argembeau & Van der Linden, 2006), and suppression is an emotion regulation strategy associated with GAD symptomology (Sexton & Dugas, 2009). It must be noted that drawing conclusions from these studies however is difficult due to small sample sizes and variations in methodology (i.e. naturalistic setting diary study vs. laboratory recombination task). As such further research investigating the phenomenological experience of thinking about the future is critical in our conceptualization of anxiety.

Overgeneral Thinking & Anxiety

The extant literature on MTT in anxiety suggests that overgeneral thinking may be limited to events in the future rather than extending to both the past and future like other clinical groups (Miloyan et al., 2015). In research investigating memory only, overgeneral memory has not been consistently demonstrated across anxiety samples (*for review see* Williams et al., 2007; Zlomuzica et al., 2014). For example, individuals with social phobia do not exhibit overgeneral memory (Wenzel, Jackson, & Holt, 2002) nor do those mixed anxiety aetiology (Wessel, Meeren, Peeters, Arntz & Mercklebach, 2001) when measured according to the specificity of events produced from the autobiographical memory task. Yet overgeneral memory has been consistently demonstrated in PTSD (Brown et al., 2013; McNally, Lasko, Macklin & Pitman, 1995).

It is surprising that overgeneral thinking varies across anxiety groups particularly as the behaviours characteristic of anxiety, including social/experiential avoidance and thought suppression (Wenzel et al., 2002), are similarly associated with overgeneral thinking (Hermans, Defranc, Raes, Williams & Eelen, 2005).

Further, in the few studies that have investigated MTT, that is both episodic memory and episodic future thought, evidence for overgeneral thinking is also mixed. To my knowledge, investigations have only been conducted in two anxiety populations, namely individuals with health anxiety and PTSD (Sansom-Daly et al., 2014; Brown et al., 2013; 2014). In a PTSD sample of war veterans, the veterans produced fewer episodic details and more semantic details when talking about both past events and when imagining future events in response to neutral word cues (Brown et al., 2013). Additionally, events were coded for content (Brown et al., 2014) and the analysis showed that both past and future events contained more trauma-related content than events generated by healthy controls. Whereas, university students with clinical levels of health anxiety report no differences in the specificity of past or future events produced, relative to controls, when cued by positive or negative words after a rumination induction task (Sansom-Daly et al., 2014). However, past events were coded as more specific and future events were coded as less specific (more overgeneral) when produced in response to somatic-cues relative to controls (Sansom-Daly et al., 2014). Although these results in relation to past events are opposite to those found in PTSD, in that high levels of health anxiety did not affect levels of overgenerality, they are consistent for future events demonstrating overgeneral thinking.

The extant literature points to specificity impairments in PTSD and a specificity dissociation between past and future events in health anxiety. However, there are a number of issues that must be considered when comparing these studies. First, the

PTSD research (Brown et al., 2013; 2014) used a clinical sample with individuals diagnosed with PTSD by a clinician according to DSM-IV revised criteria. In contrast, the health anxiety sample (Sansom-Daly et al., 2014) included a non-clinical sample that met clinical cut-off levels of health anxiety on a self-report inventory. It is possible that the severity of symptomology between clinical and sub-clinical populations contributed to the differences seen in the patterns of overgeneral thinking. Second, PTSD is a somewhat unique anxiety disorder in that it is precipitated by an experience of a traumatic event (Brown et al., 2014) and has been correlated with decreased hippocampal volume (Bremner, Elzinga, Schmahl, & Vermetten, 2007; Karl et al., 2006). Hippocampal dysfunction may explain overgeneral episodic memory and episodic future thought seen in PTSD (Brown et al., 2013; 2014). The hippocampal involvement in PTSD makes this disorder more closely reflect disorders like depression, and is one of the factors that contributed to changes in the categorization of PTSD from an anxiety disorder to a stand-alone disorder within the fifth edition of the Diagnostic and Statistical Manual (APA, 2013). Importantly, the inconsistency in findings between PTSD and health anxiety highlight that additional research is required in the area of MTT and anxiety. Further, the inconsistency in results suggest that a possible dissociation in past and future thinking for anxiety disorders, other than PTSD, which deserves further attention.

Given that anxiety disorders are not typically associated with memory deficits, Miloyan and colleagues (2014) proposed a specific model to explain problematic future thinking observed in anxiety. The Reconstructive Memory Model (RMM) outlines three factors that impact on episodic future thought production in anxiety. First, *episodic memory* is necessary for the construction of episodic future thought. Given that the constructive episodic simulation hypothesis (Schacter & Addis, 2007a) suggests that

episodic memory and episodic future thinking are linked, retrieval biases for negative past events within anxiety are likely to contribute to the construction of problematic future events. Second, Miloyan et al suggest that an individual's *affective state* influences both the encoding and retrieval of memory, which in turn impacts on future thought production (Miloyan, 2014). Considerable evidence has demonstrated that memory is biased by current mood state (Williams et al., 2007), affecting both acquisition and storage of information into memory, and the type of information retrieved (Mather & Sutherland, 2011; Holland & Kensinger, 2010; Teasdale & Fogarty, 1979). Further, affective information impacts on the construction of emotionally driven future thoughts with positive thoughts being more specific, and reportedly containing more visual imagery than negative thoughts in healthy samples (D'Argembeau et al., 2011). The affect state of the individual preceding a future-thought additionally affects the affective qualities of the imagined future scenario (Barsics, Van der Linden & D'Argembeau, 2015). Anxiety is characterised by elevated levels of negative affect and hyperarousal (Clark & Watson, 1991). As such, for individuals with anxiety the RMM model predicts that memory encoding, memory retrieval and future thought in individuals with anxiety is likely to be negatively biased. Third*, attentional biases* towards negative stimuli influences memory encoding and retrieval and may result in repetitive negative future thought (Miloyan et al., 2014). Increased vigilance toward threat-related/negative cues is consistently reported within anxiety disorders (Bishop, 2007; Mogg & Braddley 1998), with difficulty disengaging from threat also contributing to attention biases (Cisler, Bacon & Williams, 2009). The continued attention to threat/negative cues results in repetitive thinking about negative future scenarios (Mogg & Bradley, 2016; Watkins, Moulds & Mackintosh, 2005). The impact of the attentional biases and repetitive thinking about negative future events is

detrimental over time as repeated simulations of emotionally laden future events increases the expectation of that future thought occurring (Szpunar & Schacter, 2013). In anxiety disorders, attentional biases are thought to underlie the increased expectations for negative future outcomes comparatively to controls (MacLeod & Byrne, 1996; Miranda & Mennin, 2007). Additionally, because emotions associated with future thoughts influence subsequent mood (Barsics et al., 2015; Boyer, 2008) the repeated simulation of a negative future is proposed to contribute to a mutually reinforcing mood state/thought cycle. Importantly, Miloyan and colleagues highlight that at present there is insufficient empirical research into future thinking and suggest specific research investigating the content and phenomenology of future thinking within individuals with heightened levels of anxiety is needed.

Given that anxiety is about negative future thoughts related to threat and fear, it is surprising that as yet we still know relatively little about episodic future thought and the nature of MTT in anxiety. At present evidence for overgeneral thinking, an indication of reduction in memory accessibility is mixed and we do not know if those with anxiety experience overgeneral episodic future thought. We also do not know how the specific events are constructed. Further, relatively little is known about the subjective phenomenological experience of episodic future thought in comparison to episodic memory across anxiety disorders, or relative to controls. By investigating the nature of MTT in people with heightened anxiety levels, this research will inform our understanding processes that have been implicated the maintenance of anxiety, thus informing future treatment strategies for anxiety disorders.

This Thesis

While a lot of research has looked at the MTT ability in depression, schizophrenia, autism, and Alzheimer's, relatively little work has looked at MTT in anxiety. Yet, anxiety

disorders are some of the most prevalent psychological disorders today (Baxter, Scott, Vos, & Whiteford, 2013) and are largely characterized by maladaptive thoughts about the future. Whilst there is some evidence suggesting that MTT differs in anxiety relative to controls, no single study has investigated MTT across anxiety disorders. This is a critical limitation of the extant literature, given the heterogeneous nature of anxiety disorders and the indication that MTT may contribute to the maintenance of anxiety symptomology (Miloyan et al., 2014; Zlomuzica, 2014). Therefore, the studies reported here extend the MTT literature by investigating MTT in individuals with increasing levels of anxiety.

We know little about potential objective differences in specificity and subjective differences in experience that may differ in individuals with heightened levels of anxiety relative to healthy controls, because studies have yet to compare objective and subjective measures of MTT in the same population. Understanding the qualitative differences in recollection of past episodes and the simulation of future episodes, in combination with the reported phenomenological impact of remembering or imagining these events, is an important step to understanding the nature of memory and future thinking across anxiety. It will provide further insights into how thoughts about the future are impacted by increasing levels of anxiety and may elucidate how MTT deficits may contribute to maladaptive compensatory behaviours seen in clinical presentations of anxiety disorders.

This thesis investigated MTT in populations with varying levels of anxiety, and addressed several methodological limitations of the extant literature. Study 1 investigated whether methodological adaptations for this thesis made to the autobiographical memory task, a task used extensively in memory and MTT research, affected the dependent variables of interest including overgenerality and episodic detail production. Study 2 explored the effects of increasing levels of anxiety on

overgenerality and episodic detail in MTT within a large online sample. Study 3 aimed to determine whether the online findings of Study 2 generalised into a laboratory setting within a sub-clinical anxiety sample. Further, it aimed to extend the research to investigate both the quantitative (objective) and qualitative (subjective) profiles of MTT within the sample. Study 4 aimed to investigate whether individuals in a transdiagnostic sample had both objective and subjective differences in their MTT, or if there was a dissociation between the objective and subjective experience of MTT like that demonstrated in a university sample of Study 3. These studies represent the first investigation of anxiety and MTT that combine both subjective and objective MTT measures. Finally, Study 5 aimed to investigate the nature of MTT in a naturalistic setting in both a non-clinical anxiety population and transdiagnostic clinical anxiety population. These studies aimed to determine whether the impairments we see in MTT in the lab, generalize to a naturalistic setting and address validity concerns raised within the literature. These studies represent the first MTT studies to use traditional laboratory methods in combination with mobile phone technology in a naturalistic setting.

CHAPTER 2

Study 1

Methodological Pilot Study

There are a limited number of empirical studies in MTT in anxiety disorders and those that have been have typically focused on only one component of MTT, either episodic memory (i.e. D'Argembeau, Van der Linden, d'Acremont & Meyers 2006; McNally et al., 1995; O'Toole, Watson, Rosenberg & Berntsen, 2016; Wenzel et al., 2002; Wenzel, Werner, Cochran & Holt, 2004; Williams & Broadbent, 1986; Williams & Dritschel, 1988) or episodic future thought (i.e. Jing, Madore & Schacter, 2016; Wu et al., 2015). It is difficult to draw conclusions about MTT in anxiety from these studies, because researchers use different methods and outcome measures. A key problem in assessing MTT in anxiety is that asking a participant to talk to an experimenter may bias the results.

Variability in Methodological Approach

Studies testing MTT in anxiety use a number of different approaches including word fluency tasks (i.e. MacLeod & Byrne, 1997), cue word tasks (i.e Brown et al., 2013; 2014; Sansom-Daly et al., 2014; Wenzel et al., 2004), the recombination task (Wu et al., 2015) and naturalistic diary methods (Finnbogadóttir & Berntsen, 2011; 2013). In studies using adapted word fluency tasks, participants are given a temporal period (ie. today, the next year, the next 5-10 years) and asked to generate as many positive future experiences and as many negative future experiences as possible, within a one-minute time limit. The number of items generated is used as an index of future thinking ability (MacLeod & Byrne, 1996; MacLeod et al., 1997). In contrast, word-cueing studies have used adapted versions of the Autobiographical Memory Test (AMT;

Williams & Broadbent 1986), in which participants are asked to remember past or generate future events in response to cue words. Participants provide verbal descriptions of the events and the content of these descriptions is scored (i.e. Brown et al., 2013; 2014). In some studies, participants also make phenomenological judgements about their MTT experience (D'Argembeau et al., 2006). Critically, while word cueing protocols such as the AMT are a gold standard in research, the AMT is not standardized and protocols vary across studies. In a review of the literature, Griffith et al., (2012) highlighted a number of areas that may affect the consistency of results across samples. These include differences in the presentation of cues (i.e. orally, visually, computerized), variation in word lists (i.e. neutral, emotionally valenced, personally relevant) and whether time limits were applied during the event generation process. In addition, AMT results depend on the study-specific scoring protocols used and the way missing data from participants who omit responses is handled (Van Vreeswijk & de Wilde, 2004). This will be discussed in detail below.

One of the criticisms of word cue procedures is that participants may perform the task by simply recasting an episodic memory in a future context. The recasting of a memory into the future is problematic as the event would not contain a key feature of MTT, namely goal pursuit. The recombination task was designed by Addis et al., (2009) as a way to test MTT while controlling for recasting. There are two protocols for the experimental recombination procedure. One way asks participants to provide events from their past that include a person, place and object. The experimenter then recombines these details from the listed memories and asks participants to generate a future event using these recombined details (see Addis et al., 2009; Addis & Schacter, 2012). The second way asks participants to generate novel future events using a novel combination of person, place and object obtained from lists of people, places and

objects participant generated. (i.e. Szpunar et al., 2012, Szpunar & Schacter, 2013). Each of the above protocols differs in the way that it elicits episodic memory and episodic future thinking, making it difficult to compare across studies of anxiety, however, each approach has both benefits and limitations. On the one hand, cue word techniques allow a participant to generate events that are personally relevant to them, which is a critical distinction that separates episodic future thinking from other types of future thinking. However, word cue techniques may elicit memories and future thoughts that have been thought of on a previous occasion (Jeunehomme & D'Argembeau, 2016), resulting in events that come to mind rapidly, with little effort and minimal information manipulation (see Berntsen & Jacobsen, 2008; D'Argembeau & Mathy, 2011; Finnbogadóttir & Berntsen, 2013). Events that have been thought about previously are thought to be generated via an associative "bottom-up" direct retrieval process. It is possible that is participants directly retrieve events we may not see the same relationship between past and future thinking as the constructive episodic simulation hypothesis predicts relative to when participants use a deliberate generative process and flexibly construction novel events such as that in the recombination task. Further, it is important to consider these differences in retrieval process in clinical populations, as variation may arise due to the processes involved in recall (Jeunehomme & D'Argembeau, 2016). Relative to word-cue techniques, tasks such as the recombination task require participants to use effortful constructive processes to simulate novel future events and prevent participants from recasting past events into the future (Schacter et al., 2008; 2012). However, these tasks limit the possibility of generating personally relevant, sensory rich and goal-driven events that are characteristic of true episodic future thought. Given that personal relevance and goals is important, particularly in the context of anxiety, I decided that an adapted cue-word

paradigm was the most appropriate protocol to elicit both episodic memory and episodic future thought for the purpose of this thesis.

Variability in Outcome Measures

In addition to different methods of eliciting MTT, variability in the dependant variables used across studies also makes it challenging to interpret the literature in relation to anxiety and MTT. The literature currently includes three main categories of dependent variable. First, some studies use objective measures of overgeneral thinking that characterise generated past and future events as specific or not (Brown et al., 2013; O'Toole et al., 2016; Sansom-Daly et al., 2014). Second, other studies use objective measures of the episodic details (and semantic details) provided within specific past and future event descriptions (Brown et al., 2014). Third, some studies use participants' subjective ratings of the phenomenological experience of generating past or future events (D'Argembeau, Comblain & Van der Linden, 2005; Finnbogadóttir & Berntsen, 2013; O'Toole et al., 2016; Wu et al., 2015; Zermatten et al., 2008).

Two of the three dependent variables come from protocols in which an experimenter objectively codes the quality of past and future events that are generated by participants. The first is *overgeneral coding*, developed by Williams et al., (1996). In this protocol, past and future events are grouped into three categories (i.e. general, categoric/intermediate and specific). These three categories are consistent with the three levels of Conway and Pleydell-Pearce's (2000) hierarchical model of memory (general, intermediate and event specific knowledge) discussed previously. In studies using overgeneral coding, the past or future event is categorized as specific if it is personally relevant and bound within a single 24-hour period, categoric/intermediate if it is a repeated event, such as Christmas or a two-week holiday, or general if it is not a memory, such as an utterance or semantic knowledge (Williams et al., 1996). While this

practice is useful as it indicates the presence of overgeneral thinking (i.e. an individual provides fewer specific events in response to cue words in spite of directions to be specific), it does not provide information about the nature of past or future thinking beyond this broad classification.

The second objective coding protocol used in MTT research is *episodic detail coding,* adapted from autobiographical memory research (Levine et al., 2002). Episodic detail coding is qualitatively different from overgeneral coding in that it provides a nuanced profile of the event narrative, with different patterns of detail production suggested to indicate a reliance on different neural processes implicated in episodic vs. semantic memory function (Addis et al., 2009; Moscovitch et al., 2005). In this type of coding, the main specific event is identified and then the narrative provided is parsed into segments of episodic detail (called internal details) or semantic detail (called external details). Internal details are grouped using categories adapted from the memory questionnaire (i.e. perceptual, emotional, spatial and temporal details) (Johnson, Foley, Suengas & Raye, 1988). External details include personal and generic semantic information, as well as repetition and cognitive meta-statements. The relative frequency of internal (episodic) and external (semantic) details are used to draw conclusions about differences in construction of episodic memory and episodic future thought, such as whether relatively more episodic or semantic information is accessed (Addis et al., 2008). Breaking down the events that individuals recollect or imagine into the episodic and semantic details provides researchers with a clearer conceptualization of the how specifically an individual imagines their future or remembers their past.

In addition to the objective coding methods described above, phenomenological measures index the subjective experience of the participants' during episodic memory and episodic future thought. Questions from the Memory Characteristics Questionnaire

(Johnson et al., 1988), typically used within autobiographical memory research (i.e. Comblain, D'Argembeau & Van der Linden, 2005), have been adapted for research in MTT (i.e. Addis et al., 2008; Berntsen & Bohn, 2010; D'Argembeau and Van der Linden, 2004; 2006; Finnbogadóttir & Berntsen, 2013) Participants are asked to remember or imagine events and then rate, using a 5-point or 7-point Likert scale, the extent to which the event includes sensory-perceptual details, contextual details, affective details, and how important the event is to one's life-story. Some studies have also used subjective ratings of detail, vividness and the level of specificity to draw inferences about the specificity of events (i.e. Finnbogadóttir & Berntsen, 2011; Wu et al., 2015). This approach is important because it is the phenomenological experience (sensory-perceptual qualities, feelings of re-experiencing and by extension pre-experiencing events, and emotional reaction) that differentiate episodic memory and episodic future thought from other types of memory (i.e. procedural) or future thought (i.e. planning) (Comblain & D'Argembeau, 2005). While phenomenological ratings are useful in providing an understanding of the experiential qualities of MTT, it is often difficult to know what parameters participants use to make their ratings, which limits the extent to which data can be compared across individuals/populations.

Importantly, studies using each of the measures described above have reported *reduced specificity* of MTT in the context of clinical disorder, however, we need to be cautious when comparing studies that use different dependent variables. Overgeneral coding indexes the frequency of events occurring within a temporal period of 24-hours. Episodic detail coding indexes the specificity of details provided within events that are bound within 24-hours. Phenomenological ratings of vividness, level of detail or how specific the event was, are subjective in nature. Given that few studies have used more

than one of these measures in the same sample, it is not yet clear whether they tap into related or independent processes.

While at present it is difficult to draw strong conclusions about the effect of anxiety on MTT due to varied methodological approaches and dependent variables of interest, each outcome measure provides conceptually unique information that is necessary in developing our understanding of the nature of MTT in anxiety. For instance, by combining both types of objective coding protocol (i.e. overgenerality and detail coding) we may gain insight into not only the presence of overgeneral past and future thought, but also the contextual richness of specific events. To date, only one laboratory has combined these two coding protocols when investigating MTT in a PTSD sample (Brown et al., 2013; 2014). Further, comparing the subjective experience of episodic memory and episodic future thought with the objective coding measures provides a unique platform to explore the consistency between MTT content and phenomenological experience. While episodic detail coding has been used in combination with phenomenological analysis in the investigation of MTT and ageing (Addis et al., 2008; Addis et al., 2010), only one recent study has investigated episodic memory in a mixed anxiety sample (panic disorder and social anxiety) using overgeneral coding and phenomenological ratings (O'Toole et al., 2016). At present, no study combines both objective measures (overgeneral and episodic detail) and subjective phenomenological ratings in the investigation of MTT in any sample. Thus, by combining all three outcome measures, this thesis provides a unique and novel investigation of MTT in the context of clinical disorder.

Test Modality

Word cue paradigms used to test MTT have largely developed from the autobiographical memory literature (Johnson et al., 1988; Levine et al., 2002; Williams

& Broadbent, 1988). The traditional format of the interviewer-administered AMT task involves participants providing a verbal description of past or future events in the presence the experimenter. The verbal description is recorded, transcribed and then coded for analysis (i.e. Addis et al., 2010; Wenzel et al., 2004; Williams & Broadbent, 1988). Some researchers have argued that the examiner-examinee interaction in a research setting can impact the anxiety state of participants either positively or negatively (Fuchs & Fuchs, 1986). For instance, research has shown that highly-anxious participants perform more poorly, feel less positive about their ability to complete tasks and report elevated anxiety that interferes with performance in testing situations (Deffenbacher, 1980). The presence of an experimenter can also increase threat-related attentional biases in clinical and highly-anxious non-clinical individuals (Bar-Haim, Lamy, Pergamin, Bakermans-Kranenberg, van Ijzendoorn, 2007). In contrast, the presence of an experimenter can also reduce anxiety during the testing session via reassurance seeking, which is a safety-seeking behaviour argued to provide a brief reduction in the sense of threat (i.e. related to the completion of the task appropriately, or with appropriate content) (Salkovskis & Warwick, 1986). When investigating the effect of anxiety on a particular construct, it is important that experimental design and experimental environment neither increases nor reduces the anxiety level of participants. To date some modifications have been made to remove the presence of the experimenter by asking participants to use audio recording devices to record responses in isolation (i.e. Brown et al., 2013; 2014). However, the recordings lack participant anonymity in that participants may fear they can be identified from their voices. Issues with embarrassment or fears of social evaluation in people with anxiety have been argued to mask effects of interest and bias participant's responses (Wenzel et al., 2004). It may be possible to mitigate the effects of having an experimenter present, by asking

participants to write about events rather than to tell an experimenter about them or record audio versions of them. As such, a shift from a verbal AMT protocol to written AMT protocol may minimize the impact of the testing environment and be beneficial to the anxiety population being investigated in this thesis.

Autobiographical memory studies have shown no significant difference between verbal and written responses. Research using written versions of the AMT have found similar results between interviewer-administered versions and a self-report written version (Henderson, Hargreaves, Gregory, & Williams, 2002). For example, in studies of childhood sexual assault self-report written versions of the AMT have been used to preserve the anonymity of the respondents. Events provided were categorised as specific if they occurred in a single day. The authors replicated results from interview-administered version in a study using the written version and concluded that the written version was comparable. Henderson and colleagues suggest that the written version was beneficial both in the context of providing participants with anonymity when discussing negative memories, and in improving speed of data collection (Henderson et al., 2002).

To date, we do not know whether asking participants to write about events rather than providing verbal descriptions will impact the specificity of past and future events they provide. While Henderson and colleagues (2002) identified specific events, they did not use the overgeneral coding protocol (Williams et al 1996) (i.e. identifying the production of categoric/intermediate or general events in addition to specific events). As such, it is unclear whether asking a participant to write about their past and future episodes will affect the number of categoric/intermediate or general events they produce. Henderson and colleagues also did not analyse the effect of response modality on episodic detail production. Therefore, for the purpose of this thesis, it was important

to first investigate the effect of verbal vs. written responding on the objective measures, which rely on the content of the events provided by participants.

The pilot study investigated the effect of modality on the production of overgeneral memory or future thought, and on episodic detail production using an adapted AMT protocol. The aims of the pilot study were twofold. First, the study aimed to determine if there was a difference in the production of *overgeneral* past and future events when participants were asked to provide written vs. verbal responses. Second, the study aimed to determine if there was a difference in the amount of *episodic detail* generated within specific events when participants were asked to provide written vs. verbal responses. It was hypothesised that, in line with previous research, there would be no difference in the specificity of events provided via written responses vs. verbal responses.

Method

Participants

.....Participants (N=23) were undergraduate psychology students from the University of New South Wales. All participants spoke English as a first language as a condition of participation. The ethnic composition of the sample was 70% Caucasian, 20% Asian and 10% other. The mean age was 21.4 years (SD = 5.6). 56.5% were female. Participants received course credit for their participation. The study was approved by the School of Psychology ethics committee at the University of New South Wales.

Materials

Both written and verbal protocols were computerized. Qualtrics® software was used to construct and run the computerized online test platform for both protocols. De-identified data was exported from the Qualtrics® programme into a SPSS data file for

analysis. In addition, for the verbal protocol the online soundbite platform Soundcloud® was used to digitally record participants' event descriptions via an external microphone. Participants completed a demographics form and a modified AMT task.

Demographics Form. The demographics form asked participants to provide information about their age, gender and ethnicity.

Modified Autobiographical Memory Test. The modified Autobiographical Memory Test (mAMT) closely modelled the well-replicated AMT paradigm from behavioural and neuroimaging studies (eg., Addis et al., 2007; Addis et al., 2008; Brown et al., 2013; D'Argembeau et al., 2003; D'Argembeau et al., 2008; D'Argembeau & Van der Linden, 2004). The mAMT asks participants to generate events in response to neutral cue words presented on a computer screen. The following three modifications were made to the AMT for this thesis:

1) Temporal direction was manipulated by asking participants to generate and describe both episodic events that had happened in the past and episodic events that might happen in the future

2) Emotional valence was manipulated via instructions that directed participants to recall/imagine events which were neutral (i.e. did not indicate any particular emotion valence), positive (i.e. asked participants to describe an event which they had felt or would feel a positive emotion) and negative (i.e. asked participants to describe an event which they had felt or would feel a negative emotion) in response to neutral cue words (Crovitz & Schiffman, 1974). Each participant was asked to provide two events for each of six event conditions (past neutral, past negative, past positive, future neutral, future negative, future positive).

3) The response modality was manipulated such that participants completed two versions of the mAMT, one verbal and one written. The verbal version of the mAMT was identical to the written version except that the instructions asked participants to provide a verbal description of each event using the microphone provided. This methodology reflected the verbal AMT used in MTT research in PTSD (Brown et al., 2013). For the verbal version participants were also instructed to time each response and include how long each description lasted within the text entry box presented on the screen. The timing was to keep the participant engaged with the task and also help provide a data entry point to successfully move between screens for each event within the experimental platform. Additionally, when providing a written response, a participant is able to visually see that they have provided a sufficiently detailed memory. When providing an unprompted verbal response, it was considered much harder to keep track of how long the event had lasted for. Thus, participants were asked to time their responses to ensure to discourage participants from describing events for long periods of time. Soundcloud® was run simultaneously with the Qualtrics® program to record all verbal input during the computerized protocol administration. See Appendix A for full instructions. The order of the written and verbal versions was counterbalanced across participants.

Each participant provided 6 past and 6 future events for each version of the mAMT (verbal/written), providing a total of 24 events. Each event type was blocked (i.e. participants were asked to recall *both* neutral past events in succession, or *both* positive future events in succession). Neutral events occurred first to prevent priming of positive or negative events for the neutral condition. Following neutral event presentation, past and future negative and positive events were completed in randomized order. Neutral events always preceded the randomized positive/negative event presentation to prevent

any emotional carry-over effect or priming effects from valenced events. Instructions were presented on a new screen for every event that participants were asked to generate. The emotional valence instruction (positive or negative) was presented in a bold colour different from the rest of the text and participants were asked to provide written responses in the space provided (see Appendix A for instruction examples). Participants were told that they could use the cue words to "freely associate", that is, the event remembered or imagined did not have to directly relate to the word they selected. Inbuilt programming logic prevented participants from skipping questions and required that they provide a minimum of 150 characters (approx. 20 words) for each written response.

Neutral Cue Words. Sixty neutral cue words were selected from Clark and Paivio (2004) list of extended norms and were matched for frequency (M =1.88, SD = 0.39), imageability (M = 6.45, SD = 0.62) and concreteness (M = 6.66, SD = 0.22). The 60 words were randomly divided into twelve lists of five nouns. Six cue word lists were assigned to the verbal condition and six cue word lists were assigned to the written condition. A list of words was then assigned to each event type (i.e. past neutral). Of the five possible neutral word cues per condition (i.e. past neutral) only two cues were completed by each participant. For each participant, cues were randomly selected via inbuilt programming logic from the assigned word list in each condition.

Procedure

Participants were told about the elements of the experiment and the experimenter obtain informed consent. The experimental phase was completely computerized and included the demographic information questionnaire, a written version of the mAMT and a verbal version of the mAMT. Participants were told that they would be asked to recall or imagine events, and to provide as much detail as

possible about the events in a written or verbal response. Participants were told that the events needed to be specific, personal and occur within a 24-hour period. To avoid confusion, participants were told that the 24-hour period did not have to be yesterday or tomorrow, rather it could occur at any point in time. An example was then provided (*i.e. "I imagine being in Thailand with my friend Lucy on holiday and we are doing a day trek, riding elephants through the mountains is an example of a specific detailed event. I can imagine going on holiday to Thailand is not a specific event")*. The instructions were presented both verbally prior to starting the experimental component and in written form on the computer at the beginning of the mAMT. Participants were required to provide both verbal and written confirmation that they understood the instructions prior to commencing the task.

The verbal and written test protocols were presented in a counterbalanced order. Participants were left in the computer booth alone to complete the first protocol (verbal or written). Prior to starting the verbal version of the mAMT participants, the experimenter started the online recording platform. The participants were instructed to speak directly into the microphone provided. A stopwatch was provided for participants to monitor the length of their recordings. Recordings were conducted in isolation within the computer booth to avoid experimenter prompting and to reduce anxiety that may be caused from telling a stranger personal memories and personal imagined future events. In accordance with Brown and colleagues (2013) AMT administration, there were no time constraints placed on the verbal condition. Responses were later transcribed. All subjects finished the experiment within an hour. After the participants had finished both written and verbal versions of the task, they were debriefed on the experiment and assigned course credit.

Scoring. All events from participants included in the final analysis were scored by a single rater blind to event type and group allocation. Additionally, a second independent rater, who was blind to group allocation, event type and hypothesis, scored 20% of the events. These scores were subjected to intra-class correlation analysis to determine inter-rater reliability using Cronbach's Alpha (Crocker & Algina, 1986)[1].

Overgenerality Coding. Following previous work (Brown et al., 2013; Sansom-Daly et al., 2014; Williams et al., 1996) the specificity of each event was coded using a dummy-coding procedure. Throughout the literature, the terminology used to distinguish between the three categories within the dummy coding protocol has varied (see Brown et al., 2013; Conway & Pleydell-Pearce, 2000, Sansom-Daly et al., 2014, Williams et al., 1996; Williams & Dritschel, 1992). Within this thesis I chose to use the terms specific, categoric/intermediate and general because they account for the variation in terms that are used in the two key models of overgeneral memory (i.e. CaR-Fa-X model; Williams et al., 2007; Dysfacilitation model; Conway & Pleydell-Pearce, 2000) described in the introduction. Specific events, namely those that were distinct events that took place or could take place within a 24 hours period, and included specific

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[1] Intra-class correlations are used as measures of inter-rater reliability (Shrout & Fleiss, 1979). Currently there is significant lack of consistency within the literature with standard reporting of intra-class correlations (Koo & Yi, 2016). Examples of intra-class correlation measures in the literature include (but are not limited to) twin correlations, Cronbach's Alpha, heritability coefficients and Kish's rate of homogeneity (MchGraw & Wong, 1996). At times, Cohen's Kappa (Cohen, 1960) is used when determining the degree of consensus between raters is above chance on categorical items (i.e. dummy coding). While some studies use this approach, kappa values are limited as they cannot be compared across studies unless the base rates and scorers are identical (Stemler, 2004). Across this thesis, different raters were used for studies 4 and 5 compared to studies 1, 2 and 3, as such Kappa values was not considered appropriate. Additionally, Cohen's Kappa is not appropriate for non-categorical data. For this thesis, Cronbach's Alpha (Cronbach, 1951) was selected as a measure of intra-class correlation to determine inter-rater reliability as it provides a single estimate of consistency in ratings and can control for systematic differences across multiple judges (Stemler, 2004).

people and location, were given a score of 3. Categoric/intermediate events, namely repeat events such as birthdays and any event taking place over a longer period than 24hrs, were given a score of 2. General events, namely events that contained only semantic information or no specific details, were given a score of 1. The score for each trial was *summed* to create a total score for each condition (e.g. past neutral, past negative, past positive, future neutral, future negative, future positive); participants were able to obtain a maximum score of 6 and a minimum score of 2 for each condition, replicating the scoring protocol conducted in PTSD research (Brown et al, 2013). The coding procedure was conducted for each test modality (verbal or written). Table 1 provides examples of the overgeneral coding protocol. Adequate inter-rater reliability was achieved using intra-class correlations (Cronbach's $\alpha = .74$). Varying from the literature, this thesis does not present these specificity proportion scores (proportion of specific event provided for each participant) for the dummy coding procedure as it is a fairly broad level of classification that does not reflect event specificity as defined in the CAR-Fa-X and dysfacilitation models (Conway & Pleydell-Pearce, 2000; Williams et al., 2006) which was the focus of this thesis. Rather, a more nuanced profile of specificity analysis is presented with the inclusion of episodic detail coding, a procedure which quantifies the number of episodic (internal) and the number of semantic (external) details provided within each narrative, reflecting specificity defined in the models explored within this thesis.

Episodic Detail Coding. While overgenerality scoring has been used in previous studies investigating MTT, it does not provide an index of the quality of the information about the event described. The Autobiographical Interview (AI) scoring procedure is the gold-standard in autobiographical memory research (Levine et al., 2002) and has been

adapted for use in MTT research to determine the level of detail provided by participants about past and future simulations (Addis et al., 2008; Brown et al., 2014). I applied this procedure for all events identified as 'specific' during overgenerality scoring. The central event was identified and the event was segmented into distinct details (i.e., chunks of information, a unique occurrence or thought). Each detail was then categorized as internal (episodic information relating to the central event) or external (non-episodic information including semantic details, repetitions, meta-cognitions). Importantly, the presentation of AI coding in this thesis has been modified from what is typically presented in the literature. Although studies using AI scoring protocols typically present and use raw scores for episodic detail coding analysis (Addis et al., 2009; Brown et al., 2014), some researchers have suggested that individual differences in narrative and communicative style may account for differences seen in levels of episodic detail (Gaesser et al., 2011). Further, there appears to be age related differences in types of details (semantic or episodic) provided (Gaesser et al., 2011). As such, it was thought that the presentation of raw scores for internal or external details are potentially misleading as they do not account for such variation in narrative style or age-related differences. Therefore, to control for variation in individual narrative style and possible age-related differences across groups within this thesis, the number of internal details was expressed as a *proportion* of the total number of details (internal and external) provided for each event type for each participant; the proportion score was used as an index of episodic detail specificity. The proportion of episodic detail scores were averaged across each event type (i.e. average proportion of episodic details for future neutral events). Good inter-rater reliability was achieved using intra-class correlations for internal (Cronbach's α =.84) and external scores (Cronbach's α =.86).

Table 1.

Example of overgenerality according to Williams et al., (1996) scoring procedures

Category		**Score Given**	**Example for imagine a future event** (using the cue 'storm')
Specific	specific events were identified as an event that took place or could take place within a 24 hr time period, included specific people and a specific location	3	Next Sunday it's going to storm. I can hear the large rain drops falling on the roof. The sky is being lit up once in a while and I can hear the thunder. I am sitting in my room watching from my window
Categoric/intermediate	identified as repeated event or an event that took place or could take place over a period of more than one day	2	storm days will be the days we stay in and watch movies
General	general event was identified as event that did not contain specific details or was something other than a memory	1	storms sometimes happen in my country

Analyses

Separate 2 (Modality: Verbal vs Written) x 2 (Condition: Past, Future) x 3 (Valence: Neutral, Negative, Positive) mixed design ANOVAs were conducted for overgenerality analysis and episodic detail analysis. A mixed design ANOVA was considered the most appropriate analysis for the data, as parametric statistics can be used with small samples, unequal sample sizes, unequal variance and non-normal distributions. While use of equal group distribution is ideal, evidence indicates that parametric methods examining differences between means of samples larger than five per group yield robust statistical output for non-normal and asymmetric distributions and are robust against violations of homogeneity, sphericity and unequal sample sizes (see Norman, 2010; Schmider, Zeigler, Danay, Beyer & Bühner, 2010; Wilcox, Char1in & Thompson, 1986). Further, ANOVAs and Pearson correlations are highly robust to skewness (Norman, 2010). Additionally, Greenhouse & Geisser (1958) corrections was applied in an attempt to control for false positives that can occur with small sample sizes, such that if the assumption of sphericity was violated (as indicated by a Greenhouse–Geisser estimate of sphericity, epsilon, of less than .90), the degrees of freedom were adjusted using Greenhouse– Geisser correction (Geisser & Greenhouse, 1958). Effect sizes of ANOVAs were expressed in partial eta squared (η_p^2) and values of .02, .13, and .26 were considered small, medium and large effects respectively (Cohen, 1988). Interactions were followed up using paired-sample t-tests.

Results

The final sample consisted of 20 participants (10 whom were female). Data from three participants had to be discarded due technical errors or incomplete audio recordings. Preliminary analysis including gender showed no main effects or interactions, thus data was collapsed across gender on all subsequent analyses.

Overgenerality Analysis

A mixed design ANOVA using the dummy-coded scores determined whether overgenerality differed as a function of modality, temporal direction or valence. Lower scores indicated more general events (i.e. overgeneral) and higher scores indicated more specific events (i.e. occurring within a 24-hr period, personally relevant). There was a significant main effect of modality, F (1,19) = 10.9, p = .004. η_p^2 = .36. As is illustrated in Figure 1, events were more specific in nature when participants completed the written mAMT than when they completed the verbal mAMT. A main effect of temporal condition (past/future) also approached significance, F (1,19) = 4.04, p = .06, η_p^2 =0.18 (See Figure 2), suggesting that future events were somewhat more overgeneral than past events. No other main effects or interactions were significant (all ps > .05).

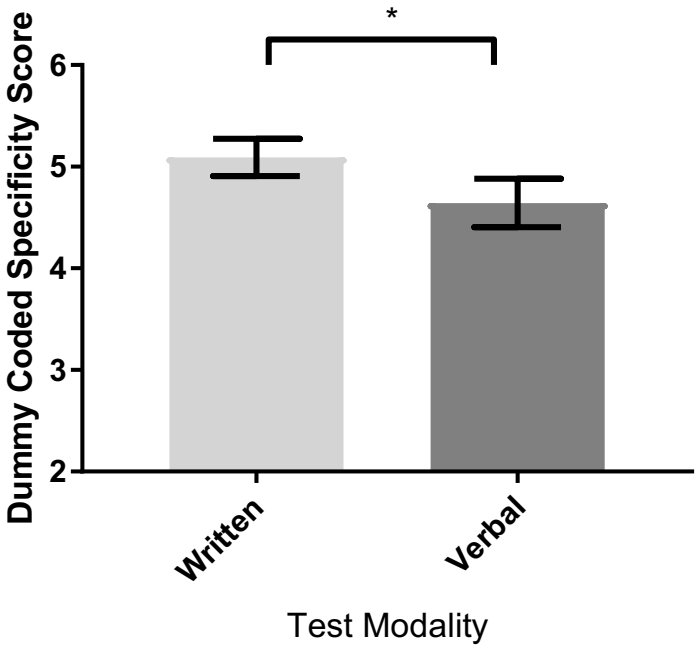

Figure 1. Mean (+SEM) dummy-coded specificity score as a function of test modality, collapsed across temporal direction and emotional valence instruction. Higher scores

indicate production of more specific events, lower scores indicate production of more categoric/intermediate and general events.

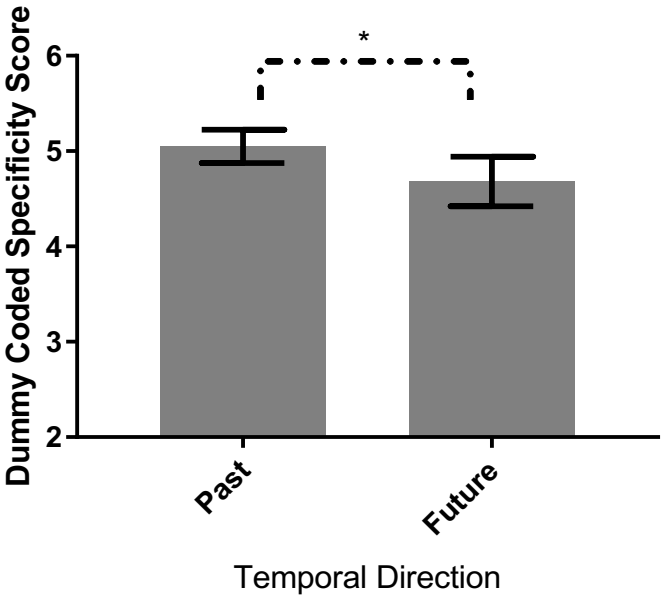

Figure 2. Mean (+SEM)) dummy-coded specificity score as a function of temporal direction, collapsed across test modality and emotional valence instruction. Trend towards significance $p > .05$ but $< .07$ indicated by broken bracket. Higher scores indicate production of more specific events, lower scores indicate production of more categoric/intermediate and general events.

Episodic Detail Analysis

Missing Values and Data Replacement for Episodic Detail Analysis. Events scored as categoric/intermediate or general did not have any episodic detail values, which meant that a large proportion of participants contained missing data values. Of the 480 total events (total number of written and verbal events from all participants) 16.25% of all events were coded as general (78 events) and 20.20% of events were scored as categoric/intermediate (97 events). Only 6 of the 20 participants had specific events for all events. For ANOVA analysis, only cases with complete data sets are included, which

would require a considerable amount of data to be discarded. Missing value replacement techniques were employed to prevent sample reduction. Structural equation modelling and multiple imputations are considered the most suitable methods for data replacement (Acock, 2005; Schafer & Graham, 2002; Young, Weckman, & Holland, 2011). Multiple imputation procedures were conducted rather than listwise deletion or MCAR (missing completely at random) missing value analysis because the missing data was a result of methodological coding choice and missing values were not completely random (Little, 1988: Rubin, 1976). Multiple imputation procedures have also been shown to perform better than specifying the exact pattern of missingness using Missing Not At Random (MNAR) protocols (Graham, 2009). Multiple imputation procedures considered suitable for missingness estimates ranging from 15% - 50% (Graham, 2009; Young et al., 2011) Ten missing values imputations were conducted. Some researchers have questioned the practice of using ten imputations for missing data replacement (see Bodner, 2008). However, Horton and Kleinman (2007) indicate that the statistical processes incorporated into the imputation procedures in statistical packaging programs accommodates for the limitations of using only a few imputations (i.e. potential bias and variability in results) and they argue it is a valid statistical approach for missingness. The implementation of missing values procedures maintained all 20 participants within the data analysis, rather than a reduction to only six participants if imputation methods were not conducted. Importantly, while within the thesis the calculation of the proportion of episodic detail scores was determined to be the most appropriate presentation of the episodic detail data, the necessity for missing value data replacement techniques precludes the presentation of the raw internal and external data as may typically be presented with research using AI scoring.

Repeated Measures ANOVA Analysis for Episodic Detail. For the episodic

detail analysis, a mixed design ANOVA was conducted to determine whether the proportion of episodic details produced differed as a function of modality, temporal direction or valence. Consistent with the overgeneral thinking analysis, there was a significant main effect of modality, F (1,19) = 13.18, $p < .00$ $\eta_p^2 = 0.4$ (see Figure 3). Participants provided a greater proportion of episodic details (internal details) in their written event descriptions than in their verbal event descriptions. There were no main effects or interactions involving either temporal condition or valence (all ps > .05).

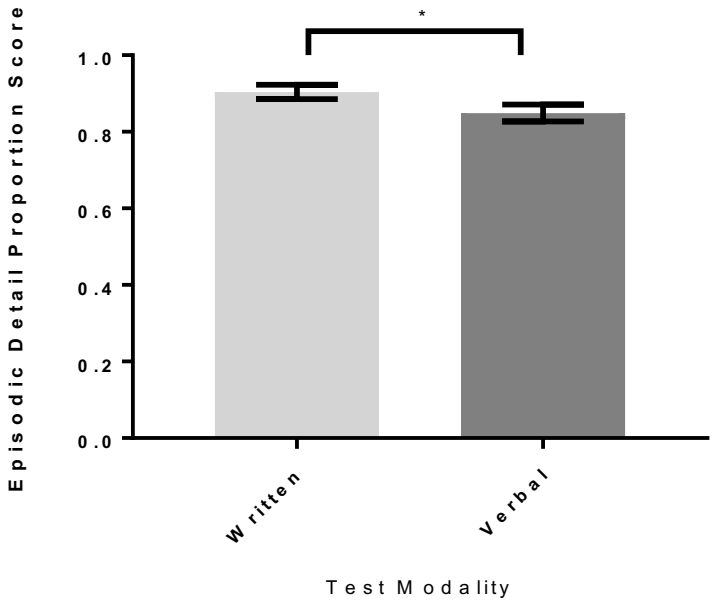

Figure 3. Mean (+SEM) proportion of episodic details produced by participants when asked to provide written vs. verbal responses

Discussion

This pilot study showed that a written response version of a mAMT procedure produced more specific events, which on average contained a greater proportion of episodic details relative to the standard verbal response version. The results highlight a

potential advantage for using a written format AMT task in MTT research. Previous work in autobiographical research has suggested no difference in specificity between written and verbal testing conditions, however, this was based on comparisons of different experiments rather than a within-subjects comparison in a single experiment (Henderson et al., 2002). This is the first study to directly compare verbal and written protocols. The findings of this pilot study highlight the potential benefit of using written protocol measures in the investigation of overgeneral thinking and episodic detail within MTT research.

In line with the literature, there was a trend towards past events being more specific in nature than future events (D'Argembeau et al., 2008; D'Argembeau & Van der Linden, 2004). When asked to recall past events, participants are able to draw on specific situations they have previously experienced and are thus less likely to produce general or categoric/intermediate events. However, we did not replicate previous research that has found past specific events contain more episodic details than future events (Addis et al., 2008). The findings of the pilot are thus in contrast to the reality-monitoring framework, which argues that real events contain more details than imagined events (Johnson et al., 1988). There are two possible reasons that might account for the results not replicating the temporal direction effect typically reported in the literature. First, normalising data using proportion scores rather than raw detail scores may have affected the magnitude of differences seen between episodic detail in past and future events. I reanalysed the data using the raw scores produced by the missing data replacement techniques and found the same pattern of results, ruling out this possibility. Second, participants provided a large proportion of events that were identified as categoric/intermediate or general, rather than specific, which meant that it was necessary to conduct missing data imputation to prevent a large reduction in sample

size. It is possible that the missing data procedure affected the findings by increasing bias within the data, an issue that is particularly salient when multiple categorical and continuous values are missing (Horton & Kleinman, 2007). For instance, it would also be beneficial to determine whether the difference between the verbal and written protocols is due to differences in external or internal details, however this was not possible due to data replacement techniques. As such, future research is needed using a larger sample and an amended protocol that ensures participants follow instructions to provide specific event in order to confirm these results.

Future research should investigate why written testing responses produce more specific events than verbal testing. It is possible that when writing a response, participants are able to editorialize, insert and delete information as they go before experimenters review the response, thus making it more likely that they provide specific detailed events as per the task instructions. In contrast, when a participant is providing verbal responses they are thinking on their feet and may provide the first thought relevant to the cue that comes to mind, which according to Conway and Pleydell-Pearce's (2002) model of memory is likely to be general information or categoric/intermediate information resulting in non-specific events. Further, for verbal specific events, it is likely that semantic information (repetition, editorializing speech or metacognitions) is increased as participant's utterances (i.e. "let me think, maybe it was because…") are included within the transcripts and coded as semantic information, thus reducing the proportion of episodic details provided. As such, future research needs to investigate whether significant differences between modalities remain when participants are able to review and editorialize their event descriptions in both conditions. Comparing a written protocol to a verbal protocol that similarly allows participant to summarise their event, review or change anything within their response, with only the

summarised/edited versions used for coding would clarify the possibility that editorializing improves on response quality.

Researchers have long suggested that how we ask questions and the ways in which we allow individuals to respond to these questions influences the data we collect, and in turn the conclusions that can be drawn from the data (Dockrell, 2004). This experiment highlighted that test modality (written or verbal) influenced participants' responses. Responses generated in a written version of a modified Autobiographical Memory Task were more specific and contained more episodic details than responses generated in a verbal version of the task. For the purpose of the research of this thesis, responses that are specific and perceptually rich provide a better platform to investigate and deepen our understanding of the connection between episodic memory and episodic future thought in anxiety. Therefore, the written protocol will be used.

CHAPTER 3

Study 2

Investigating the effect of increasing levels of anxiety on overgenerality and episodic detail within emotionally valenced MTT in a large online sample.

Affective information influences participant's ability to construct past and future thoughts (Barsics et al., 2015; D'Argembeau et al., 2011; Ford, Morris & Kensinger, 2014; Gilbert & Wilson, 2007; Holland & Kensinger, 2010; Miloyan & Suddendorf, 2015). For this reason, it was important to consider the impact of emotional valence on MTT in the context of anxiety. Anxious adults tend to report a negativity bias for future thoughts, thinking about future negative events more frequently and generating future negative events more easily than healthy controls. In addition, they report that negative events are more likely to occur and find it easier to explain why negative events might happen in the future compared to healthy controls (Foa, Franklin, Perry & Herbert, 1996; MacLeod & Byrne, 1996; MacLeod et al., 1996; 1997; Newby-Clarke & Ross, 2003; Wenze, Gunthert & German, 2012). Anxious adults also generate more vivid imagery for negative future scenarios than healthy controls or patients with depression (Morina et al., 2011). The negatively biased pattern of future thinking that we see in anxiety is in stark contrast to healthy individuals, who typically have a positivity bias when thinking about the future (Newby-Clark & Ross, 2003; Sharot, 2011; Taylor & Brown, 1988; Wilson & Gilbert, 2005).

The negatively biased pattern of thinking about the future in anxiety disorders described above, is thought to be due to a combination of attentional biases and retrieval biases (Cisler & Koster, 2010; Miloyan et al., 2014). Studies have shown that individuals with anxiety are more likely to attend to negative or threat-related information (Bishop, 2007; 2008; Mogg et al., 2000). In addition, people with anxiety

exhibit retrieval biases for negative past events across several anxiety disorders (Åström, Wiberg, Sircova, Wiberg & Carelli, 2014; Krans, de Bree, & Bryant, 2014; Mathews & Mackintosh, 1998; O'Toole et al., 2016; Richards & Whittaker, 1990; see also Morgan 2010; Wenzel et al., 2004). For instance, people with social phobia produce a greater number of negative memories when remembering past events relative to controls, irrespective of whether the event is related or unrelated to social situations (Wenzel et al., 2002). Likewise, individuals with GAD recall a greater number of memories that are anxiety provoking, and recall them more quickly, relative to controls (Burke & Mathews, 1992). There also appears to be differences in how individuals with panic or social anxiety experience past negative memories, rating them to be more intense, more vivid, and with higher levels of re-experiencing relative to healthy controls (O'Toole et al., 2016). The impact of increased attention and retrieval bias for negative information arguably makes it difficult for people with anxiety to disengage with negative content (Miloyan et al., 2014). Further, these processes likely contribute to the construction of negative episodic future thoughts, because the type of information recently retrieved influences the character and nature of future thoughts (MacLeod & Salaminiou, 2001; see Szpunar, 2010 for review; Schacter et al., 2008).

While there are differences in the way that people with anxiety think about negative events, differences in how they think about positive events may also contribute to future thinking differences in anxiety disorders. Initial evidence suggests that elevated levels of anxiety do not reduce the frequency with which positive future events are generated nor reduce the expectation that positive events will occur (MacLeod & Byrne, 1997; Martin & Quirk, 2015; Wenze et al., 2012). However, there does appear to be some indication that the *construction* of positive future events may be different in anxiety. Individuals with GAD, produce fewer details about positive future events and

find it more difficult to repeatedly simulate positive events, a pattern of results not seen in controls (Wu et al., 2015). Further, there is some evidence indicating that people with anxiety find it more difficult to access positive memories. For example, individuals with PTSD find it more difficult in retrieve specific memories that are cued by positive words than those cued by negative words, an effect not seen in controls. (McNally et al., 1995; McNally, Litz, Prassas, Shin & Whethers, 1994). Given that the constructive episodic simulation hypothesis (Schacter & Addis, 2007a), posits that we flexibly recombine past events to create future simulations, increased difficulty in accessing positive memories is likely to impact on the generation of positive future thoughts (Schacter et al., 2007b, 2009). The combination of findings from the above PTSD and GAD samples points to a possible difficulty in the ability to engage in positive MTT, yet at present there has been little research exploring these potential differences.

The research above illustrates that emotional MTT is likely to differ in anxiety. To date research there has been little research investigation how people with anxiety elicit and construct positive and negative MTT narratives. As highlighted in Chapter 2, there is significant variability in the methodological approaches taken when investigating MTT in clinical groups and early work placed little emphasis placed on evoking specific events (personally relevant, bound within 24 hours), which has been an important focus more recently. Table 2 presents a summary of studies of episodic memory or episodic future thought in anxiety disorders and highlight the limitations of research comparing both elements of MTT. There is only one study that has investigated how participants with anxiety construct emotionally driven past and future events. In the study, university students meeting the clinical cut off for heath anxiety on a self-report measure did not differ from controls in overgeneral memory production, when using positive or negative word cues to elicit MTT (Sansom-Daly et al., 2014).

Sansom-Daly and colleagues (2014) asked participants to complete an AMT task using negative, positive and somatic cues after participants completed either a rumination task (a circular, self-focused thinking style, *see* Nolen-Hoeksema, Morrow & Fredrickson, 1993) or general thinking task. They did not find differences in overgenerality between groups for past and future events that were cued by positive or negative cues. However, when using somatic health-related cues, individuals with elevated health anxiety showed an increase in specificity for the past and an increase in overgenerality for the future in the rumination condition, an effect not seen in controls. These findings are in line with other research that demonstrates increased memory recall of threatening information relative to controls in anxiety (Mitte, 2008), and also supports research that proposes increased memory recall for disorder specific information (i.e. social information for social phobics; panic related information for panic disorder) (O'Toole et al., 2016). Arguably, the somatic cues are a specific type of negative cue for those with elevated healthy anxiety symptomology, one related to threat. It is important to note that the researchers manipulated thinking style prior to event generation and they did not investigate difference between positive, negative and somatic cues across conditions, nor did they include a neutral cue. For these reasons, it is difficult to draw specific conclusions about the effect of emotional valence on overgenerality. Nevertheless, the results do provide some support for the suggestion that emotional valence may affect MTT in anxiety differentially across past and future events, a possibility that warrants further investigation (Miloyan et al., 2014)

Table 2.

Summary of MTT literature in Anxiety disorders and the outcomes

Authors	Group	Episodic Memory	Episodic Future Thinking	Event required to be specific (within 24 hrs, personally relevant)	Dependent Variable	Independent Variable other than Group	Findings
Astrom et al., 2014	Anxious	X			Frequency	Valence	Increase retrieval for negative events (recall bias)
Brown et al., 2013	PTSD cf. Control	X	X		AMT Dummy Coding		PTSD generated more general events
Brown et al., 2014	PTSD cf. Control	X	X	X	Level of detail		PTSD generated more internal details for memories than future events and fewer details for future events, more anxiety content
Burke & Mathews, 1992	GAD cf Control	X			Anxious event frequency, speed of recall		GAD produce > number of events and quicker than controls
Krans, Bree & Bryant, 2014	Social Anxiety (non-clinical)	X		X	Anxiety content	Valence	High social anxiety recalled more negative memories and more social anxiety memories. Low social anxiety recalled more positive memories to negative cue words.
Macleod & Byrne, 1996	Anxious adults, mixed (anxious depressed) cf. controls		X		Frequency, Likelihood		Anxiety differed anticipated more negative futures cf. controls Mixed anticipate more negative experiences and anticipate fewer positive experiences

Authors	Group	Episodic Memory	Episodic Future Thinking	Event required to be specific (within 24 hrs, personally relevant)	Dependent Variable	Independent Variable other than Group	Findings
MacLeod et al., 1997	Panic, depressed cf. controls	X	X		Number of items	Temporal periods Valence	Anxious more negative responses Depressed less positive responses
McNally et al, 1994	PTSD cf. Control	X			AMT Dummy Coding Trauma content	Priming Manipulation Valence	Exposure to trauma prime increased overgenerality in PTSD (neutral cues only) PTSD retrieved more trauma content
Mitte, 2008	Anxiety	X			Threatening information		Increased information recall for threatening information
Morina et al., 2011	Anxious, Depression & Control		X		Vividness	Valence	Anxious more vivid negative future events
Newby-Clarke & Ross, 2003	Healthy participants	X	X		Phenomenological mesaures Speed of recall Likelihood	Valence	Increased likelihood and increased positivity ratings for future. Same speed of recall
O'Toole et al., 2016	Panic Disorder, Social Anxiety cf. Control	X			Phenomenological measures (Vividness, Intensity, re-experiencing)	Cue Manipulation (panic or social related)	Panic cued memories stronger imagery and more traumatic. Panic events, more central to identity for Panic disorder but not Social anxiety. Anxiety groups performed similarly but differed from controls on phenomenological ratings.

Authors	Group	Episodic Memory	Episodic Future Thinking	Event required to be specific (within 24 hrs, personally relevant)	Dependent Variable	Independent Variable other than Group	Findings
Richards & Whittaker, 1990	High and Low state anxiety	X			Speed of recall	Anxiety/Mood manipulation, Valence	High trait anxiety faster for anxiety cues cf, happiness cues.
Sansom-Daly et al., 2014	Sub-clinical health anxiety	X	X		Specificity Dummy Coding	Rumination Task, Valence	Anxiety related sures increase specificity for past, increase in overgenerality for future event in rumination group
Wenzel et al., 2002	Social Phobia	X			Frequency	Social situation vs. nonsocial situation of event	Social Phobics produce more negative events
Wu et al., 2015	GAD		X		Level of details	Valence of event, Repeated simulations	Fewer positive event details, less elaboration of details for repeat simulations

Study 2 aimed to identify differences in MTT as a function of emotional valence across levels of elevated anxiety. Given the modifications made to the AMT protocol being used in this thesis (a written protocol, using emotional valence instructions and neutral word cues), it was prudent to conduct a feasibility study in a large online sample (i.e. via Amazon's Mechanical Turk (MTurk) platform) prior to beginning laboratory-based testing. The benefits of this approach are threefold. First, using an online sample provided an opportunity to refine the written task method and the coding protocols (overgenerality and episodic detail) to be used in future studies of MTT in anxiety reported in this thesis. Second, the use of an online collection platform offered the practical advantages of rapid recruitment and reduced cost (Horton et al., 2010), along with the ability to recruit a large sample that is likely to be more representative of the general population than a university population (Behrend, Sharek, Meade, Wiebe, 2011; Kittur, Chi & Suh, 2008). Previous research has also shown that the data obtained via MTurk is of equivalent reliability and quality to university samples (Buhrmester, Kwang & Gosling, 2011; Casler, Bickel & Hackett, 2013; Krantz & Dalal, 2000), and the use of online labour markets arguably removes bias caused by the presence of an experimenter (see Horton et al., 2010). Third, the use of a large online sample provided sufficient statistical power to identify differences in the measures of interest (i.e. overgenerality and episodic detail) in varying levels of anxiety in a non-clinical sample. Although anxiety symptomology is a dimensional characteristic, which varies continuously, the focus of this thesis was on MTT in individuals with anxiety disorders. To meet criteria for the diagnosis of an anxiety disorder, individuals must exceed an a-priori defined threshold according to diagnostic criteria. Across this thesis, I used online samples and sub-clinical student populations to conduct feasibility studies prior to

clinical investigations. To investigate MTT in anxiety at a level consistent with clinical diagnosis, it was necessary to maintain a-priori defined clinical cut-offs using gold-standard anxiety measures within the sub-clinical groups. As such, dimensional anxiety measures were transformed into categorical variables. It is true that previous work has shown that the power of hypothesis testing is reduced when using categorical diagnoses, with evidence indicating that statistical results vary depending upon the clinical cut-offs are used to transform dimensional data (Cohen, 1982; MacCallum 2002). Further, while the field is starting to shift to a more dimensional approach, and the DSM-V suggests that future diagnostic manuals will navigate towards dimensional applications (i.e. see Autism Spectrum Disorder) (APA, 2013), at present the diagnostic criteria continue to rely on clinical cut-offs. Therefore, research that has potential clinical application is limited to categorical approaches, particularly when the focus is on diagnostic criteria (Kraemer, Noda & O'Hara, 2004). As such, the research in this thesis applies the clinical cut-offs of gold-standard measures (i.e. Depression, Anxiety and Stress subscale, Lovibond & Lovibond, 1994) that have good convergent and discriminant validity in detecting clinical levels of anxiety and mood disorders (Brown, Chorpita, Korotitsch & Barlow, 1997).

This study aimed to investigate whether individuals with elevated anxiety exhibited differences in the overgenerality (specificity) and level of detail of past and future events that were elicited by positive, negative and neutral cues, relative to individuals with nil and normal anxiety levels. The combination of temporal direction, emotional valence and varying anxiety levels is novel and as such several hypotheses were made using the limited literature within the field from research in past and future thinking and varying anxiety presentations**.** First, I hypothesised that individuals with elevated anxiety would report more specific past negative events. This hypothesis is in

line with evidence suggesting increased attention and retrieval biases for negative events in individuals with anxiety (Åström et al., 2014) and evidence of increased specificity for negative past events (i.e. threat related events) in individuals with elevated health anxiety (Sansom-Daly et al., 2014). Further, while there is no specific research that has yet looked at the level of episodic detail for emotionally-valanced events in anxiety disorders, based on research that anxious individuals report more vivid and intense negative events (O'Toole et al., 2016), I predicted that individuals with higher levels of anxiety would report more episodic details in relation to past negative events than would individuals with lower levels of anxiety. Secondly, I predicted that as anxiety levels increased from nil to elevated, the number of overgeneral future events would increase. This hypothesis is in line with research suggesting that those with elevated anxiety report more overgeneral future events than do healthy controls (see Sansom-Daly., 2014). In contrast, I hypothesised that there would be no difference in the number of past events categorised as overgeneral as a function of anxiety levels (Heidenreich, Junghanns-Royack & Stangier, 2007; Wessel, Meeren, Peeters, Arntx & Merckelbach, 2001; Williams et al., 2007; for review see Zlomuzica et al., 2014). Third, I predicted that participants in the elevated anxiety group would exhibit the highest levels of overgeneral thinking and lowest levels of episodic detail for negative future events. This hypothesis is in line with evidence from individuals with health anxiety, showing that somatic cues (negative for health anxious individuals) elicited more overgeneral future events (Sansom-Daly et al., 2014) and with the idea that individuals with anxiety use avoidance mechanisms to reduce the experience of negative affect (Clark 1999; Williams et al., 2007) and therefore are likely to avoid thinking about possible negative futures. Fourth, in relation to detail coding, I predicted that for future events that were coded as specific, individuals with elevated levels of anxiety would

report less episodic details relative to those in the no anxiety or normal anxiety range. This hypothesis is consistent with PTSD research, which showed those with PTSD produce fewer episodic details for future events relative to controls (Brown et al., 2014). Finally, my fifth hypothesis, predicted that individuals with elevated anxiety would report more overgeneral and fewer detailed positive future events than neutral events. This hypothesis is in line with evidence showing that individuals with GAD construct positive future events in less detail compared to health controls (see Wu et al., 2015).

Method

Participants

Participants (N=600) were recruited and completed the experiment online using Amazon's MTurk® website. Participants were excluded if they responded incorrectly to any of the Attention Check Questions (ACQs) (*n*=178) or if they reported that they did not speak English as a first language (*n* = 21). Additionally, to ensure that comorbid depression did not affect results, participants were excluded if they scored 13 or higher (i.e. the clinical cut-off) on the depression subscale of the Depression Anxiety Stress Scale (DASS; Lovibond & Lovibond, 1995) (n=44). The final sample included 357 participants for analysis. The ethnic composition of the sample was 66.6% Caucasian, 11.7% Asian, 15.4% other (Hispanic, African, Arabic, Mixed), and 6.2% were undisclosed. All participants were over the age of 18 as a condition of participation. Participants received US$1 for their participation. The School of Psychology ethics committee at the University of New South Wales approved the study.

Materials

The same computerized online platform was used to administer a slightly modified version of the written mAMT from Study 1. In addition, participants completed a detailed demographics form and anxiety questionnaires including the DASS-21 (Lovibond and Lovibond, 1995) and PSWQ (Meyer et al., 1990). Following each event description in the mAMT they also completed an adapted Phenomenological Questionnaire (D'Argembeau & Van der Linden, 2004; Finnbogadóttir & Berntsen, 2011; Johnson et al., 1988). Finally, attention capture questions (ACQs) were included in all questionnaires to ensure that only data from participants who were paying attention was included.

Demographics form. The demographics form asked participants to provide information about their age, gender, marital status, ethnicity, education, employment status and languages spoken.

DASS-21. The Depression Anxiety Stress Scale (DASS) 21-item version (Lovibond & Lovibond, 1995) is the short version of a self-report instrument, which measures the related emotional states of depression, anxiety and stress. The correlation between the DASS-21 scales and the component factors of the original 42-item DASS is moderate to high (Sinclair et al., 2012). It is a well-validated and reliable measure that has normative data from a large non-clinical sample (Crawford & Henry, 2003). The subscales have high internal consistency and have good convergent validity in clinical and non-clinical groups with other measures of depression and anxiety (Antony, Bieling, Cox, Enns, & Swinson, 1998; Henry & Crawford, 2005).

PSWQ. The Penn-State Worry Questionnaire (Meyer et al., 1990) is a 16-item self-report measure that identifies individual differences in intensity and excessiveness of worry. Participants are asked to rate to what extent statements are typical of them using a 5-point Likert scale. The PSWQ has excellent psychometric properties in both

non-clinical and clinical populations (Molina & Borkovec, 1994). While typically used to differentiate individuals with GAD from individuals with other anxiety disorders and from non-clinical groups (Brown, Antony & Barlow, 1992; Brown, Chorpita, Korotitsch, & Barlow, 1997), good convergent validity with the anxiety subscale of the DASS has been shown in young and older adults (Gloster et al., 2008).

ACQs. Attention Check Questions (ACQs) are a series of items designed to check if participants were responding to the questions without reading them (e.g. "If you are reading this, select 'Never' as the answer). In order to preserve data quality using online platforms such as MTurk, studies have shown the importance of using ACQs because they enable researchers to exclude data from individuals who are simply clicking through the items or mindlessly responding without reading the question (Aust, Diedenhofen, Ullrich, & Musch, 2013; Oppenheimer, Meyvis & Davidenko, 2009). They were interspersed in the demographic questionnaire, DASS-21, PSWQ and phenomenological questionnaire. Participants who incorrectly answered any ACQs were removed from the sample.

mAMT (modified Autobiographical Memory Test). The written version of the mAMT that was piloted in Study 1 was used. One amendment was made to the task. Rather than randomly allocating neutral cue words, participants self-selected their own cue words from the same word-lists created from Clark and Paivio's (2004) revised normed list of words in Study 1. It was reasoned that self-selection would encourage participants to produce more personally-relevant specific events, and therefore reduce the incidence of participants reporting many categoric/intermediate and general events as was seen in Study 1. Participants were instructed that they would be self-selecting word cues, and that they could use the cue words to "freely associate", that is, the event remembered or imagined did not have to directly relate to the word they selected (please

see Appendix B for full instructions and self-selection). As with the previous study, neutral events were presented first in randomised order (past or future), followed by a randomised presentation of negative/positive past and future events.

Phenomenological Questionnaire. (Berntsen & Bohn, 2008; D'Argembeau & Van der Linden, 2004; Johnson et al., 1988) A combination of self-report questions from a number of studies were used, asking participants to rate on 7-point Likert scales their subjective experience of the events described. Phenomenological ratings asked participants to rate the vividness of the event, feelings of pre/re-experiencing of the event, the sensory experience of the event (i.e. sights, sounds, smells, tastes), the contextual location of elements in the event (i.e. objects/people), the perspective the event was remembered/imagined from (observer or field perspective), the physiological reaction to the event, how coherent the event was and the importance of the event to the participant's life story. The questionnaire was presented to participants after the completion of each event description in the mAMT.

Procedure

Informed consent was obtained after participants were presented with a written description of the elements of experiment to be completed. Participants were asked to complete the demographic information questionnaire, followed by the anxiety measures, which were presented in a counterbalanced order.[2] Upon completion of the anxiety measures, the written instructions for the mAMT were presented. Participants were

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[2]The anxiety/mood questionnaires ask about a participant's mood over the last two weeks. Given that the experimental procedure asked participants to remember or imagine negative events, it was thought that the recollection or imagined future of negative events would impact on a participant's perception of their current mood state and thus may impact on the ratings of mood/anxiety if mood ratings were presented after the experimental paradigm. As such presenting questions that ask participants to report their mood over the last two weeks was only presented prior to the experimental task was to prevent this. However, it is important to note that reflecting on the past two weeks prior to beginning the experiment may also have impacted on participants mood.

presented with a screen that required them to confirm they understood the instructions. Once participants selected 'yes,' the experimental phase began and participants completed the written mAMT and phenomenological questionnaires. All participants were asked to complete the experiment in a single sitting in a quiet solitary location, and were given a two-hour period to complete it. After the participants finished, a debriefing screen was displayed. Upon successful completion of the experiment, participants were provided with a completion code that they were required to enter prior to receiving US$1 compensation for their time.

Scoring. All events from participants included in the final analysis were scored by a single rater blind to event type and group allocation. Additionally, a second independent rater, who was blind to group allocation, event type and hypothesis, scored 20% of the events. These scores were subjected to intra-class correlation analysis to determine inter-rater reliability.

Overgenerality Coding. Overgenerality coding replicated that used in Study 1. Adequate inter-rater reliability was achieved using intra-class correlations (Cronbach's α = .76).

Episodic Detail Coding. Episodic detail coding replicated that used in Study 1. High inter-rater reliability was achieved using intra-class correlations for internal (Cronbach's α =.90) and external scores (Cronbach's α =.86).

Analyses

Pearson correlations were conducted to assess the relation between the DASS anxiety scores and the PSWQ to validate the use of the anxiety subscale to assign participants to groups. Internet administered versions of the PSWQ and DASS have previously demonstrated good internal consistency and good inter-scale correlation

(r=.32) (Zlomke, 2009). Chi-squared analyses were also conducted to ensure that the frequency of demographic characteristics did not differ as a function of group.

Separate 2 (condition: Past, Future) X 3 (Valence: Neutral, Negative, Positive) X 3 (Group: Nil Range, Normal Range, Elevated Range) mixed design ANOVAs were conducted for analysis of overgenerality and episodic detail. Note that for ANOVA, if the assumption of sphericity was violated (as indicated by a Greenhouse–Geisser estimate of sphericity, epsilon, of less than .90), the degrees of freedom were adjusted using Greenhouse– Geisser correction (Geisser & Greenhouse, 1958). Effect sizes are expressed in partial eta squared (η_p^2) and values of .02, .13, and .26 were considered small, medium and large effects respectively (Cohen, 1988). Interactions were followed up using paired-sample and independent-sample t-tests.

Analysis of phenomenological questionnaire data is not presented here because preliminary analysis data indicated that all effect sizes for main effects and interactions related to group (critical area of interest) were less than or equal to small ($\eta^2 \leq .02$). In addition, there were concerns about the robustness of the data as some groups contained fewer than 5 participants when demographic variables were included. One of the benefits of using online platforms such as MTurk is that it has made it easier for experimenters to reach large and diverse samples of participants at low costs. However, while experiments with large samples may detect non-random differences between groups that are statistically significant, the clinical significance of these findings may be minimal (Kraemer et al., 2004). Additionally, recent research has identified some particular characteristics of MTurk participants that may jeopardise the integrity of the phenomenological measures. For example, MTurk participants endorse clinical symptoms such as emotion regulation and lower tolerance for physical distress/psychological distress at a substantially greater rate than traditional non-clinical samples (Arditte, Cek, Shaw & Timpano, 2016). In sum, I decided not include the phenomenological analysis because I was concerned that the effect sizes were too small to be

clinically relevant and that the ratings may not be generalizable to another non-clinical sample.

Results

Participant Characteristics

Scores on anxiety subscale of the DASS were moderately correlated with scores on the PSWQ (r =.316, p = .00). As the DASS anxiety subscale showed good convergent validity, it was used to assign participants to three groups (nil, normal, elevated anxiety). Participants who scored '0' on the anxiety subscale were assigned to the nil anxiety group. Participants who scored between 1-9 on the subscale were assigned to the normal range anxiety group. Participants who scored 10 or more were assigned to the elevated range anxiety group, as 10 is suggested by Lovibond & Lovibond (1995) as the cut-off for individuals with clinical levels of anxiety.

Of the final 357 participants, a total of 62 participants (31 female, 26 male, 5 non-disclosed) were assigned to the nil anxiety group. The normal range anxiety group consisted of a total of 265 participants (159 female, 91 male, 15 non-disclosed). The elevated anxiety group consisted of a total of 30 participants (20 female, 8 male, 2 non-disclosed). See Table 3 for further demographic information.

Chi-square analysis of group demographics indicated there were no difference in the distribution of gender frequency χ^2 (1, N =357) = 3.16, p = .53, age χ^2 (1, N=357) = 1.96, p = .74, number of languages spoken χ^2 (1, N =357) = 8.69, p = .19, education χ^2 (1, N =357) = 5.36, p = .25, and ethnicity χ^2 (1, N =357) = 3.23, p = .78, across the three anxiety groups.

Table 3.

MTurk group demographic information for the final participants included in analysis for Study 2

	Nil anxiety			**Normal anxiety**			**Elevated anxiety**		
n	62			265			30		
Gender (Female/Male)	31	26		159	91		20	8	
Languages (Monolingual/Bilingual+)	46	10		180	70		23	5	
Age (18-45/45+)	48	8		199	46		25	3	
Education (HighSchool/Degree/Masters)	21	31	10	117	107	41	9	17	2
Ethnicity (Caucasian/Asian/Other)	39	7	11	177	34	39	22	1	5

NB. A number of participants included in the final analysis did not disclose all demographic information.

Overgenerality Analysis

For overgenerality analysis, a mixed design ANOVA was conducted to determine whether there was any difference in the overgenerality of events that participants produced as a function of temporal direction (past/future), emotional valence instruction (no instruction, positive, negative) and group (nil, normal, elevated). While the distribution of males and females did not vary across groups according to chi-squared analysis, due to the higher percentage of women included in each group, gender was included as a covariate (Ros & Latorre, 2010).

There was a main effect of temporal direction, F (1, 353) = 34.94, p < .00, η_p^2 = .09, reflecting that past events were more likely to be specific than future events. There was also a significant main effect of emotional valence instruction F (2, 706) = 10.48, p <.00, η_p^2 = .03. These main effects were qualified by a significant temporal direction by valence interaction, F (2,706) = 6.29, p <.00, η_p^2 = .02 (See Figure 4). Paired samples t-tests compared the specificity of past and future events separately for each level of valence. For both negative and positive events, past events were more likely to be specific (bound in a 24-hour period and personally relevant) than were future events (negative: t *(356)* =10.28, p < .00; positive: t *(356)* = 4.76, p < .00). However, there was no significant difference in the specificity of past and future neutral events (t *(356)* = 1.19, p = 0.23). There was also a significant interaction between emotional valence instruction and gender, F (2, 706) = 3.29, p = .04, η_p^2 < .00. Because the effect size was negligible, follow up analysis was not conducted.

There was a significant main effect of group, F (2,353) = 3.53, p = .03, η_p^2 = .02 (see Figure 5). As is illustrated in Figure 5, when averaged across temporal direction and valence instruction, participants in the elevated anxiety group produced significantly less specific events than the normal range anxiety group, t (293) = 2.59, p = .01, d = .30 and the nil anxiety group, t (90) = 2.050, p = .043, d = 0.43. There was no significant difference in overgenerality of events produced by participants in the normal range and nil anxiety groups t (325) = -.33, p = .74, d = -.04. There were no other significant interactions (all ps > .05).

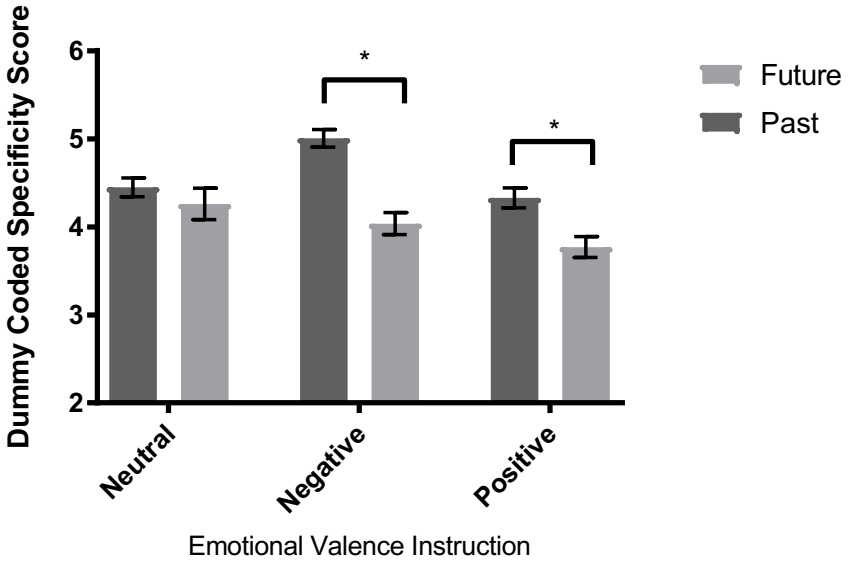

Figure 4. Mean (+SEM) dummy-coded specificity score as a function of emotional valence instruction and temporal direction, collapsed across group. Higher scores indicate production of more specific events, lower scores indicate production of more categoric/intermediate and general events.

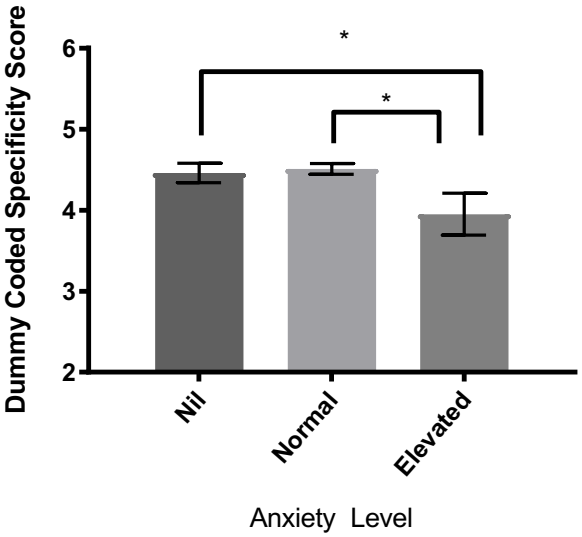

Figure 5. Mean (+SEM) dummy-coded specificity score as a function of groups collapsed across temporal direction and emotional valence instruction. Higher scores indicate production of more specific events, lower scores indicate production of more categoric/intermediate and general events.

Episodic Detail Analysis

Missing Values and Data Replacement for Episodic Detail Analysis. As in Study 1, a large proportion of events provided were coded as categoric/intermediate or general, despite the fact participants were instructed to provide specific events occurring in a 24-hour period. Only 111 participants (31%) had complete data sets. Figure 6 highlights the frequency of missing events (i.e. one event, two events, three events etc.) across the sample.

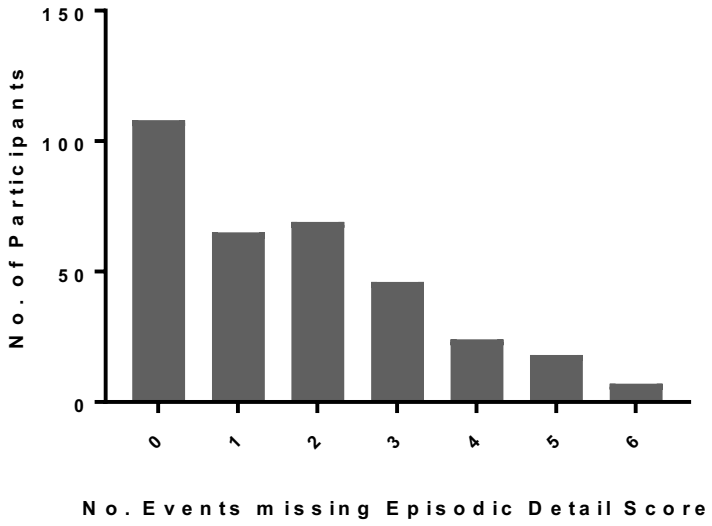

Figure 6. Frequency of missing episodic detail event score across MTurk sample

When conducting ANOVA analysis, participants are automatically removed from the sample if there are any missing values. Thus, in order to prevent considerable data loss, the same multiple imputation protocol used in Study 1 was applied to this MTurk data set. After missing data imputations were conducted, the total number of participants included in the analysis for episodic detail analysis was reduced (N=345; low anxiety group n =61, mid anxiety group n= 258, high anxiety group n=28) because 12 participants were still incomplete at the end of the 10th imputation. Table 4 highlights

the large increase in sample size and minimal change to means across each event type as a result of the imputation protocol.

Table 4.

Mean episodic detail proportion score of specific events for each event condition pre and post imputation implementation

	Original Data		**10th Imputation**	
	N	Mean	N	Mean
Past Neutral	272	0.83	345	0.82
Past Negative	313	0.85	345	0.85
Past Positive	243	0.79	345	0.78
Future Neutral	242	0.85	345	0.83
Future Negative	226	0.80	345	0.77
Future Positive	200	0.81	345	0.79

Repeated Measures ANOVA Analysis for Episodic Detail. For the episodic detail analysis, a mixed design ANOVA was conducted to determine whether there was any difference in the proportion of episodic details that participants produced as a function of temporal direction (past, future), emotional valence instruction (no instruction, positive, negative) and group (nil, normal, elevated). Gender was included as a covariate.

There was a main effect of temporal direction, F (1,341) = 5.54, p =.02, η_p^2 =

.02, highlighting that across groups, participants provided a greater proportion of episodic details for past events than for future events. There was also a significant main effect of emotional valence F (2, 682) = 10.40, p <.00, η_p^2 = .03, however, these main effects were qualified by a temporal direction by valence interaction, F (2, 682) = 9.11, p <.00, η_p^2 = .03 (see Figure 7). The proportion of episodic details provided for past and future events were compared separately for each valence using paired-sample t-tests. The analysis showed that while negative past events contained significantly more episodic details than negative future events, t (344) = 8.14, p < .00, this difference in episodic details provided in relation past and future events was not seen when participants were not provided with a valence instruction, t (344) = -1.59, p = 0.14, or positive events, t (344) = -1.40, p = 0.16.

There was also a significant main effect of group, F (2,341) = 8.02, p < .00, η_p^2 = .05, which was qualified by a group by emotional valence interaction, F (4, 682) = 2.60, p = .04, η_p^2 = 0.2 (*See* Figure 8). The proportion scores for each valence were compared separately for each group using independent samples t-tests. For neutral events, individuals in both the nil anxiety group and the normal anxiety group generated significantly more episodic details compared to individuals in the elevated anxiety group t (85) = 3.02, p = .00, d = .70; t (282) = 3.27, p = .00, d = .40 respectively. There was no group difference between nil and normal range anxiety levels in the proportion of episodic details produced for neutral events, t (317) = .60, p = .55, d = .06. For negative events, individuals in the nil anxiety group generated significantly more episodic details than both than normal range anxiety group and the elevated anxiety group (t (317) = 3.43, p = .00, d = .39; t (85) = 3.69, p =.00, d = .80 respectively) which did not differ from each other (t (282) = 1.04, df =282, p = .30, d = .12). For positive events, individuals in the nil anxiety group generated significantly more episodic details

compared to individuals in the normal range anxiety group and those in the elevated anxiety group, t (85) = 4.0, p =.00, d =.86; t (317) = 2.19, p =.03, d = .25 respectively. Individuals within the normal range anxiety group also generated significantly more episodic details for positive events than individuals in the elevated range anxiety, t (282) = 2.96, p <.00, d =.35. Overall, as anxiety levels increased to within the normal range there appeared to be a reduction in the number of episodic details produced for events that were positively and negatively valenced. As anxiety increased further to clinically-elevated levels, there were additional decreases in episodic detail generation for positive and neutral events only, however, the proportion of episodic details produced for negative events remained similar to individuals with normal levels of anxiety.

Figure 7. Mean (+SEM) proportion of episodic details as a function of emotional valence instruction collapsed across group

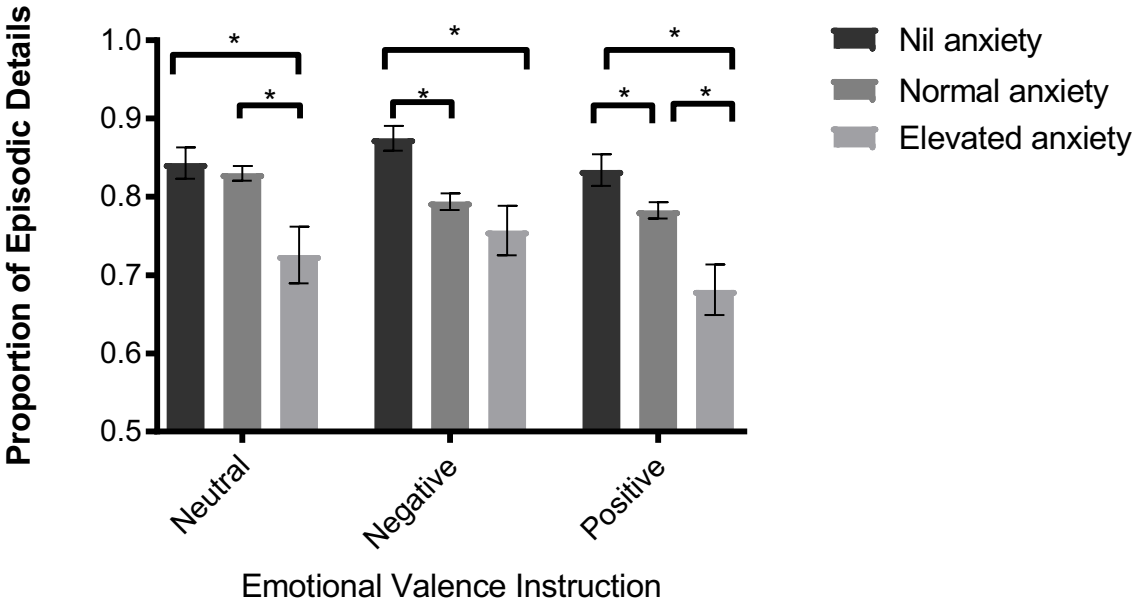

Figure 8. Mean (+SEM) proportion of episodic details as a function of each emotional valence instruction produced by participants in each group, collapsed across temporal direction

Discussion

This study investigated whether individuals with elevated anxiety exhibited differences in emotionally driven MTT. I was particularly interested in whether anxiety level impacted overgenerality and episodic detail, when asked to construct positive, negative and neutral narratives that have occurred in the past and could occur in the future.

I predicted that individuals with elevated anxiety would produce more specific and more detailed negative past events than individuals with nil or normal levels of anxiety, consistent with the findings from health anxiety showing that past events related to negative cues (threat cues) are more specific than those provided by healthy controls (Sansom-Daly et al., 2014). In contrast to my predictions, the results showed that individuals with elevated anxiety produced more overgeneral events than those in the nil anxiety or normal anxiety groups, when remembering past and imagining future

events for all emotional valences. Further, participants in the elevated anxiety group produced fewer episodic details for positive, negative and neutral events than those in the nil anxiety group, and for positive and neutral events than those in the normal range anxiety group. These effects of reduced episodic detail were seen in both past and future direction. Further, when looking at the pattern of results, past emotional events (both positive and negative) were more specific in nature than neutral events and past negative events contained proportionately more episodic details than positive or neutral past events. Contrary to expectation this was a pattern seen across all groups and was not specific to individuals with elevated anxiety.

The results of this online study showing that negative past events contain proportionally more episodic details than neutral or positive past events, are only somewhat consistent with previous research. For instance, in healthy individuals negative emotions enhance episodic memories with participants producing a greater number of episodic details for negative events relative to positive or neutral events (Holland & Kensinger, 2010; Mickley & Kensinger, 2009). Yet other studies have not found differences in the production of episodic details between positive and negative events (Jacques & Levine, 2007). It is possible that the increase in the proportion of episodic details produced for negative past events is a result of the prevailing mood state of the participants, which can enhance the retrieval of events with a matching emotional valence (Buchanan, 2007). While it is difficult to argue that the majority of a large sample (N=300+) would be in a negative mood state during participation, it is possible that the time consuming nature of the experiment, for which participants were only being paid $1 could have impacted mood. Future experiments could assess mood before and after the experiment to investigate this possibility. The lack of positivity bias seen within this study may also be due to characteristics of the online sample. Recent

research found that MTurk workers experience significantly higher clinical symptomology than the general population (Arditte, Cek, Shaw & Timpano, 2015), suggesting that the control groups within my study may have elevated clinical symptomology. The use of two gold-standard clinical measures (DASS, Lovibond & Lovibond, 1995; PSWQ, Meyers et al., 1994) for group allocation within this study would suggest otherwise, with individuals in the nil anxiety group reporting no anxiety symptomology, however it is important to replicate this study in a university or community sample to test this possibility.

In line with Sansom-Daly et al.'s (2014) and Miloyan et al.'s (2014) suggestions, I predicted that individuals with elevated anxiety would exhibit overgeneral thinking and fewer episodic details when reporting about the future but not the past. In contrast, the results showed that individuals with elevated levels of anxiety generated more overgeneral events with fewer episodic details in both past and future directions. I also predicted that participants in the elevated anxiety group would report more overgeneral emotional events than those with nil or normal levels of anxiety and that the largest difference of overgeneral events would be for negative future events. The results showed that emotional valence did not affect the level of overgenerality between groups. Moreover, the reduction in episodic details was not specific to the elevated anxiety group relative to those with normal levels of anxiety. Rather there was also a significant difference in the level of episodic detail between those with normal levels of anxiety and nil anxiety. Suggesting that any increase in anxiety has an impact on MTT ability.

Although Miloyan et al. (2014) suggested that MTT impairment in individuals with anxiety would occur in a future direction only, the results of this study highlight decreases in the specificity of both memory and future thinking in elevated anxiety.

These results are consistent with PTSD research that has shown overgenerality (Brown et al., 2013; Dalgleish et al., 2001) and episodic detail reductions in MTT (Brown et al., 2014). Despite the fact that this study controlled for depression by removing individuals from the sample meeting the clinical cut-off in the depression subscale of the DASS, the findings were in line with previous work with individuals with depression. More specifically, individuals with depression and dysphoria produce more overgeneral past and future events relative to healthy controls (Addis, Hach & Tippet, 2016; Anderson & Evans, 2014; Holmes, Lang, Moulds & Steele, 2008; Williams et al., 1996). The similarity between the findings in this study and the depression literature suggests that MTT impairment in anxiety may be more similar to depression than the current literature suggests (see Miloyan et al., 2014; 2015).

I also predicted that individuals with elevated anxiety would produce more overgeneral and produce fewer episodic details for future negative events relative to future positive or future neutral events. In contrast to prediction, there was no difference in levels of overgenerality as a function of emotional valence, for events in a future direction. Further, negative events for those with elevated anxiety had proportionally *more* episodic details than positive or neutral events; this pattern was true for both temporal directions.

The finding that negative events contain more episodic detail across both temporal directions is supported by previous research which has shown that anxious individuals access negative events more easily than positive events (Wenzel et al., 2002) and have a preferential memory for threatening situations (Coles & Heimberg, 2002). The results are also consistent with research showing a recall bias for negative events in anxiety (Åström et al., 2014; Krans et al., 2014 O'Toole et al., 2016). However, the pattern of results for episodic detail are somewhat inconsistent with the

MTT models. The similarity in overgenerality for emotional valences and increase in episodic detail for negative events is in contrast to self-memory model (Conway and Pleydell-Pearce, 2000) model that posits individuals regulate their emotions via enhancing access to positive memories and diminishing access to negative memories. Further, the CaR-Fa-X (Williams, 2006; Williams et al., 2007) model implicates the use of functional avoidance strategies to reduce the experience of negative affect, which would suggest a greater reduction for episodic details in negative events. It is possible that both attentional and retrieval biases for negative information seen in anxiety prevented the expected reduction in detail. Future research could measure reaction times during event construction to see whether negative event construction is quicker than neutral or positive event construction to investigate this possibility.

Finally, I predicted that positive future events would be more overgeneral and contain fewer episodic details than neutral events for those with elevated anxiety. Individuals with elevated anxiety did produce positive events with fewer episodic details than negative or neutral events, unlike individuals in the nil and normal level anxiety groups. However, in contrast to the hypothesis, the effect occurred for both past and future events. Additionally, the reduction in episodic detail for positive events was not specific to those with elevated anxiety. The same pattern of results observed in the normal anxiety group. The results suggest that as anxiety increases, episodic detail for positive events decreases. Interestingly in contrast to my predictions, positive events, not negative had the greatest reduction in episodic details for individuals with elevated anxiety.

The results showing reduced detail generation for positive events are consistent with previous findings from PTSD samples showing difficulties in generating specific episodic memories in response to positive cue words (McNally et al., 1994). Further,

the results are consistent with those from Wu et al., (2015) which showed deficits in positive future event simulation in those with GAD relative to controls. The indication that positive events had the *greatest* level of episodic detail reduction for individuals with elevated anxiety was unexpected. It is possible that individuals with elevated anxiety have difficulty accessing positive events because they are inconsistent with their world-view (i.e. the world is dangerous) or current goals (i.e. avoiding threat) (Miloyan et al., 2014; 2015). Additionally, it is possible that engagement in functional avoidance strategies (Williams, 2006) is successful for positive events but not negative events. This possibility could be tested by incorporating behavioural measures of avoidance, rumination and executive function into the experimental battery, which could be correlated with results of overgenerality and episodic detail elicited by each emotional valence.

This study is not without limitations. First, while a large sample size is typically an advantage, with high power comes the ability to detect effects that are small in magnitude. While statistically significant, the clinical significance of the differences observed remains to be determined. Second, data quality can be problematic in research using online samples. Oppenheimer and colleagues (2009) highlighted that one of the potential draw-backs of using MTurk and web-based experiments is the unsupervised nature of the task. Due to the lack of supervision, subjects in online studies are less attentive than those participating in a lab-based experiment. Almost 30% of the original sample was not included within the analysis because they incorrectly responded to attention check questions. Third, within the current data set, even with the amendment from Study 1 to remind participants to be as detailed as possible and specific, many participants still provided events that were categoric/intermediate and general, particularly for future events. As a such the amount of missing data within the episodic

detail analysis was high. Therefore, we should be cautious in drawing strong conclusions from the data. It is important to replicate these results using a university sample to determine that effects are not due to special characteristics of the types of participants recruited through MTurk or because of missing data imputations.

The results of this large online experiment showed that individuals with elevated anxiety had an overgeneral thinking style and produced past and future events with fewer episodic details than did controls. Importantly, the results from my study extend the literature, highlighting MTT deficits are not specific to PTSD but rather occur in participants with non-specific elevated anxiety. Moreover, there was a particular deficit in the ability to construct detailed positive events in the future. Engaging in specific and detailed simulations of the future is essential for wellbeing particularly as such simulations can inform current feelings, thoughts and behaviours (Fishbach, Dhar, & Zhang, 2006; Taylor & Schneider, 1989; Taylor et al., 1998, Zhou, Sedikides, Wildschut, & Gao, 2008). Further, overgeneral thinking is associated with a reduced ability to generate effective problem-solving strategies, reduced mood and poor coping strategies (Evans et al., 1992; Goddard et al., 1996; Raes et al., 2005). It is possible that the increased overgenerality and reduced episodic detail in individuals with elevated anxiety levels seen in this study may be a contributing factor to the maintenance of clinical symptomology and warrants further research within a clinical population. However, replication within a university sample is first needed to address the limitations of using an online sample.

CHAPTER 4

Study 3

The effect of increasing levels of anxiety on MTT in a university sample: Exploring objective and subjective differences

This research is important because it may explain why individuals with elevated anxiety levels exhibit problematic future thinking. The goals of Study 3 aimed to determine whether the online findings of Study 2 generalise into a laboratory setting and to extend the research to investigate both the quantitative and qualitative experience of MTT within a sub-clinical anxiety sample. By determining whether there are group differences in the subjective experience of MTT in addition to objective/quantitative deficits, I aimed to provide a clearer conceptualization of how individuals with elevated anxiety construct and experience emotionally-valenced past and future thought.

As discussed in the general introduction, studies investigating the phenomenological experience of individuals with anxiety point to some differences in MTT relative to healthy individuals, however, at present the findings are inconsistent. Some studies have reported increases in some components of phenomenological experience (i.e. vividness, intensity and bodily sensations) in episodic memory in social anxiety and panic disorder relative to controls (O'Toole et al., 2016; Wild et al., 2007). However, other studies have reported reductions in the phenomenological experience (i.e. vividness, sensory-perceptual details) of past remembering in social phobics (D'Argembeau et al., 2006). These reductions extend to both past and future events in individuals with OCD traits (Zermatten et al., 2008) and in individuals who regularly use suppression, a feature commonly used as an avoidance mechanism in individuals with anxiety disorders (D'Argembeau & Van der Linden, 2006). There are also some studies that report no differences in the phenomenological experience of episodic

memory in individuals with high trait anxiety (D'Argembeau, Comblain & Van Der Linden, 2003), episodic future thinking in individuals with GAD (Wu et al., 2015), and MTT, in individuals identified as high worriers (Finnbogadóttir & Berntsen, 2013).

Some of the discrepancies in this literature may be attributed to methodological differences. For instance, variation in populations used (i.e. sub-clinical and clinical groups) and variation in the specific anxiety disorder being investigated (i.e. social anxiety, panic disorder, GAD) might contribute to the conflicting findings. Additionally, differences in AMT methodology such as variation in cue-words (i.e. neutral cues vs. emotional valenced cues vs. temporal word cues) may also contribute to differences in findings. Moreover, it is difficult to compare results from studies that only investigate one component of MTT (i.e. EM *or* EFT) and those that measure both components of MTT (i.e. EM *and* EFT). These differences in methodology, samples, and design mean we are limited in our understanding of the subjective experience of MTT in elevated anxiety. Nevertheless, the findings do suggest that it is important to consider differences in the phenomenological experience of MTT in anxiety.

The aims of this study were twofold. First, I aimed to replicate the results of the online study in a laboratory setting using a university/community sample, to determine whether in this context there is evidence of quantitative differences in MTT in people with elevated anxiety. Second, I aimed to determine whether there were differences in the subjective experience of MTT in individuals with elevated anxiety compared to individuals with nil anxiety or with anxiety in the normal range. I predicted that participants with elevated anxiety within the university sample would exhibit similar differences in the nature of MTT to that of the online MTurk sample. More specifically, it was expected that participants in the elevated anxiety group would have more overgeneral MTT and would provide proportionately fewer episodic details when

describing both past and future events. Further, I predicted that the reduction in episodic detail provided by individuals with elevated anxiety would be largest for positive events relative to negative and neutral events. In relation to hypotheses for the phenomenological experience ratings, I drew from the results of D'Argembeau et al., (2006) and Zermatten et al., (2008) who have investigated MTT in emotional suppression and individuals high in OCD traits. I predicted that for both past and future events individuals with elevated anxiety would rate their experience of vividness, pre-re/experiencing, sensory details, contextual details and emotional reaction as being lower than controls (D'Argembeau et al., 2006). Further, like OCD-trait individuals, I predicted that for negative past events, participants with elevated anxiety would rate these phenomenological experiences more highly than for neutral or positive past and future events (Zermatten et al., 2008). Consistent with the often reported positivity bias in MTT, I predicted that individuals in the nil anxiety group and normal range anxiety group would rate positive future thoughts as more vivid, containing more sensory details, with higher levels of pre-experiencing than negative future thoughts (D'Argembeau & Van Der Linden, 2004; D'Argembeau et al., 2011; De Vito, Neroni, Gamboz, Della Sala, & Brandimonte, 2015; Finnbogadóttir & Berntsen, 2011; Rasmussen & Berntsen, 2013; Wilson & Gilbert, 2005). It is important to note, that the predictions made regarding the phenomenological experience of individuals with elevated anxiety are based on the limited literature that exists from specific anxiety samples (i.e. social anxiety and OCD). It may be that the phenomenological experiences reported in these studies are disorder specific and our results may not replicate them.

Method

Participants

Participants (N=127) participants were recruited for the study. The majority of participants (n=85) were recruited though the first-year undergraduate psychology participation pool at the University of New South Wales and received course credit for their participation. Additional participants (n=42) were recruited though the university paid participant program, which is open to other students and community members. Community participants received $15 remuneration for their participation. The mean age was 20.6 years (SD = 5.4; range: 17-57). 57.4% were female. The ethnic composition of the sample was 43.3% Caucasian, 31.5% Asian, 25.1% other (Aboriginal/Torres Strait Islander, African, Arabic, Hispanic, Mixed). Participants were excluded if they did not speak English as a first language (n = 4) or if they scored 13 or higher (i.e. the clinical cut-off) on the depression subscale of the Depression Anxiety Stress Scale (DASS; Lovibond & Lovibond, 1995) (n = 9). The study was approved by the School of Psychology ethics committee at the University of New South Wales.

Materials

Participants completed the same test battery as Study 2 with three amendments made to the materials. First, the ACQs (attention capture questions) were removed from the experiment because ACQs are typically not necessary in laboratory-based experiments. Second, during the mAMT, the instructions asking participants to provide specific (personally relevant, bound within a 24-hour period) past or future events were included on *every* screen above the text entry box rather than just the beginning of the experiment. This amendment was made to reduce the high number of non-specific (i.e. categoric/intermediate, general) events provided by participants seen in the online

sample. Additionally, the order of event presentation was changed to ensure that if participants ran out of time during the experimental phase they had completed at least one of every type of event (i.e. past neutral, future neutral, past negative, future negative, past positive, future positive). The events were grouped into two blocks, and each block included each event type presented in random order. Finally, changes were made to the demographic questions so that they simply asked participants to provide ethnicity, gender, exact age and to confirm English as a first language. No other demographics were obtained.

Procedure

Participants were presented with a written and verbal description of the elements of experiment to be completed and were asked to provide informed consent. The instructions were presented verbally prior to starting the experiment. Participants were instructed they would be asked to either recall or imagine specific events in as much detail as possible. A specific event was described as personally relevant that happened/could happen within a 24-hr period and an example was provided to the participants (*i.e. "I imagine being in Thailand with my friend Lucy on holiday and we are doing a day trek, riding elephants through the mountains. This is a specific future event, whereas, I will go on holiday to Thailand for two weeks, is not specific as it is for longer than a single day").* Participants were instructed that they would be self-selecting word cues, and that they could use the cue words to "freely associate", that is, the event remembered or imagined did not have to directly relate to the word they selected. Participants were encouraged to spend between 1- 2 minutes describing each event, but no time restrictions were enforced (please see Appendix B for full instructions and self-selection). The test battery was completely computerized and presented in the same order as Study 2. Following verbal briefing, written instructions

on the computer at the beginning of computerized experiment were presented to confirm that participants understood the instructions. Participants were required to provide both verbal and written confirmation that they understood the instructions prior to commencing the task. Participants were given 1 hour to complete the experiment. After the participants finished they were verbally debriefed. Upon successful completion of the experiment, participants were either assigned course credit or paid $15 remuneration.

Scoring.

Overgenerality Scoring. The same coding protocol for Study 1 was used. A second independent rater blind to group membership and the hypotheses of the study coded 20% of the mAMT responses and high inter-rater reliability was achieved using intra-class correlations (Cronbach's α = .80).

Episodic Detail Scoring. The same coding protocol for Study 1 was used. A second independent rater blind to group membership and the hypotheses of the study coded 20% of the mAMT responses. Scorer inter-rater reliability using intra-class correlations was high for internal details (Cronbach's α =.94) and external details (Cronbach's α =.88).

Phenomenological Scoring. Participants rated their memories and future events on several 7-point Likert rating scales, adapted from the literature (Berntsen & Bohn, 2010; D'Argembeau & Van Der Linden, 2004; Johnson et al., 1988). Past events and future events were rated on 12 separate scales which asked for ratings related to event vividness, feeling of re/pre-experiencing, sensory details, contextual details, perspective the event was experienced (observer or field), emotional reaction to the event, importance of event and event coherence (see Appendix B for specific questions).

Before conducting analyses, the individual ratings for visual details, sounds, smells and taste were averaged into a sensory detail measure (e.g. D'Argembeau et al., 2006; Suengas & Johnson, 1988). Similarly, items regarding the clarity of location and clarity of spatial arrangement of objects were averaged to produce a combined contextual details rating for each event. A ratio rating for perspective was created by dividing the results for the two perspective scales including "seen through my own eyes" and "as if I was a fly on the wall" to determine whether field or observer perspective was experienced; higher ratings indicated field perspective and lower ratings indicated observer perspective. A combined reaction score was created by averaging the ratings for intensity and physical reactions. All phenomenological ratings were then averaged across each event type such that each participant had a single phenomenological rating for vividness, feeling of re/pre-experiencing, sensory details, contextual details, perspective, emotional reaction, importance and coherence for each event type (i.e. past neutral, past positive, past negative, future neutral, future negative, future positive).

Analyses

The same Pearson correlations between the DASS anxiety subscale and the PSWQ used in Study 2 to validate the use of the anxiety subscale to assign participants to groups was conducted. Chi-squared analyses were also conducted to ensure that the frequency of demographic characteristics did not differ as a function of group.

Separate 2 (condition: Past, Future) X 3 (Valence: Neutral, Negative, Positive) X 3 (Group: Nil Range, Normal Range, Elevated Range) mixed design ANOVAs were conducted for analysis of overgenerality, episodic detail and for each phenomenological rating. Note that for ANOVA, if the assumption of sphericity was violated (as indicated by a Greenhouse–Geisser estimate of sphericity, epsilon, of less than .90), the degrees of freedom were adjusted using Greenhouse– Geisser correction (Geisser &

Greenhouse, 1958). Effect sizes of ANOVAs were expressed in partial eta squared (η_p^2) and values of .02, .13, and .26 were considered small, medium and large effects respectively (Cohen, 1988). Interactions were followed up using paired-sample and independent-sample t-tests. Effect sizes of independent samples t-tests were expressed in Cohen's d (*d*) and values of .20, .50 and .80 were considered small, medium and large effects respectively (Cohen, 1988).

Results

Participant Characteristics

Scores on anxiety subscale of the DASS were strongly correlated with scores on the PSWQ (r =.41, *p* =.27). As the DASS anxiety subscale showed good convergent validity, it was used to assign participants to three groups (nil, normal, elevated anxiety) using the same subscale score cut-offs as Study 2. A total of 22 participants were assigned to the nil anxiety group (13 female, 9 male). The normal range anxiety group consisted of a total of 74 participants (40 female, 34 male) and the elevated anxiety group consisted of a total of 18 participants (13 female, 5 male).

Chi-square analysis of group demographics indicated there were no difference in the distribution of gender χ^2 (2, N =114) = 1.98, *p* = .37. Chi-squared analysis was not conducted on ethnicity as a number of expected frequencies were less than five, (Yates, Moore & McCabe, 1999). Further participants reported exact age rather than an age category (i.e. 18-45/45+) therefore a one way ANOVA was conducted. There was no difference in the mean age of participants in each group, *F* (17,113) = 1.0, *p* =.47.

Overgenerality Analysis

For overgenerality analysis, a mixed design ANOVA using the dummy-coded overgenerality scores ranging from 2 to 6 was conducted to determine whether there was any difference in the overgenerality of events that participants produced as a

function of temporal direction (past/future), emotional valence instruction (no instruction, positive, negative) and group (nil, normal, elevated). Similar to Study 2, gender was included as a covariate.

There were no observed main effects of temporal direction F (1, 110) = 1.67, p = .23, η_p^2 = .01, emotional valence F (2, 220) = 1.04, p = .36, η_p^2 = .01 or group F (2, 110) = 1.728, p = .18, η_p^2 = .03. Additionally, there were no observed interactions (all ps > .05).

Episodic Detail Analysis

Missing Values and Data Replacement for Episodic Detail Analysis. Despite additional instructions about the importance of providing specific events, a large proportion of events provided were still identified as categoric/intermediate or general. Only 75 participants (66%) completed the experiment and generated events that were all identified as specific. The same missing imputation procedure used in Study 1 and Study 2 was conducted for this data set. After missing data imputations were conducted all 114 participants were included in the episodic detail analysis.

Repeated Measures ANOVA Analysis for Episodic Detail. For the episodic detail analysis, a mixed design ANOVA was conducted to determine whether there was any difference in the proportion of episodic details that participants produced as a function of temporal direction (past/future), emotional valence instruction (no instruction, positive, negative) and group (nil, normal, elevated). Gender was included as a covariate.

Like the overgenerality analysis in this study, there were no observed main effects of temporal direction F (1, 110) = 1.16, p = .28, η_p^2 = .01, emotional valence F (2, 220) = .115, p = .90, η_p^2 < .00 or group F (2, 110) = 1.53, p = .22, η_p^2 = .03. Additionally, there were no observed interactions (all ps > .05).

Phenomenological Analysis

For the phenomenological analysis, separate mixed design ANOVAs were conducted for each phenomenological rating (vividness, feeling of re/pre-experiencing, sensory details, contextual details, perspective, emotional reaction, importance and coherence) to determine whether there was any difference in the subjective experience of the events that participants produced as a function of temporal direction (past/future), emotional valence instruction (no instruction, positive, negative) and group (nil, normal, elevated). Gender was included as a covariate.

Vividness. A main effect of temporal direction was found for self-report ratings of vividness, F (1,108) = 3.83, p = .05, η_p^2 = .03. Across groups and emotional valence instruction, past events were rated as more vivid than future events (see Figure 9). There was also a significant main effect of group, F (2,108) = 3.49, p = .03, η_p^2 = .06. Individuals in the elevated anxiety group reported events to be less vivid compared to individuals with nil anxiety (t (35) = 2.50, p = .02, d = .85). However, there was no difference in ratings of vividness between individuals in the elevated and normal anxiety group, or between the normal anxiety and nil anxiety group (t (89) = 1.39, p = .17, d =.29; t (96) = 1.68, p = .10, d =.34 respectively) (see Figure 10). Further, there was a main effect of gender, F (1,108) = 6.09, p = .02, η_p^2 = .05, with women rating their events as more vivid than men (t (111) = -2.29, p = .02, d =-.43). There were no other main effects or interactions for vividness (all ps > .05).

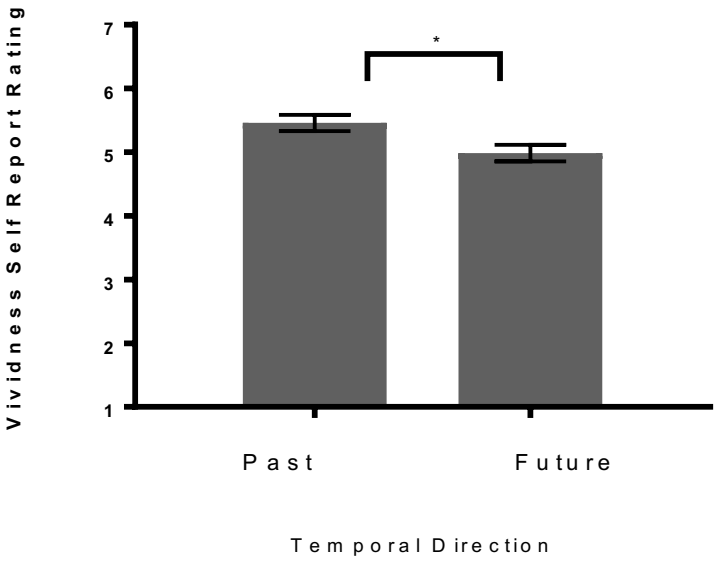

Figure 9. Mean (+SEM) Vividness self-report ratings in each temporal direction, collapsed across group and emotional valence instruction

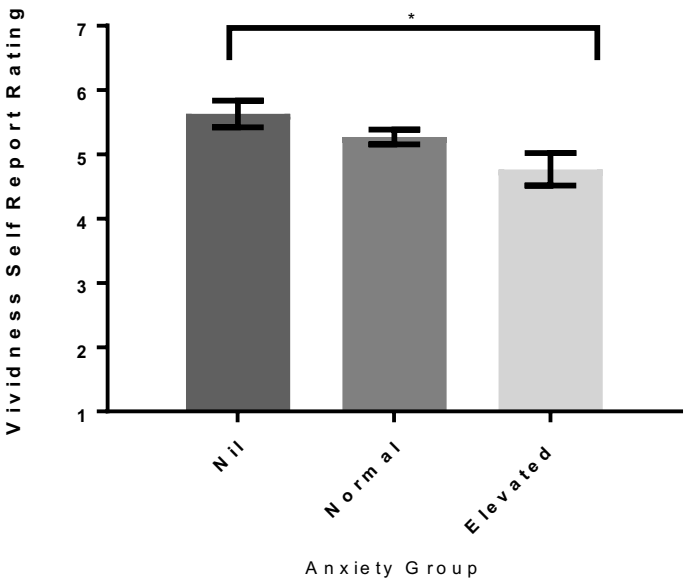

Figure 10. Mean (+SEM) Vividness self-report ratings produced by participants in each group, collapsed across temporal direction and emotional valence instruction

Pre-Re/Experiencing. There were no main effects or interactions for self-report ratings of pre-re/experiencing (all *ps* > .05).

Sensory Details. There were no main effects or interactions for self-report ratings of sensory details (all *ps* > .05).

Contextual Details. There were no main effects for self-report ratings of contextual details. However, there was a significant interaction between temporal direction and group, F (2,108) = 4.0, p = .02, η_p^2 = .07, that was qualified by a three-way interaction between temporal direction, group and emotional valence, F (4,216) = 2.27, p =.06, η_p^2 = .04 (see Figure 11). Separate paired sample t-tests were conducted for each group. For both past and future events, individuals with the nil anxiety reported no differences in the contextual detail ratings across the three levels of emotional valence instruction (all *ps* > .05). For individuals in the normal range anxiety group, the same was true for past events (all *ps* > .05). However, for future events, neutral events were rated as having significantly more contextual details than positive and negative events (t (76) = 2.35, p = .02; t (75) = 2.75, p <.00 respectively) yet positive and negative events did not differ from each other (t (75) = -.78, p = .43). For individuals in the elevated anxiety group, there were no significant differences in ratings of contextual detail in future events across the three levels of emotional valence instruction (all *ps* >.05). However, past negative events were reported as containing fewer contextual details than both positive or neutral events (t (15) = -2.93, p = .01; t (15) = -2.26, p = .04 respectively); yet there was no difference in past positive and neutral events (t (15) = .00, p = 1).

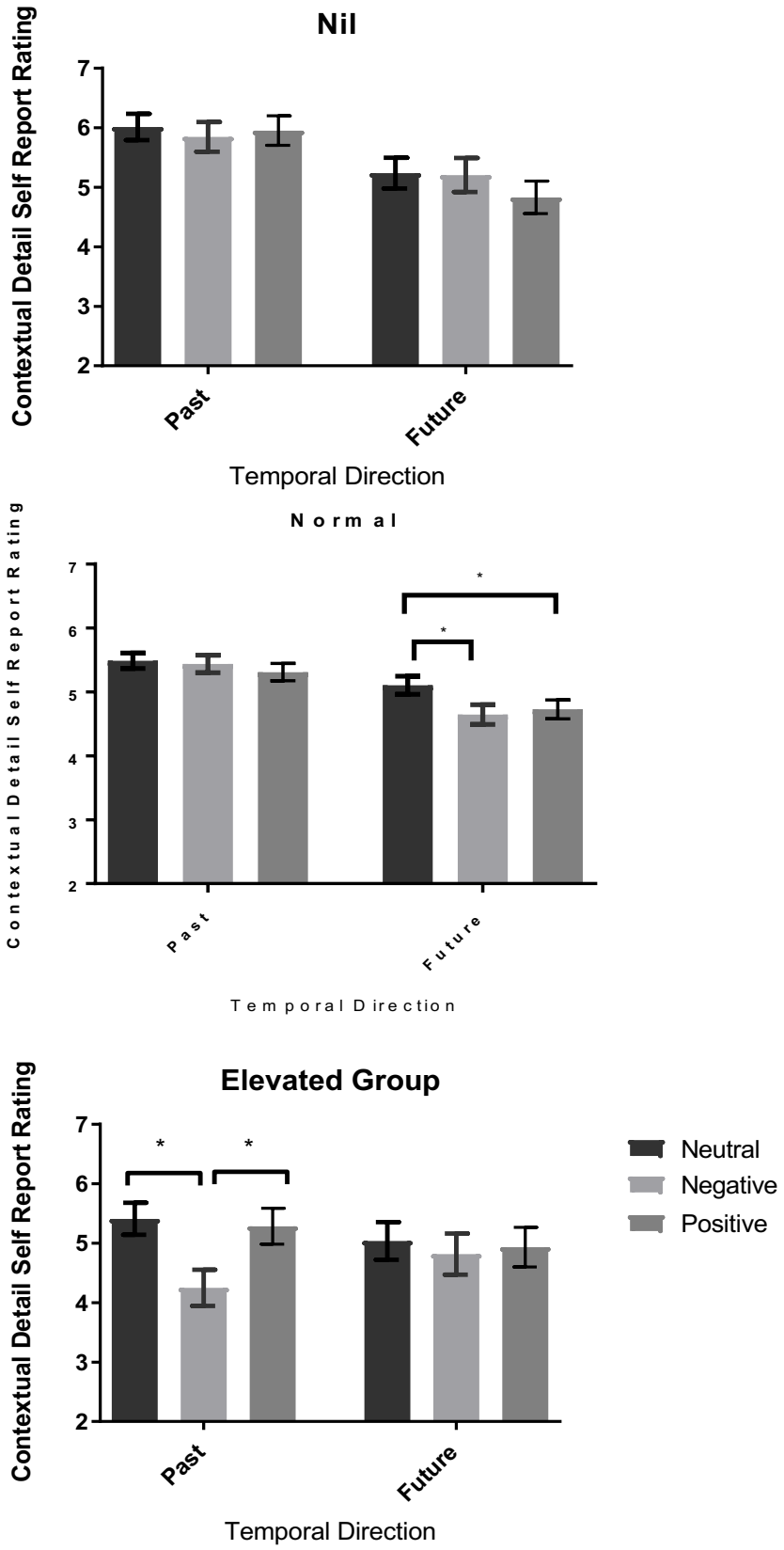

Figure 11. Mean (+SEM) contextual detail self-report rating as a function of temporal direction and emotional valence produced by each group

Perspective. Ratings for perspective were based on a ratio calculated by dividing field perspective ratings ("seen through my own eyes") by observer perspective ratings ("like a fly on the wall"). Ratios greater than 1 indicated higher field ratings than observer ratings. There was a main effect of temporal direction for self-report ratings of perspective, F (1,108) = 10.43, $p < .00$, $\eta_p^2 = .09$. Across groups and emotional valence instruction, the extent which participants rated events from a field perspective was greater for past events (see Figure 12). There were no other main effects or interactions for perspective self-report ratings (all *ps* > .05).

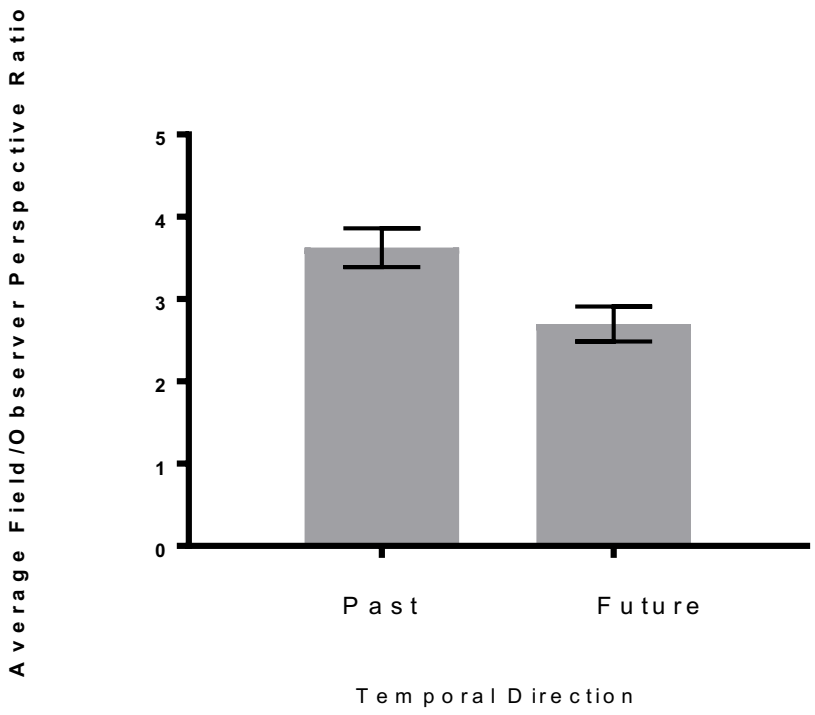

Figure 12. Mean (+SEM) perspective ratio self-report ratings in each temporal direction, collapsed across group and emotional valence instruction

Reaction. There was a significant main effect of group for self-report ratings of reaction, F (2,108) = 5.24, $p < .00$, $\eta_p^2 = .09$. This was qualified by a group x temporal direction interaction F (2,108) = 6.11, $p = .00$, $\eta_p^2 = .10$ (see Figure 13). Individuals in the

elevated anxiety group reported significantly greater emotional reaction to events in the past compared to individuals in the nil anxiety group and normal anxiety group (t (36) = 2.16, p = .04, d =.72; t (91) = 2.17, p =.03; d =.45 respectively). Those in the elevated anxiety group also reported significantly more emotional reaction to events in the future compared to individuals in the nil anxiety group and normal anxiety group (t (35) = 3.7, p < .00, d = 1.3; t (89) = 4.00, p <.00, d = .85 respectively). However, there were no significant difference in the self-report reaction scores between those in the nil and normal anxiety group for past or future events (t (97) = -.27, p = .79, d =-.05; t (96) = .08, p =.93, d = .01 respectively). Further, there were no other main effects or interactions for reaction self-report ratings (all ps > .05).

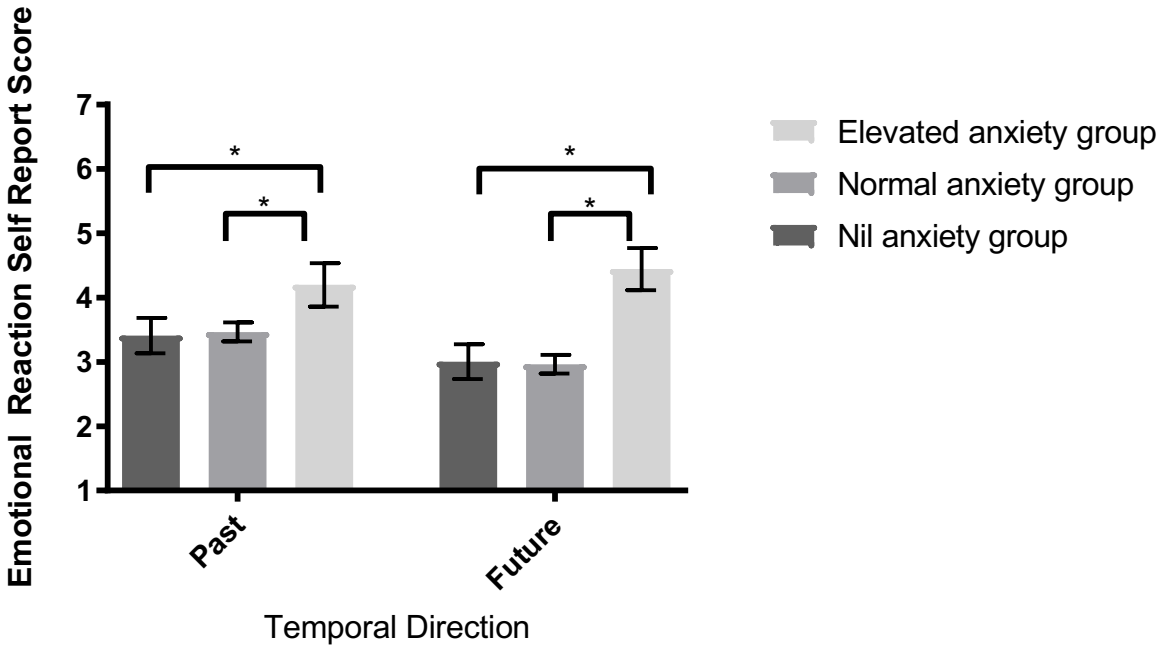

Figure 13. Mean (+SEM) self-report ratings for emotional reaction in each temporal direction produced by each group, collapsed across emotional valence instruction

Importance. There was a main effect of emotional valence instruction for self-report ratings of importance, F (2,216) = 4.0, p = .02, η_p^2 = .04 (see Figure 14). Positive events were rated as significantly more important than neutral events (t (114) = -2.96, p < .00) and

negative events (t (112) = -6.22, p < .00). Neutral events were rated as more important than negative events (t (112) = 2.72, p < .00).

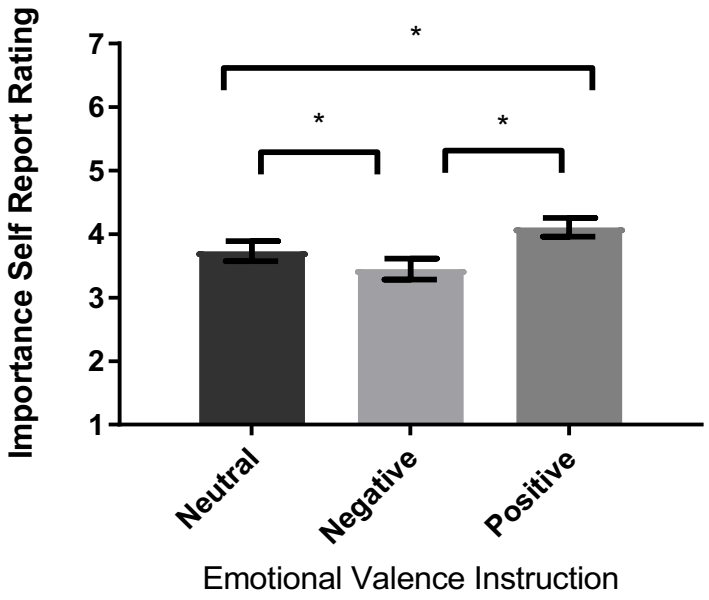

Figure 14. Mean (+SEM) importance self-report ratings as a function of emotional valence instruction, collapsed across group and temporal direction

Discussion

This study investigated whether individuals with elevated levels of anxiety would exhibit differences in overgenerality and episodic detail in MTT compared to individuals with nil and normal anxiety levels, when tested in a laboratory setting. Further, it extended the research conducted online and reported in Chapter 3 by investigating whether the subjective experience of MTT differs as a function of anxiety symptomology.

I expected that participants in the elevated anxiety group would have more overgeneral MTT and would provide proportionately fewer episodic details in both temporal directions reflecting the results obtained in the online study. Further, I predicted that reduction in episodic detail in individuals with elevated anxiety would be largest for positive events relative to negative and neutral events. Contrary to my hypotheses, I did not replicate

the differences in MTT seen in the online MTurk sample in the university sample. In the university sample in fact, there were no differences in the overgenerality or episodic detail between nil, normal and elevated anxiety groups. Additionally, I did not replicate previous research that has found that past events are more specific in nature than future events (Addis et al., 2008; 2009; Anderson, Boland & Garner, 2015; Brown et al., 2013; Williams et al., 1999). Rather, I found no main effects of temporal direction in specificity or episodic detail analysis. Nor did I replicate the findings from previous research that has demonstrated differences in the overgenerality and episodic detail as a function of emotional valence (Holland & Kensinger, 2010; Mickley & Kensinger, 2009). Rather, there were no main effects of emotional valence.

The inconsistency in results between this study and Study 2 are somewhat surprising. One explanation is that the methodological amendments made to the testing protocol reminding participants to produce specific and detailed events on every screen impacted group differences. Previous research has shown that manipulating the instructions can impact the specificity of events (Williams et al., 1996); providing minimal instructions can increase the sensitivity with which the AMT task is able to detect reductions in memory specificity in non-clinical samples (Debeer, Hermans & Raes, 2009). Thus, specifically asking and reminding participants to be as specific and detailed as possible for each event (presented on every screen) is likely to have affected the results. The methodological amendments to the instructions may also explain why I did not replicate temporal and emotional valence differences typically seen in both healthy and clinical samples (Addis et al., 2008; 2010; 2016; Anderson et al., 2015; Anderson & Evans, 2015; Holland & Kensinger, 2010; Holmes et al., 2008; Mickley & Kensinger, 2009; St. Jacques & Levine, 2007; Williams et al., 1996). However, it is more likely that sample characteristics can explain the difference between Study 2 and Study 3. For instance, research has shown that MTurk workers differ from the

general population in that they present with a greater range of psychological symptomology, including social anxiety than traditional community samples (Arditte et al., 2016). In addition, anxiety symptomology may not have been sufficiently elevated in the university sample to detect MTT differences using the objective measures. On closer inspection of the anxiety subscale scores of the DASS (Lovibond & Lovibond, 1995), 22% of participants in elevated anxiety group within the university sample scored above a 12 on the anxiety subscale, whereas in the MTurk sample 30% scored above a 12 on the anxiety subscale. The elevation in reported symptom severity observed in the MTurk sample may have contributed to the observed differences in overgenerality and episodic detail. It is likely that the results seen in the MTurk sample are more representative of outcomes we would expect in a clinical anxiety group than are the results of the university sample.

When thinking about the future, individuals who regularly use suppression strategies rate report reductions in a number of phenomenological experiences (i.e. pre/experiencing, visual detail, contextual detail and emotional reaction) when thinking about the past and the future, relative to individuals who do not engage in suppression strategies (D'Argembeau & Van der Linden, 2006). My hypotheses that individuals in the elevated anxiety groups would similarly report lower phenomenological ratings for several measures including vividness, pre/re-experiencing, sensory details, contextual details and emotional reaction relative to individuals in the control groups (nil and normal anxiety groups) were somewhat supported. Individuals in the elevated anxiety group reported lower levels of vividness than those in the nil anxiety group, but did not differ significantly from individuals in the normal anxiety range. For contextual details, reductions in ratings were observed for individuals reporting any anxiety (normal range or elevated) compared to those with nil anxiety, however the effect was dependent on temporal direction and emotional valence. Those with normal levels of anxiety reported fewer contextual details for future emotionally valenced events (both

positive and negative), whereas those with elevated anxiety reported fewer contextual details for past negative events. In contrast to hypotheses, there were no differences between groups for pre/re-experiencing of events or reported levels of sensory details, nor were there differences for ratings of coherence, perspective or importance. Further, the emotional reaction ratings for individuals within the elevated anxiety range were in the opposite direction to predictions, with both past and future events being rated as causing *more* emotional reaction than individuals in the nil and normal range anxiety groups.

The variability in phenomenological differences between anxiety groups is somewhat characteristic of this literature. For instance, consistent with MTT research in individuals with high levels of worry (Finnbogadóttir & Berntsen, 2013) and in individuals with high trait anxiety (D'Argembeau et al., 2003) in this study I did not see group differences in ratings of pre/re-experiencing, sensory details, coherence and perspective. However, these findings are inconsistent with other studies using participants who engage in emotional suppression and those with OCD traits (D'Argembeau & Van der Linden, 2006; Zermatten, 2008). Methodological differences in eliciting past and future events, in addition to sample selection are likely to have contributed to the inconsistent findings. Therefore, clarification of phenomenological differences in a clinical anxiety group is needed.

Previous research in individuals with OCD traits has shown that phenomenological ratings are higher for negative events (Zermatten et al., 2008). I therefore predicted that differences in phenomenological experience of MTT would be more marked for negative events in individuals with anxiety. In contrast, the results of Study 3 showed that the effect of anxiety on phenomenological ratings did not differ as a function of emotion valence instruction. The only exception was for ratings of contextual detail. I expected participants with anxiety to report greater contextual details for negative events irrespective of temporal direction of the event. However, individuals with normal levels of anxiety rated their future

positive and negative events as having lower levels of contextual details than neutral events, an effect not seen for past events. Whereas individuals with elevated anxiety reported fewer contextual details for past negative events than positive or neutral events relative to those with nil or normal levels of anxiety.

The variable results across increasing anxiety levels for phenomenological contextual ratings is perplexing. The normal range group report a different pattern of contextual detail ratings to those in the elevated anxiety group, yet there were no observed differences between these groups in the objective scores of overgenerality or episodic detail. While there is insufficient information at present to draw significant conclusions, or to make inferences as to why this may be the case, the results do highlight the potential for dissociations between subjective and objective findings that vary according to the level of anxiety experienced. Consequently, differences in the perceived experience of contextual details in MTT in anxiety is an interesting line of enquiry for future research given that contextual information for spatial details and scene construction is a key element in successful MTT (Hassabis & Maguire, 2011).

Finally, in line with previous research from several healthy and sub-clinical samples, I predicted that individuals in the nil anxiety and normal range anxiety groups would rate positive future thoughts as more vivid, containing more sensory details, with higher levels of pre-experiencing than negative or neutral future thoughts (D'Argembeau et al., 2003; D'Argembeau & Van der Linden, 2004; D'Argembeau et al., 2011; De Vito et al., 2015). The results did not support this hypothesis. There is some suggestion that the *emotional intensity* of the event rather than emotional valence of the event may impact on the phenomenological ratings (Talarico, LaBar & Rubin, 2004). Therefore, it is possible that the emotional valence instructions were simply insufficient to illicit differences in the emotional intensity of events in the current university sample. Future research could replicate the current study

incorporating amended instructions requesting participants generate events that they would rate above an identified threshold of emotional intensity (i.e. 4+ on a Likert-scale) to ensure that a strong emotional response is occurring prior to investigating differences as a function of emotional valence.

In sum, this study aimed to replicate the results produced in Study 2 in a sub-clinical community sample, and extend the findings by investigating the qualitative nature of MTT produced by those with varying levels of anxiety in a sub-clinical sample. While I found no group differences in specificity and detail ratings, there were significant differences in the phenomenological ratings of vividness, emotional reaction, and context. Individuals with elevated anxiety perceived their MTT as less vivid, with fewer contextual details, particularly for past negative events, and reported more emotional reaction, relative to controls. These results indicate that there may be differences in the subjective experience of MTT even in the absence of objective differences. It may be that it is not the number of episodic details nor overgenerality per se that contributes to impairment in MTT in individuals with anxiety, but rather differences in the perceived qualities of their subjective experience, a possibility that deserves further exploration in a clinical sample. Accordingly based on the results of objective differences in Study 2 and the phenomenological results in Study 3, investigating the nuanced profile of MTT in individuals with clinical levels of anxiety was warranted.

CHAPTER 5

Study 4

Mental Time Travel in the Clinically Anxious

Researchers suggest that MTT contributes to individual differences in well-being and psychological distress (Gilbert & Wilson, 2007). Everyday tasks such as managing finances, food preparation and shopping rely on the episodic future thinking (Suddendorf & Henry, 2013). Some theorists go further and argue that the future thinking component of MTT allows humans to modulate current behaviour to avoid threats, reduce possible future risk, help facilitate goal attainment and improve individual mechanisms of coping, which in turn promote present and future wellbeing (Addis et al., 2007; Baumgartner et al., 2008; Miloyan et al., 2014; Schacter et al., 2012; Suddendorf, Addis, & Corballis, 2011; Suddendorf & Corballis, 2007a; 2007b; Suddendorf & Moore, 2011).

Evidence for the link between MTT and wellbeing comes from studies of clinical populations. MTT investigations in older aged adults (Addis et al., 2008), people with autism (Lind & Bowler, 2008; Lind & Bowler, 2010; Lind, Williams, Bowler, & Peel, 2014), people with schizophrenia (D'Argembeau et al., 2008), those who are clinically depressed (Williams et al., 1996) and those with prolonged grief (MacCallum & Bryant, 2011) have demonstrated both impaired episodic memory and impaired episodic future thought. For example, in depression, cue word paradigms have been used to show a link between reduced specificity of episodic memory and the production of non-specific future events (Watson, Berntsen, Kuyken & Watkins, 2012; 2013; Williams et al., 1996; Williams et al., 2007). Overgeneral memory in depression has been associated with impaired problem solving (Raes et al., 2005) and delayed recovery from depression (Dalgleish et al., 2001). In addition to reporting fewer specific events, MTT in individuals with clinical disorders also differs from healthy controls in the predominance of pessimism for the future, altered phenomenological experience (e.g

reduced sensory details) and the increased inclusion of disorder-related content (D'Argembeau et al., 2004; D'Argembeau et al., 2008; MacCallum & Bryant, 2011; Williams et al., 2007). It is possible that these MTT differences account for the reduced preparatory behaviour, poor planning and poor problem solving seen in clinical disorders (Lyons et al., 2015; Miranda & Mennin, 2007; Strunk et al., 2006). Importantly while a lot of research has looked at the MTT ability in depression, schizophrenia, and aging, relatively little work has looked at MTT in anxiety, with only three studies to date investigating both past and future thinking within an anxiety sample (Brown et al., 2013; 2014; Sansom-Daly et al., 2014). Yet, anxiety disorders are some of the most prevalent psychological disorders today (Baxter et al., 2013) and are largely characterized by maladaptive thoughts about the future.

The previous studies within this thesis provided evidence for both objective and subjective differences in MTT related to elevated levels of anxiety. In an online population, individuals with elevated anxiety produced more overgeneral MTT and proportionately fewer episodic details when describing both past and future events, with the greatest reduction in episodic detail observed for positive events relative to negative and neutral events (Chapter 3). However, differences in objective measures between individuals with elevated levels of anxiety and controls were not replicated in a sub-clinical university sample. Yet, within the sub-clinical university sample phenomenological differences were observed, with individuals exhibiting elevated levels anxiety reporting reduced ratings of vividness, pre/re-experiencing and contextual details for past events (Chapter 4). As discussed in Chapter 4, the online sample may be more reflective of individuals with clinical levels of anxiety than that of the university sample. Thus, replication of the current research in a clinical group within a laboratory setting is necessary. Further, the differences observed in the phenomenological outcomes of those with sub-clinical levels of anxiety in the university/community sample

highlights that the perceived qualities of MTT also requires exploration in a clinical population. It is important to clarify whether individuals with clinical levels of anxiety have both objective and subjective differences in their MTT, or if there is a dissociation between the objective and subjective experience of MTT.

In extending the results from the MTurk and sub-clinical studies reported in Chapters 3 and 4, it was critical to adopt a transdiagnostic perspective. There is significant overlap among different anxiety disorders in terms of comorbidity, genetic framework, and treatment response (Kendler, 1996; Kessler et al., 2005; Newby et al., 2015). In Axis-I anxiety disorders, comorbidity rates range from 40 - 80%, with the majority of individuals with a principal anxiety diagnosis also having a secondary anxiety diagnosis (Brown, Campbell, Lehman, Grisham & Mancill, 2001; Kessler et al., 2005). The disorders have similar cognitive, affective, interpersonal and behavioural maintaining factors, with the major difference observed largely in the content of the threat (Mansell, Harvey, Watkins & Shafran, 2008). As such, there is a considerable push for transdiagnostic research and treatment designed for diagnostically mixed samples (Brown & Barlow, 2009; Chamberlain & Norton, 2013; Martin, Ressler, Binder, & Nemeroff, 2010; Norton & Philipp, 2008). Yet most research, including future thinking research, is still conducted on disorder specific samples. Shifting towards a transdiagnostic approach in MTT research by including all participants meeting criteria for any Axis I anxiety disorder according to the DSM-V and ICD-10 within the current study, will contribute to the growing body of evidence focusing on the common and core maladaptive processes that underpin anxiety presentations (Harvey, 2004). It will also help move potential treatment towards a dimensional trait/symptom focused approach (Barlow, Allen & Choate, 2004). Such a shift is essential for future anxiety treatments, increasing efficiency and efficacy in treatment, and increasing ease of implementation

(Chorpita, Taylor, Francis, Moffitt & Austin, 2004; Newby et al., 2015; Reinholt & Krogh, 2014).

I aimed to determine whether individuals with an anxiety disorder exhibit overgeneral episodic future thinking by analysing the level of detail provided in memory and future event narratives, along with the participants' phenomenological experience, relative to healthy controls. As in the previous study I combined both objective coding (overgeneral scoring and detail scoring) and subjective ratings (phenomenological) to provide a richer understanding of future thinking in anxiety disorders. To my knowledge, there is only one research group that has combined more than one objective measure (overgenerality scoring and level of detail scoring) of MTT in PTSD (see Brown et al., 2013; 2014) and there is no research combining both overgeneral and detail objective measures, and subjective experience ratings. I took a transdiagnostic approach, including any individual who met criteria for an anxiety disorder, while excluding anyone who also met criteria for depression. This approach allowed me to determine whether MTT impairments associated with anxiety were unique or similar to other clinical disorders.

My hypotheses were threefold. First, I expected that in line with the findings of Study 2, individuals with an anxiety disorder would have more overgeneral MTT and would provide proportionately fewer episodic details when describing both past events and future events. Second, I expected that the reduction in episodic detail in the clinical group would be largest for positive events relative to negative and neutral events. Third, consistent with the findings from Study 3, I expected that individuals with an anxiety disorder would rate their subjective experience of MTT differently to those in the control group. More specifically, those with an anxiety disorder were expected to report reductions in vividness across all conditions and reductions in contextual details for past negative events. Further, it was

predicted that the reported levels of emotional reaction would be higher for those with an anxiety disorder relative to controls.

Method

Participants

Participants (N=43) were adults recruited from the University of NSW paid participant pool and from the Sydney community via advertisements in the local area paper. Anxiety group participants were recruited using advertising materials seeking individuals with an anxiety disorder. A pre-screen phone call was completed to determine eligibility. Participants were eligible if English was their first language, they had no history of head trauma, no history of schizophrenia, no history of a substance use disorder and were not currently experiencing a Major Depressive Episode. Eligible participants were invited to the laboratory where they provided written informed consent. A provisionally-registered clinical psychologist conducted the Anxiety Disorder Interview Schedule for DSM-IV (ADIS-IV; Di Nardo, Brown, & Barlow, 1994) with all potential participants to determine the presence of an Axis-I anxiety disorder and to screen for current Major Depressive Episode (MDE) or the presence of another psychiatric disorder. Individuals were excluded and debriefed if they met criteria for MDE or another psychiatric disorder.

Twenty participants met DSM-IV criteria for an anxiety disorder, and twenty-three did not. Participants ranged in age from 20 to 82 years of age; there were no group differences in ethnic composition χ^2 (2, N – 43) = 3.89, p = .14; there were significant differences in the gender distribution across groups with a higher percentage of women in the anxiety group χ^2 (1, N – 43) = 6.70, p = .01. 47% of all participants were female, with 70% female group composition for the anxiety group. Epidemiological studies have demonstrated that prevalence of anxiety disorders is higher in women with a prevalence male: female ratio

of 1:1.7 (McLean, Asnaani, Litz & Hofmann, 2011). See Table 5 for demographic characteristics.

Table 5.

Demographic characteristics of participants with an Anxiety disorder and healthy control participants in Study 4

	Anxiety	**Control**	**Total sample**
n	20	23	43
Age	37 (13.6)	30 (13.1)	33 (13.7)
% Female	70.0	26.0	48.9
PSWQ	44.0 (12.8)	35.0 (8.0)	
Depression Subscale (DASS)	11.0 (4.7)	7.7 (1.6)	
Anxiety Subscale (DASS)	9.4 (3.8)	8.2 (1.9)	

30.2% Caucasian, 58.1% Asian, 11.6% Other

N.B. Standard deviations are presented in parentheses. Controls – healthy participants; Anxiety – participants with Axis-I anxiety diagnosis. The anxiety group had higher scores on the Penn State Worry Questionnaire (PSWQ) than did controls ($t(1,41) = 2.74$, $p < .00$, $d = .85$). Anxiety participants also scored higher on depression scales of the Depression Anxiety Stress Subscale (DASS) than controls ($t(1,41)$ 3.11, $p < .00$, $d = .97$); however, participants did not meet criteria for clinical levels of depression using the ADIS.

Materials

Participants completed the same test battery as Study 3 with the addition of the clinical diagnostic interview (ADIS-IV; Di Nardo, Brown & Barlow, 1994) to screen for the presence of an anxiety disorder.

The Anxiety and Related Disorders Interview Schedule Fourth Edition. (Di Nardo, Brown & Barlow, 1994) a gold-standard semi-structured, clinician administered diagnostic interview that assesses for the presence of anxiety related psychological disorders according to the DSM-IV. A provisionally registered psychologist conducted the interview. Additionally, a trained assistant was present for 75% of interviews to allow for diagnosis reliability coding. There was 100% consistency in diagnoses made between interviewer and assistant.

Procedure

Informed consent was obtained after participants were presented with a written description of the elements of the experiment to be completed including the clinical assessment interview and were verbally briefed. The clinical assessment was counterbalanced such that it was conducted either before or after the experimental phase of the study. The experimental phase was identical to Study 3. Participants were given 1 hour to complete the experimental task and 1 hour to complete the diagnostic interview. Upon completion of the interview and the experimental task, the experimenter verbally debriefed participants and paid them $40 remuneration.

Scoring.

Overgenerality Scoring. The same coding protocol for Study 2 was used. A second independent rater blind to group membership and the hypotheses of the study coded 20% of the mAMT responses and adequate inter-rater reliability was achieved using intra-class correlations (Cronbach's α = .73).

Episodic Detail Scoring. The same coding protocol for Study 1 was used. A second independent rater blind to group membership and the hypotheses of the study coded 20%. Scorer inter-rater reliability using intra-class correlations was high for internal details (Cronbach's α =.95) and external details (Cronbach's α =.84).

Phenomenological Scoring. The same phenomenological scoring procedure conducted in Study 3 was used.

Analyses

Separate 2 (Temporal Direction: Past, Future) x 3 (Instructional Valence: Neutral, Negative, Positive) x 2 (Group: Anxiety, Control) repeated measures ANOVAs were conducted for analysis of overgenerality, episodic detail and for each phenomenological rating. Note that for ANOVA, if the assumption of sphericity was violated (as indicated by a Greenhouse–Geisser estimate of sphericity, epsilon, of less than .90), the degrees of freedom were adjusted using Greenhouse– Geisser correction (Geisser & Greenhouse, 1958). Effect sizes of ANOVAs were expressed in partial eta squared (η_p^2) and values of .02, .13, and .26 were considered small, medium and large effects respectively (Cohen, 1988). Interactions were followed up using paired-sample and independent-sample t-tests. Effect sizes of independent samples t-tests were expressed in Cohen's d (*d*) and values of .20, .50 and .80 were considered small, medium and large effects respectively (Cohen, 1988).

Results

Participant Characteristics

Those who did not complete the experiment or those who exhibited poor language comprehension or failure to understand instructions were excluded from the final analysis. A total of twenty control and fourteen clinical participants were included in analysis (see Figure

15). The demographic information of those included in the final analysis is included in Table 6. The co-morbidity of anxiety diagnosis is presented in Table 7.

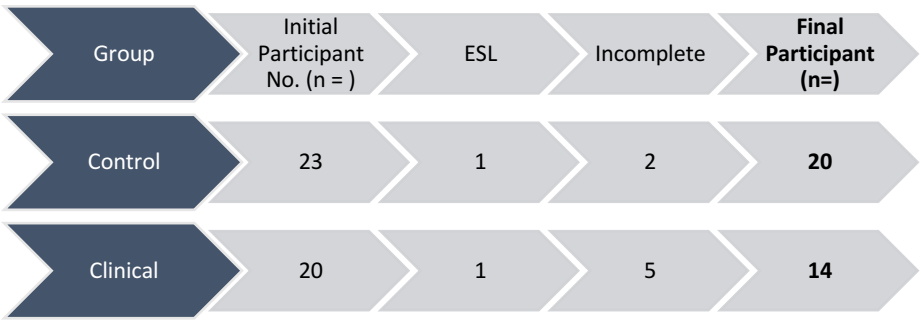

Figure 15. Participant attrition prior to final analysis

Table 6.

Demographic characteristics of participants with an Anxiety disorder and healthy control participants used in the final analysis of Study 4

	Anxiety	Control	Total sample
n	14	20	40
Age	37.5 (14.0)	25.9 (3.7)	30.7 (10.9)
% Female	78.5	28.6	44.1
PSWQ	47.4 (12.5)	36.5 (7.7)	
Depression Subscale (DASS)	11.9 (5.0)	7.5 (2.0)	
Anxiety Subscale (DASS)	9.9 (4.2)	7.7 (2.5)	

27.3% Caucasian, 54.5% Asian, 12.1% Other

N.B. Standard deviations are presented in parentheses. Controls – healthy participants; Anxiety – participants with Axis-I anxiety diagnosis. There was a significant difference in the gender distribution across groups with a higher percentage of women in the anxiety group (χ^2 *(1, N –34) = 9.49, p < .01). The anxiety group were significantly older than the controls (t(1,32) = 3.57, p <.01, d = 1.14). The anxiety group had higher scores on the Penn State Worry Questionnaire (PSWQ) than did controls (t(1,31) = -3.67, p <.01, d = 1.25). Anxiety participants also scored higher on depression scales of the Depression Anxiety Stress*

Subscale (DASS) than controls (t (1,31) -3.37, p <.01, d =1.08); however, participants did not meet criteria for clinical levels of depression on the ADIS.

Table 7.

Clinical diagnoses according to the DSM-IV criteria for those in the anxiety group in Study 4

Participant	**Clinical Diagnoses**
1	OCD / GAD / Social Anxiety / Separation Anxiety / Specific Phobia /Illness Anxiety
2	Social Anxiety
3	Panic /GAD/ Specific Phobia / PTSD / OCD
4	Agoraphobia
5	Panic with Agoraphobia / GAD
6	Panic with Agoraphobia / PTSD / Social Anxiety / GAD /Specific Phobia
7	Specific Phobia
8	Specific Phobia / Panic with Agoraphobia / GAD
9	Specific Phobia / GAD
10	GAD / Social Anxiety / Specific Phobia
11	Specific Anxiety / Social Anxiety / Separation Anxiety
12	Panic with Agoraphobia / Social Anxiety / GAD / Specific Phobia
13	Panic with Agoraphobia / Specific Phobia
14	Specific Phobia

N.B. 71.4% of the clinical group meet criteria for multiple Axis-I anxiety diagnoses.

Overgenerality Analysis

For overgenerality analysis, a mixed design ANOVA using the dummy-coded overgenerality scores ranging from 2 to 6 was conducted to determine whether there was any difference in the overgenerality of events that participants produced as a function of temporal direction (past/future), emotional valence instruction (no instruction, positive, negative) and group (anxiety, control). Similar to Study 3, gender was included as a covariate.

There was a significant main effect of temporal direction, F (1, 31) = 11.13, p <.00, η_p^2 = .26**,** with participants providing more overgeneral future events than past events. There was also a main effect of instructional valence, F (2, 62) = 8.70, p < .00 η_p^2 = .21. The main effects were qualified by a temporal x emotional valence interaction, F (2, 62) = 3.72, p = .03 η_p^2 = .10 (see *Figure 16*).

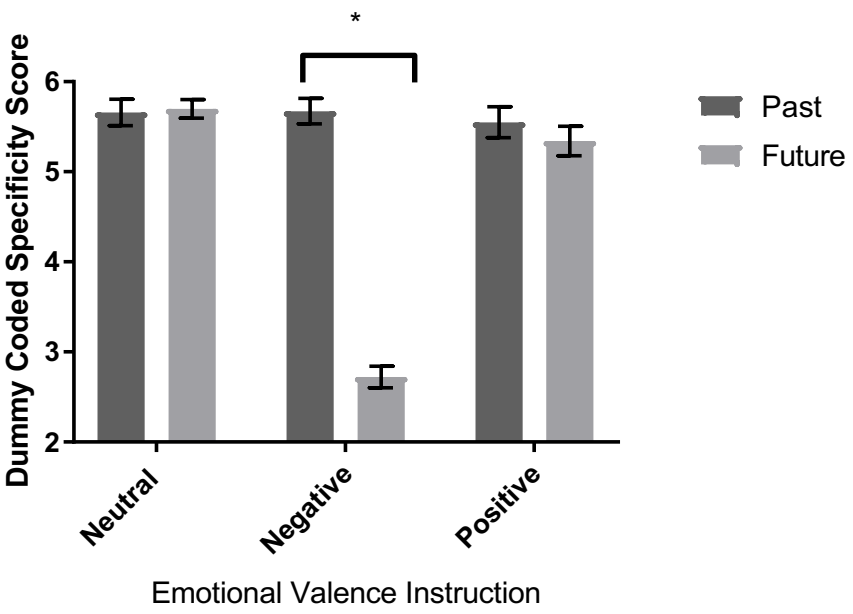

Figure 16. Mean (+SEM) dummy-coded specificity score produced for each emotional valence at each temporal direction, collapsed across groups. Higher scores indicate production of more specific events, lower scores indicate production of more categoric/intermediate and general events.

Follow-up paired sample t-tests showed that negative future events were significantly more overgeneral than negative past events (t (33) = 15.93, p < .00), however, there was no difference in the extent to which past and future neutral and positive events were overgeneral (t (33) = -.40, p =.69; t (33) = .92, p = .36 respectively). There were no significant main effects of group or gender (all *ps* > .05). There were no other significant interactions (all *ps* > .05).

Episodic Detail Analysis

For the current study, missing data imputation was not required. A mixed design ANOVA was conducted to determine whether there was any difference in the episodic details of events that participants produced as a function of temporal direction (past/future), emotional valence instruction (no instruction, positive, negative) and group (anxiety, control). There was a significant main effect of group, F (1,24) = 5.4, p =.03, η_p^2 = .19. Individuals with an anxiety disorder produced a lower proportion of episodic details than healthy controls (see Figure 17).

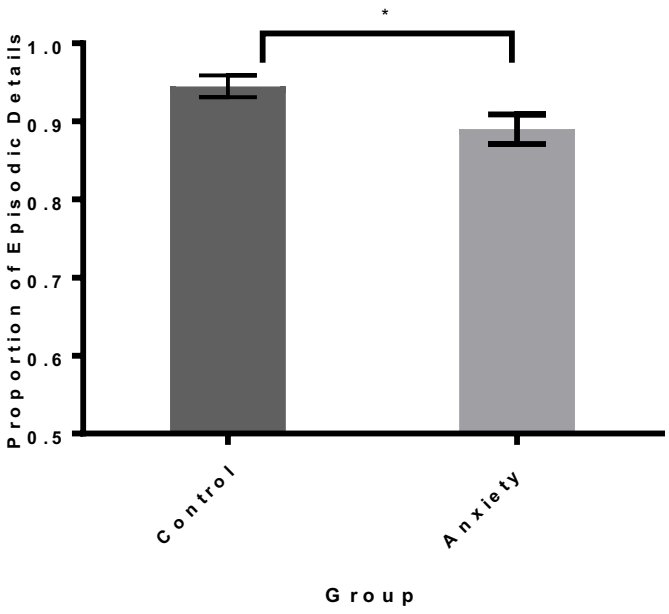

Figure 17. Mean (+SEM) proportion of episodic details produced by group, collapsed across temporal direction and emotional valence

Interactions between emotional valence x group, F (1,48) = 2.80, p =.07, η_p^2 = .10 and temporal direction x emotional valence x group approached significance, F (1,48) = 2.88, p =.07, η_p^2 = .10 (see Figure 18). Independent sample t-tests highlighted that participants in the anxiety group produced significantly fewer episodic details for neutral events in the past (t (30) = -2.47, p = .02, d = -.90). For negative events participants in the anxiety group produced significantly fewer episodic details in both the past and the future (t (31) = -2.49, p = .02, d =-.90; t (29) = -1.97, p = .06, d = -.73 respectively). For positive events, there were no differences between groups in either temporal direction (all ps > .05). No other main effects or interactions were indicated (all ps > .05).

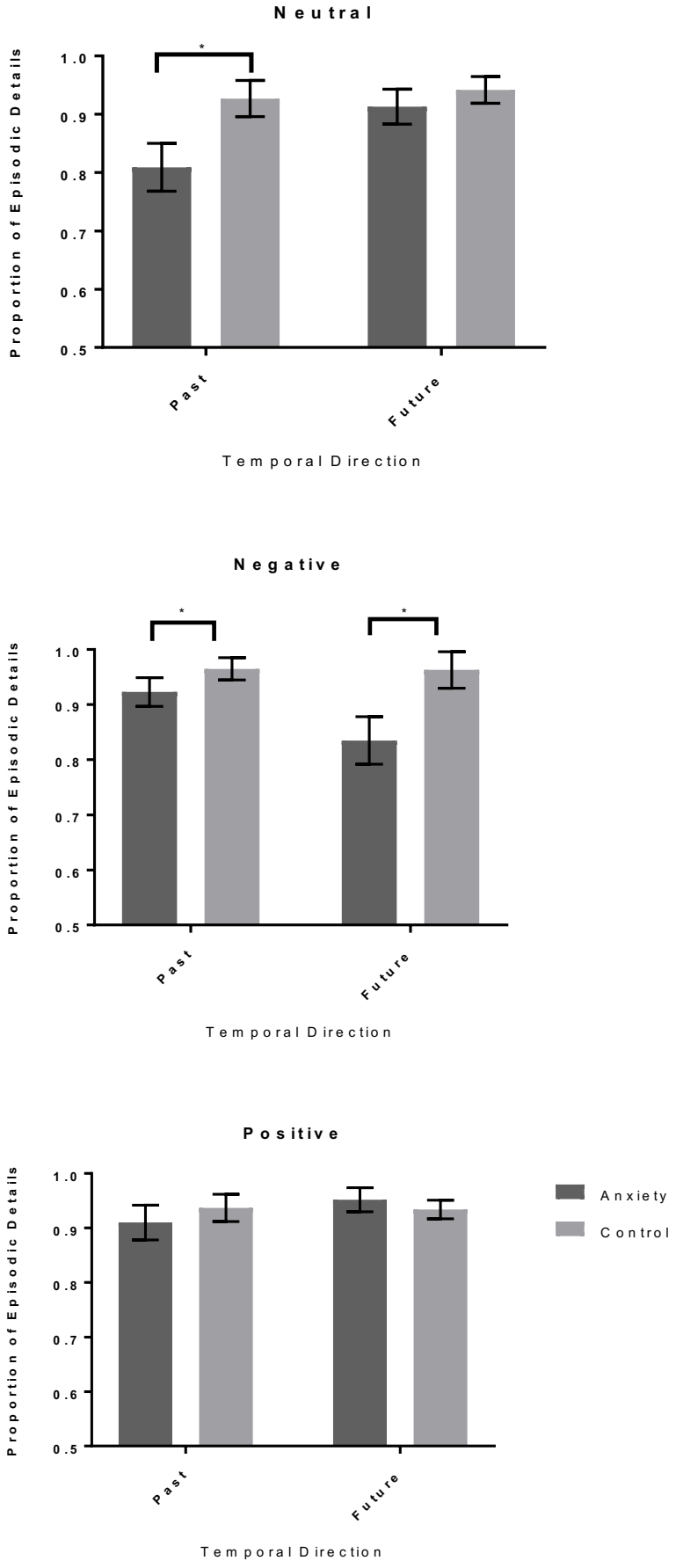

Figure 18. Mean (+SEM) proportion of episodic details produced for by each group for each emotional valence and temporal direction

Phenomenological Analysis

Mixed design ANOVAs were conducted on the phenomenological measures to determine whether there was any difference in subjective experience of events that participants produced as a function of temporal direction (past/future), emotional valence instruction (no instruction, positive, negative) and group (anxiety, control).

Vividness. There were no main effects or interactions for self-report ratings of vividness (all *ps* > .05).

Pre-Re/Experiencing. A main effect of group was found for pre-re/experiencing F (1, 31) = 4.44, p = .04 η_p^2 = .13. This was qualified by a temporal direction by group interaction, F (1, 31) = 4.59, p = .04, η_p^2 = .13 (see Figure 19).

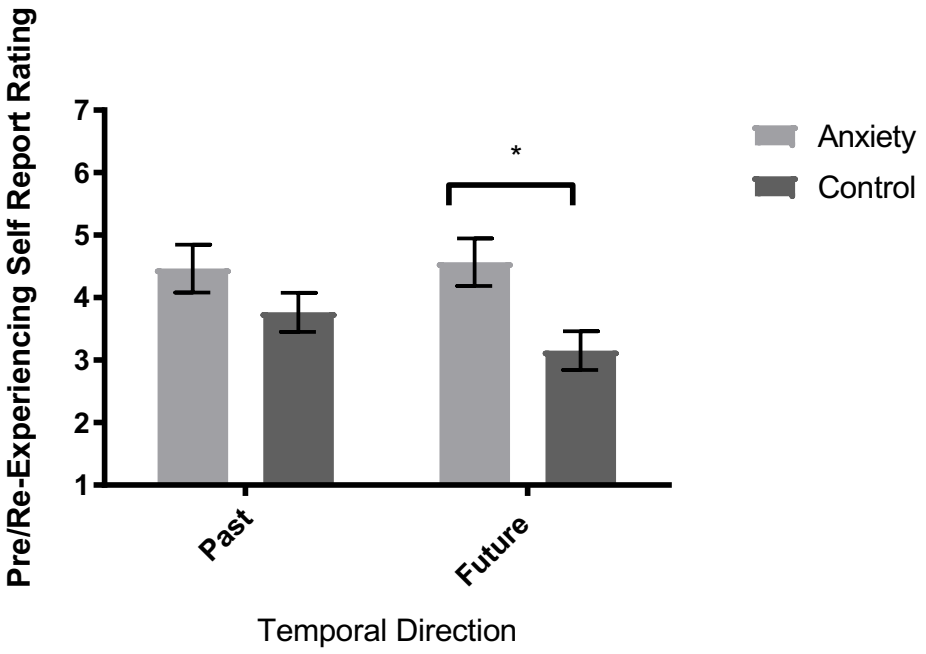

Figure 19. Mean (+SEM) Pre/Re-Experiencing self-report ratings produced by each group, for each temporal direction, collapsed across emotional valence

Follow-up analysis highlighted that the feeling of pre-experiencing future events differed significantly between anxiety participants and controls (t (32) = -2.29, p = .03, d = -0.8) with anxiety participants reporting higher pre-experiencing feelings relative to controls. Contrastingly, feelings of reliving past events did not differ between groups (t (32) = -.19, p = .85, d = - .06). Additionally, there was three-way interaction with temporal direction, emotional valence and gender for pre/re-experience, F (2, 60) = 3.06, p = .05 η_p^2 = .09 (see Figure 20).

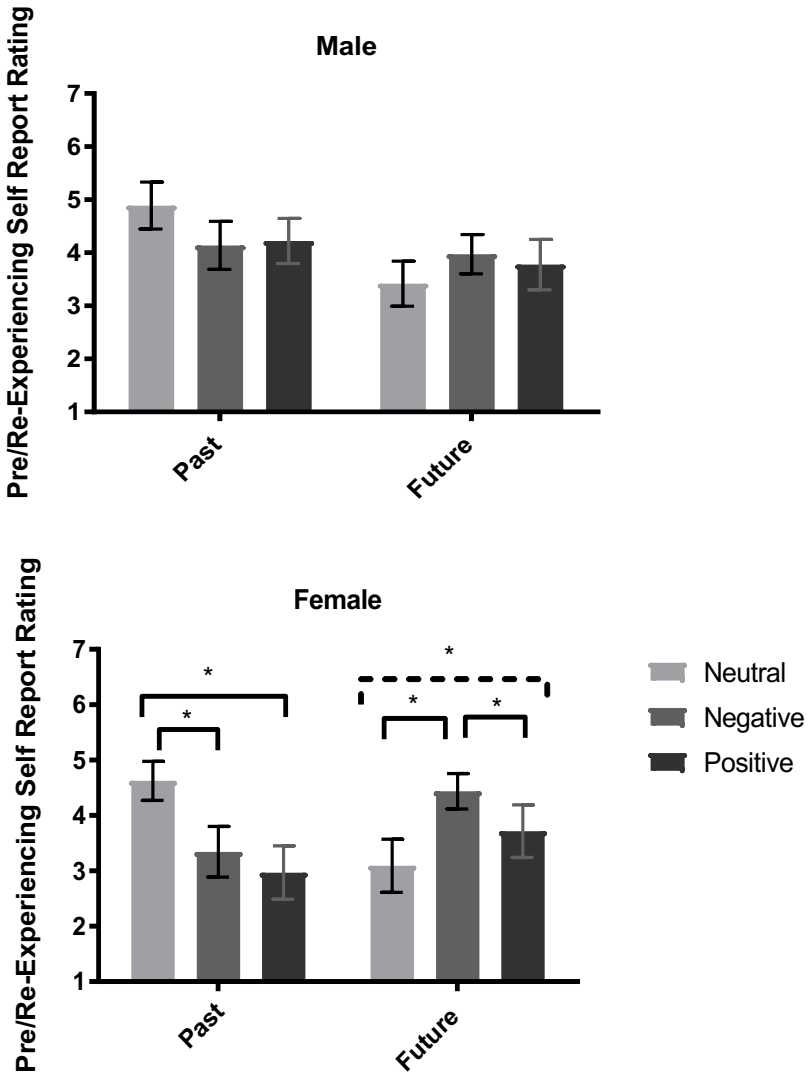

Figure 20. Mean (+SEM) Pre/Re-experiencing self-report ratings produced by each gender, for each temporal direction and emotional valence instruction. Significance of $p \leq .05$ indicated by unbroken bracket, trend towards significance p =.07 indicated by broken bracket

Follow-up separate paired sample t-tests indicated that for males, pre/re-experiencing ratings did not differ across both temporal directions and across all emotional valences (all *ps* > .05). For females, however, past neutral were rated as containing significantly more feelings of re-experiencing than past negative or positive events (t (15) = 2.65, p = .02; t (15) = 3.24, p = .01 respectively), yet the emotional (negative and positive) past events did not differ from each other (t (15) = .84, p = .41). Further, future negative events were associated with significantly more feelings of pre-experiencing than future neutral events or positive events (*t* (15) = 3.40, *p* = .00; *t* (15) = 2.35, *p* = .03). The difference in females' feelings of pre-experiences between positive and neutral valenced future events approached significance (*t* (15) = -1.95, *p* = .07). There were no other main effects or interactions (all *ps* > .05).

Sensory Details. There were no observed main effects for sensory detail ratings (all *ps* >.05). However, there was a temporal direction x emotional valence interaction *F* (2, 62) = 4.00, *p* = .02, η_p^2 = .12. This interaction was qualified by a three-way interaction between temporal direction, emotional valence and gender, *F* (2, 60) = 3.70, *p* = .03 η_p^2 = .10. Separate follow-up paired sample t-tests indicated that for male sensory ratings for future negative events were significantly less sensory than future positive events (*t* (17) = -2.42, *p* = .03) a difference not observed for female (*t* (15) = -1.88, *p* = .08). No other follow-up comparisons were significant (all *ps* > .05) (See Figure 21).

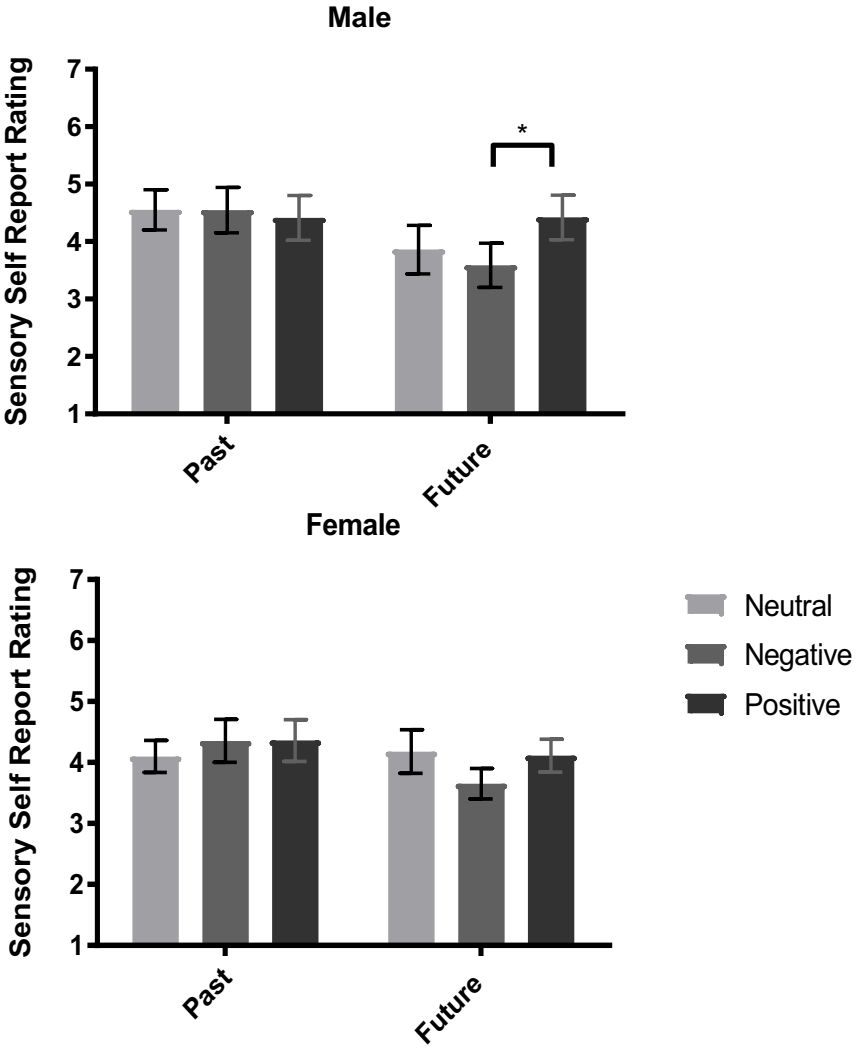

Figure 21. Mean (+SEM) Sensory self-report ratings produced by each gender, for each temporal direction and emotional valence instruction

Contextual details. There were no main effects or interactions for self-report ratings of contextual details (all *ps* > .05).

Perspective. The main effect of group approached significance for perspective ratings F (1, 31) = 3.77, p = .06 η_p^2 = .10 (see Figure 22). Anxiety participants reported experiencing events more from a field perspective than observer perspective compared to controls. There was also a main effect of gender for perspective F (1, 31) = 6.11, p = .02 η_p^2 = .17. Males reported more events from an observer perspective (M = 2.24, SD= 1.33) compared to

females (M = 3.18, SD =1.66). No other main effects or interactions were found (all *ps* > .05).

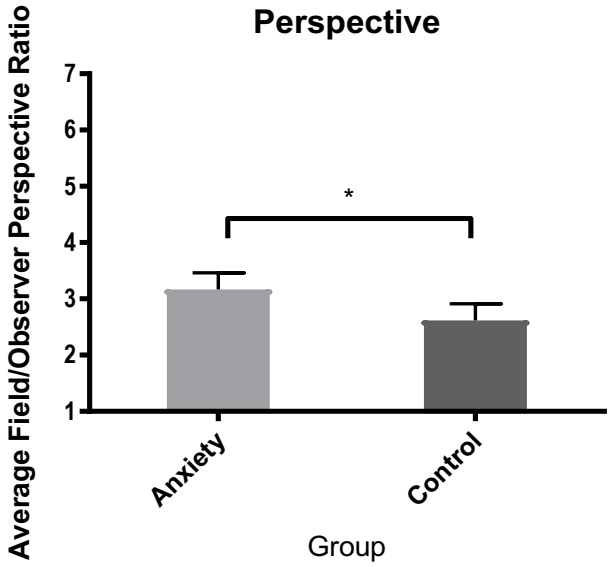

Figure 22. Mean (+SEM) ratio rating of Field / Observer perspective ratings produced by each group, collapsed across each temporal direction and emotional valence instruction

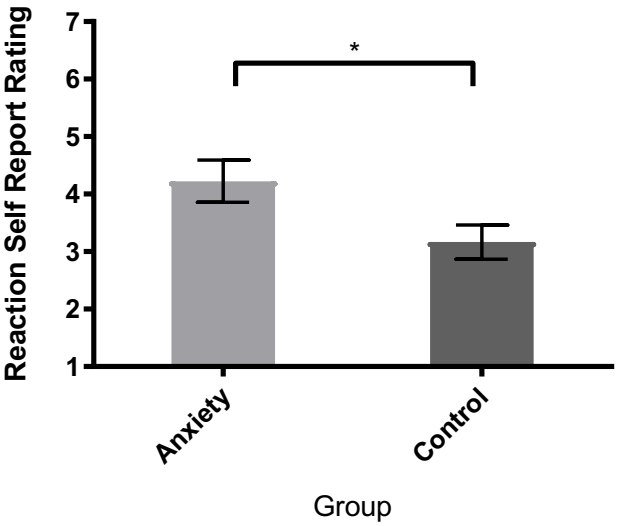

Figure 23. Mean (+SEM) Reaction self-report ratings produced by each group, collapsed across each temporal direction and emotional valence instruction

Reaction. There was a main effect of group for ratings of emotional reaction, F (1, 31) = 4.31, p = .05 η_p^2 = .12 (see Figure 23). Anxiety participants reported experiencing

higher levels of emotional reactivity than controls. There was also a main effect of gender F (1, 31) = 6.91, p = .01 η_p^2 = .18. Females reported higher levels of emotional reaction (M=3.86, SD =1.37) than men (M=3.25, SD =1.33). No other main effects or interactions were found (all *ps* > .05)

Importance. There were no main effects or interactions for self-report ratings of importance (all *ps* > .05).

Coherence. There was a main effect of group for ratings of event coherence, F (1, 31) = 7.54, p = .01 η_p^2 = .20 (see Figure 24). Anxiety participants reported their MTT was more coherent than did controls.

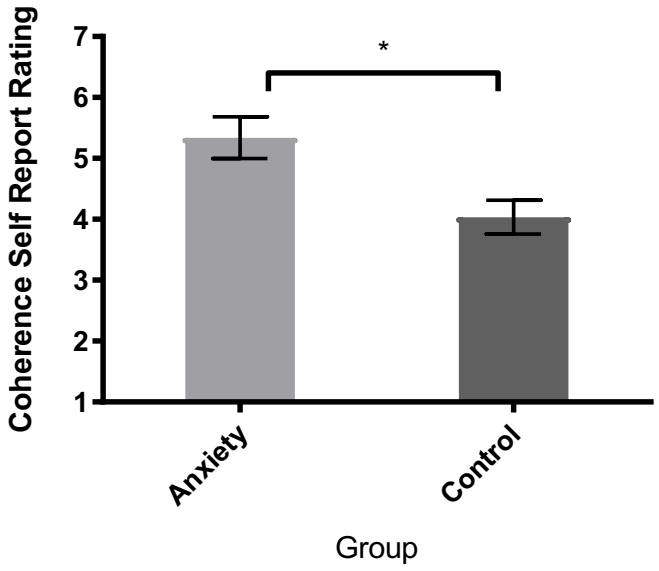

Figure 24. Mean (+SEM) Coherence self-report ratings produced by each group, collapsed across each temporal direction and emotional valence instruction

Discussion

Using a transdiagnostic approach, I investigated MTT in anxiety disorders to contribute to our understanding of the connection between past and future thinking within this clinical population. I used both objective and subjective measures to investigate

overgenerality, level of detail, and self-reported experience of MTT comparing anxiety-disordered individuals to healthy controls.

My hypotheses that anxious individuals would produce more overgeneral past and future events relative to controls was not supported. Clinically-anxious participants provided as many specific, personally-relevant, time-bound events as healthy controls. These findings are somewhat consistent with previous literature in anxiety samples, which found no difference in overgenerality of past memories (Sansom-Daly et al., 2014). However, these results are inconsistent with work using the same scoring protocol from Williams et al., (1996) and showing reduced overgenerality of future events in health anxiety and PTSD samples (Brown et al., 2014; Sansom-Daly et al., 2014). I did not replicate the previous work of overgeneral thinking using the Williams et al., (1996) coding method, however, the episodic detail scoring protocol (Levine et al., 2002) is a more comprehensive metric that quantifies the amount of detail in both past and future thought. It is arguably a better method to identify differences in the nature of MTT construction in that it provides a nuanced profile of the type information within an event rather than a broad categorization. Therefore, it is likely to be more sensitive to group differences. The results produced by episodic detail coding may offer a clearer representation of specificity of MTT in anxiety disorders.

In line with our hypothesis, those with anxiety did produce proportionally fewer episodic details than healthy controls. This is consistent with PTSD research that found a reduction in episodic detail in past and future event construction in post-trauma combat veterans (Brown et al., 2014). I also predicted that, in line with the findings from the online sample in Study 2, the greatest reduction in detail would be for positive events. The results showed that anxiety participants reported proportionally fewer episodic detail for neutral events when remembering the past relative to controls. Additionally, anxiety participants reported proportionally fewer episodic detail for negative events when remembering the past

and imagining the future relative to controls. People with anxiety may inhibit access to episodic details for negative events as an avoidance to reduce the experience of negative affect. The idea that anxious participants may avoid negative events provides support for the CaR-FA-X (Capture and Rumination, Functional Avoidance & Executive Function) model of overgeneral memory, which suggests that functional avoidance underlies overgeneral thinking styles (Williams, 2006; Williams et al., 2007). It is difficult to explain why anxious individual's past neutral events would contain fewer details than controls. Previous work has shown that the extent to which mood at the time of recall matches to the emotion at the time of event encoding and consolidation (i.e. when the event occurred) is important for event construction (Buchanan, 2007; Mather & Sutherland, 2011). It is possible that clinically anxious individuals do not frequently experience neutral mood states due to the nature of the disorder (i.e. increased hyperarousal, increased emotional reactivity), thus reducing the likelihood that they have detailed neutral memories to draw upon for event recollection. It is also possible that for anxious individuals the content of events recalled in a past direction without an emotional valence instruction may be negative or threatening, thus anxious individuals engage in similar avoidance mechanisms for past neutral and negative events. Future research investigating the anxiety content of neutral events would shed light on this possibility.

My phenomenological hypotheses were only partially supported. I predicted that, in line with the phenomenological results from the sub-clinical university sample in Study 3, those with an anxiety disorder would report lower levels of vividness, fewer contextual details for past events and increased emotional reactivity. The findings from this study showed that self-report ratings of emotional reaction were higher for those with an anxiety disorder, but there were no differences in vividness or contextual detail relative to controls. Interestingly, clinically anxious individuals reported *higher* ratings for pre-experiencing

future events, higher ratings of coherence for both past and future events and reported that they experienced their events more from a field perspective than observer perspective relative to controls. There were also unexpected gender differences in sensory and pre/re-experiencing self-report ratings. It is likely that these effects are due to the predominance of females (67%) in the current anxiety sample, however future research that specifically investigates gender differences in the phenomenology of MTT while controlling for anxiety is needed to confirm this possibility.

The variability in phenomenological differences between Study 3 and Study 4 is illustrative of the variability in phenomenological research observed within the literature. I did not replicate findings from research in individuals high in suppression which reported *lower* ratings of vividness, pre-re/experiencing, sensory details, contextual details and emotional reaction for MTT in high suppressors relative to non-suppressors (D'Argembeau & Van der Linden, 2006). Rather, the results here demonstrated that clinically-anxious individuals report *higher* ratings of pre-experiencing for future events and greater emotional reaction relative to controls. The finding from this study that there was no difference in vividness between groups replicates research that similarly found no difference in vividness ratings for episodic future thought in GAD individuals relative to controls (Wu et al., 2015). I also did not find any indication that emotional valence impacted on phenomenological ratings in either the clinical or control group. While this result replicated the findings of Study 3, it is in contrast to research in individuals with OCD-traits (Zermatten et al., 2008) and in healthy populations (D'Argembeau & Van Der Linden, 2004; D'Argembeau et al., 2011; De Vito et al., 2012; Rasmussen & Berntsen, 2013; Wilson & Gilbert, 2005). The increase in field perspective for the clinical group is also somewhat surprising, as previous research has shown that individuals with social anxiety or agoraphobia and blood/injury were more likely to rate past events from an observer perspective relative to controls (Wells & Papageorgiou, 1999).

There are a number of possibilities to account for the significant variability in phenomenological results across the literature, including differences in sample selection (non-clinical vs. clinical) and methodology (i.e. manipulating temporal distance of events, cue type). Nevertheless, the results from the current study highlight that the perceived experiential qualities of MTT in individuals with an anxiety disorder are fundamentally different to healthy controls. Replication and further exploration of why the subjective qualities would be perceived differently is needed.

Here I have shown that those with anxiety disorders do not necessarily provide fewer events that can be described as specific (i.e. occurring within 24-hrs and personally relevant), however, within each specific event, people with anxiety produce fewer episodic details. Yet phenomenological ratings of participants' experience indicate *greater* feelings of pre-experiencing and higher levels of emotional reactivity despite reductions in the details reported. The implications of these results are threefold. First, given that the observed differences occur for both past and future events, they provide further support for the constructive episodic simulation hypothesis (Schacter & Addis, 2007; Schacter et al., 2007b) which suggests a common mechanism underlying both episodic memory and episodic future thought. Second, the findings are in contrast to Miloyan and colleague's (2014) suggestion that anxiety disorder impairment in MTT would be in a future direction only. Rather these results highlight that MTT in anxiety is more similar to that seen in individuals with depression than previously thought, occurring for both past and future events. Third, the fact that emotional valence affected the level of episodic detail for anxious individuals, particularly for negative events, and that there is a dissociation between the reported perceived quality of MTT and the objective differences for those with clinical anxiety disorders have important implications for future treatment. More specifically, episodic future thought is adaptive because by constructing different futures people can problem solve, plan,

make decisions and regulate emotions in relation to those futures before they experience them (Boyer, 2008; Schacter et al., 2012; Suddendorf & Corballis,1997; 2007; Taylor & Pham, 1996; Taylor & Schneider, 1989). By avoiding thinking about possible negative futures in detail, yet experiencing high emotional reactivity, individuals with anxiety may be less likely to believe in their ability to cope with a possible future negative event and more likely to maintain maladaptive behaviours (Borkovec & Inz., 1990; Jing et al., 2016; Williams, 2006). Recent experimental work illustrates that changing how an individual views their capacity to manage stressful events in the past impacts on the specificity and content of imagined futures (Brown, Dorfman, Marmar & Bryant, 2012). Manipulations aimed at increasing event specificity and detail not only improves problem solving (Madore & Schacter, 2014a; 2014b), but was shown to improve psychological well-being when participants were required to imagine detailed constructive behaviours regarding worrisome events (Jing et al., 2016). Therefore, understanding the objective and subjective differences in MTT in anxiety disorders has practical implications for possible future treatments.

While this experiment does extend the literature on MTT in anxiety, it is not without its limitations. Even though the study is one of the first experimental examinations of MTT across anxiety disorders using a combination of objective and subjective measures, the generalizability of this study's findings is limited by the small sample of clinical participants. Future studies need to replicate these findings in a larger sample. The inclusion of a minimum word restriction within the experimental design may have impacted on the magnitude of group differences for both overgenerality and level of detail. For instance, individuals who engage in more overgeneral thinking with fewer episodic details may have provided fewer words originally, but due to the 150 character restriction which equates to approximately 20 words, added content and detail to the events they provided, thus impacting on the observed differences. However, on investigation of character count, data from most events exceed 400

characters, or 50 words, for each event description indicating that participants were likely writing more than necessary without prompt. Additionally, the use of cue word paradigms to generate emotionally-laden and detail-rich episodic future thought has been brought into question (Berntsen and Bohn, 2008). It has been argued that cued word paradigms may not be the best way to elicit emotionally reactive events because they do not elicit MTT in a way that is reflective of how individuals think within a naturalistic setting. Research investigating observed MTT differences between laboratory and naturalistic settings provides some support for this argument. For example, impairments in the specificity of the MTT have not been replicated in depressed samples when using tasks that investigate involuntary memory (non-deliberate recall in a naturalistic environment) (Watson et al., 2013). As such, future research using alternative methodology to the traditional laboratory cueing techniques needs to be conducted to investigate this possibility.

In summary, this the first transdiagnostic study to use a combined objective and subjective paradigm to compare MTT in individuals with an anxiety disorder. Using a modified Autobiographical Memory Test, I showed that individuals with a clinical anxiety disorder think about the past and future with fewer episodic details and this was particularly pronounced for negative events. Individuals with anxiety also report that these events occur with greater feelings of pre-experiencing, more emotional reaction, greater levels of coherence and are seen more through their own eyes, distinctions not seen in their non-anxious counterparts. These results contribute to the growing literature investigating future-oriented cognitive processing in anxiety disorders and have potential implications for clinical interventions of a transdiagnostic nature. Understanding the differences in MTT between people with anxiety and healthy individuals will continue to help provide a clearer understanding of the cognitive underpinnings in anxiety disorders, informing potential shifts in treatment including a focus on imagery rescripting and emotionally valenced simulations.

These in turn may help with increased problem solving and coping skills, which are essential for adaptive functioning and survival.

CHAPTER 6

Study 5

Involuntary and Voluntary Mental Time Travel in Anxiety

Researchers working in the MTT field have started to question the way in which laboratory tasks elicit MTT. Tasks such as the AMT are limited in their ecological validity, particularly because they ask participants to generate past and future events in an environment that is void of the social or environmental cues present in everyday life (Addis et al., 2016). As such, there have been calls for researchers to develop more clinically-relevant tasks to study how MTT operates in naturalistic settings (see Addis et al., 2016; Anderson et al., 2015; Berntsen & Bohn, 2010).

Typically, laboratory-based studies assess *voluntary MTT,* which is the ability to deliberately and strategically retrieve past and imagine future events (Berntsen & Jacobsen, 2008). For instance, word-cuing, procedures such as the AMT, require deliberate, strategic and intentionally initiated MTT. Voluntary MTT arguably accesses specific episodes (memory or future thoughts) via a *generative retrieval* process in which individuals conduct a "top-down," schema-based search of their knowledge base (general knowledge through to event specific knowledge). The output is then evaluated by the individual and further search, activation, elaboration and inhibition occurs until a contextually suitable specific event is generated (Conway & Pleydell-Pearce, 2000; D'Argembeau & Mathy, 2011; Haque & Conway, 2001; Irish, Addis, Hodges & Piguet, 2012; Jeunehomme & D'Argembeau, 2016).

In contrast, *involuntary MTT* refers to memories or future thoughts that come to mind spontaneously with no conscious attempts at retrieval (Berntsen, 1998; Berntsen & Jacobsen, 2008). Involuntary MTT is common in everyday life (Walker et al., 2003), occurs in situations that require little attention (Schlagman, Kliegel, Schulz & Kvavilashvili, 2009) and is more frequent than voluntary MTT (Rasmussen & Berntsen, 2011). Involuntary MTT

episodes are thought to be generated via an associative "bottom-up," *direct retrieval* process in which individuals form a unique associative link between the current situation (i.e. contextual cue or thought) and an episodic memory. The link between the context and episodic memory leads to a specific event being recalled or generated automatically (Berntsen, 1998; 2009; 2010; Berntsen & Hall, 2004; Conway & Pleydell-Pearce, 2000).

Studies comparing voluntary and involuntary methods have highlighted some important differences between voluntary and involuntary episodic memory (see Berntsen, 2009; 2012 for review). First, involuntary memories have a greater impact on mood and generate a stronger emotional and physical response than do voluntary memories. Second, voluntary memories are frequently retrieved, tend to be related to life-scripts (i.e. finishing school, getting a job, getting married, having kids) and are reported as being more important to an individual's life-story than involuntary memories. Third, voluntary memories contain fewer sensory-perceptual details than involuntary memories (Berntsen 1998; Berntsen & Hall, 2004; Johannessen & Berntsen, 2010; Schlagman & Kvavilashvili, 2008).

Similar differences are observed in involuntary and voluntary MTT. For instance, in a structured diary task comparing voluntary and involuntary MTT, participants were asked to record 10 involuntary past and 10 involuntary future events in a diary during an open-ended time period, with a maximum of two events of each kind per day. Using a three-step structured diary (see Berntsen & Hall, 2004), participants first recorded a brief description or key points of the event as the thought happened. Second, at a later point that day, participants were then asked to write a more detailed description and answer a number of phenomenological questions about the event. Third, after recording the involuntary event, participants were asked to generate a voluntary event by revealing a cue word from the back of the diary provided. Similar to the involuntary event, participants were asked to provide a detailed descriptions and answer several phenomenological questions for each voluntary

event. Both involuntary past and involuntary future thoughts were rated by participants as more specific, more vivid, less emotionally positive and having a greater impact in reducing mood than voluntary past or voluntary future events (Berntsen & Jacobsen, 2008). Berntsen and Jacobsen (2008) theorise that different retrieval processes (i.e. strategic 'top-down' for voluntary events; associative "bottom-up") are likely to underlie the observed differences in the content and phenomenological qualities of voluntary and involuntary events. Neuroimaging data provides some support for the argument that different retrieval processes may underlie differences in voluntary and involuntary event generation, with greater neural activation in the right PFC seen during voluntary recall relative to involuntary recall (Hall, Gjedde & Kupers, 2008). In light of the reported differences in healthy controls, research has begun to consider potential differences in voluntary vs. involuntary MTT in clinical populations.

Studies of involuntary MTT in clinical populations have failed to replicate effects found in voluntary paradigms. As discussed earlier, in clinical populations such as depression (Andersen et al., 2015; Williams et al., 1996), PTSD (Brown et al., 2013; 2014), social phobia (D'Argembeau et al., 2006) and GAD (Wu et al., 2015) individuals exhibit deficits in MTT when assessed using voluntarily laboratory based MTT protocols. These protocols such as the AMT and recombination task are thought to rely on generative retrieval such as the AMT and recombination task. Further, the results of Study 4 in this thesis similarly indicate reduced episodic detail and phenomenological differences in MTT in a transdiagnostic anxiety sample using a modified AMT task. However, emerging research investigating involuntary MTT, which relies on directive retrieval, have failed to replicate such differences (Finnbogadóttir & Berntsen, 2011; 2013; Watson et al., 2013). More specifically, clinically depressed patients exhibited no evidence of overgenerality in involuntary memories (Watson et al., 2013). Memories were provided using the three-step diary method described above

(Berntsen & Hall, 2004) and were coded for overgenerality using Williams et al., (2007) coding protocol (Watson et al., 2013). Watson and colleagues (2013) found that individuals who were depressed across the experimental period retrieved significantly fewer specific memories in the voluntary task relative to controls, however there was no group difference for the involuntary task. Research using the same method comparing involuntary MTT in sub-clinical worriers indicated that while high worriers rated their MTT as less important to their life story than low-worriers in the involuntary task, there were no other significant group differences in phenomenological qualities (Finnbogadóttir & Berntsen, 2011). Based on their findings, Finnbogadóttir and Berntsen (2011) suggest that individuals with elevated worry may not engage in cognitive avoidance strategies during involuntary MTT. The findings of Finnbogadóttir and Berntsen (2011) highlight that the differences between individuals with anxiety and healthy controls reported in this thesis may not generalize to a study where participants are asked to engage in involuntary MTT.

The current study aimed to determine whether the differences in MTT reported in Study 4 generalises to a naturalistic setting. There were three aims. First, I aimed to determine whether individuals with elevated and clinical levels of anxiety would exhibit differences involuntary MTT spontaneously elicited in a naturalistic setting, in addition to MTT elicited in a voluntary laboratory based paradigm. Second, I aimed to address issues with involuntary MTT diary use, by using mobile phone technology to accurately record participants thinking about the past and the future in real-time. Third, I aimed to extend the involuntary MTT literature by investigating objective differences (i.e. overgenerality and episodic detail) in addition to subjective differences (i.e. phenomenological ratings) in an anxiety sample to provide a more nuanced profile of involuntary MTT. The two-part study presented here is the first of its kind, comparing voluntary (i.e. in the laboratory) and

involuntary (i.e in a naturalistic setting) MTT using new technology in two populations, namely a sub-clinical anxiety (Study 5a) and clinical anxiety (Study 5b).

I made a number of predictions for the current two-part study. Firstly, given that past research has demonstrated that participants report involuntary MTT as being more specific and more vivid than voluntary MTT (Berntsen & Hall, 2004; Berntsen & Jacobsen, 2008; Finnbogadóttir & Berntsen, 2011; Johannessen & Berntsen, 2010) I predicted that involuntary past and future events would be significantly more specific than voluntary events and would contain more episodic details. Second, I predicted that participants would rate their phenomenological experiences of involuntary MTT differently to voluntary events, including higher levels of pre/re-experiencing and having higher emotional reaction ratings compared to voluntary events (Berntsen & Jacobsen, 2008; Finnbogadóttir & Berntsen, 2011). Third, reflecting upon clinical research in a depressed sample (Watson et al., 2013) and in sub-clinical worriers (Finnbogadóttir and Berntsen, 2011) I predicted that there would be differences in the specificity of events generated during voluntary MTT for individuals with anxiety (elevated or clinical levels) relative to controls, but there would not be any significant differences involuntary MTT between groups.

Study 5a: Voluntary & Involuntary MTT in Sub-clinical University Sample

Method

Participants

Participants (N= 61) participants were recruited though the first-year undergraduate psychology participation pool at the University of New South Wales and received course credit for their participation. The mean age was 19.3 years (SD = 2.8; range: 17 – 36). 63.5% were female. The ethnic composition of the sample was 41.9% Caucasian, 30.6% Asian, 27.4% other (Aboriginal/Torres Strait Islander, African, Arabic, Hispanic, Mixed).

Participants were excluded if they did not speak English as a first language (n = 1), if they scored 13 or higher (i.e. the clinical cut-off) on the depression subscale of the DASS (Lovibond & Lovibond, 1995) (n = 1) or if they did not complete the experiment (n = 7). Elevated anxiety participants were those that scored above 10 on the anxiety subscale of the DASS. Low anxiety participants were those that scored 0 to 9 on the anxiety subscale. The study was approved by the School of Psychology ethics committee at the University of New South Wales. See Table 8 for demographic information of the final sample.

Table 8.

Demographic information for participants included in the university sample investigating involuntary and voluntary MTT

	Elevated Anxiety	**Low Anxiety**	**Total sample**
n	16	36	52
Age	18.1 (1.3)	19.2 (3.3)	19.25 (2.8)
% Female	75	58.3	63.4
PSWQ	51.7 (2.3)	42.1 (10.6)	
Depression Subscale (DASS)	9.81 (2.6)	9.30 (2.6)	
Anxiety Subscale (DASS)	12.5 (2.3)	7.8 (0.8)	

41.9% Caucasian, 30.6% Asian, 27.4% other

N.B. Standard deviations are presented in parentheses. The elevated anxiety group had higher scores on the Penn State Worry Questionnaire (PSWQ) than did low anxiety participants (t (1,50) = 2.67, p =.01). Elevated anxiety participants also scored higher on anxiety scale of the Depression Anxiety Subscale (DASS) than low anxiety participants (t(1,50) = 11.21, p <.00, d = 3.1). Groups did not differ on depression scores on the DASS (t(1,50) = .68, p =.50, d =.19).

Materials

Participants completed the same detailed demographics form and anxiety questionnaires including the DASS-21 (Lovibond and Lovibond, 1995) and PSWQ (Meyer et al., 1990) used in Study 3 (university/community sample). They also completed a two part voluntary MMT task, which was a modified version of the computerized mAMT used in Studies 3 & 4. Following each event descriptions in the voluntary mAMT they also completed an adapted version of the phenomenological questionnaire used in Studies 3 & 4 (D'Argembeau & Van der Linden, 2004; Finnbogadóttir & Berntsen, 2011; Johnson et al., 1988). The involuntary MTT task was an adapted version of Berntsen & Jacobson (2008) diary task using mobile phone technology. As part of the involuntary MTT task, participants completed a series of phenomenological questions (Berntsen & Jacobson, 2008; Finnbogadóttir & Berntsen, 2011).

Voluntary (Laboratory) MTT Task. The mAMT used within this thesis was adapted for the purpose of this voluntary/involuntary study. Four modifications were made. First, the mAMT was split across two testing sessions such that half was completed during Laboratory Session 1 and half was completed during Laboratory Session 2. Second, I removed the emotional valence instruction such that participants were simply asked to generate past and future events. Participants were still able to self-select cue words from the same word-lists created from Clark and Paivio's (2004) revised normed list of words. The emotional valence manipulation was removed for the task to more closely reflect involuntary thinking. Third, the number of events was changed such that participants were asked to provide 4 past and 4 future events during Laboratory Session 1, and 4 past and 4 future events during Laboratory Session 2. Four, additional phenomenological questions were included to reflect those in the involuntary condition (see Appendix D). The voluntary MTT task was completely computerized replicating the previous studies of this thesis.

Involuntary (Naturalistic Setting) MTT Task. Participants were asked to provide written descriptions, in as much detail as possible, of past and future events that came to mind spontaneously in their everyday lives over the course of two weeks (see Appendix C for experiment instructions). Participants provided these descriptions in real-time using a mobile phone app through Google Docs ™ that was downloaded and linked to their smartphones, rather than using a hand-written diary (Berntsen & Hall, 2004; Berntsen & Jacobsen, 2008). Participants were asked to complete a total of eight past events and eight future events, providing no more than two past or two future thoughts each day. This instruction was included to prevent participants from completing all events at once. The survey asked participants to describe the past or future event that came to mind, followed by a number of phenomenological questions about the event. Phenomenological questions were adapted from Berntsen & Bohn (2008) and the phenomenological questions used within the previous studies of this thesis (see Appendix D). Additional phenomenological questions specific to the involuntary task were more descriptive in nature (i.e. "were you thinking about something related prior…?"/ "were there commonalities between your external environment/internal environment and the event?"). The use of mobile phone technology ensured the quickest, most convenient and accessible way for participants to provide information about their memories/future thoughts, and did not require them to carry any additional equipment with them throughout the two-week period. Further, Google Docs™ time stamps enabled the experimenter to monitor how the participants were completing the experiment over the two-week course of the study.

Procedure

Participants were presented with a written and verbal description of the elements of the experiment to be completed and were asked to provide informed consent. They were instructed that the experiment had three parts. The first part was an initial laboratory session

which included a 1-hr computerized MTT task, which would ask them to generate past and future thoughts to cue words, and a series of mood questionnaires. The second part was a two-week diary task in which they would be asked to monitor their past and future thoughts in their everyday lives. The third, a second laboratory session after the two-week period, which was another 1-hr computerized MTT task and another series of mood questionnaires.

After participants provided consent, they were directed to a computer cubicle to complete the experimental phase (part 1 of the voluntary MTT task). Participants were instructed to generate specific, personally relevant events occurring within a single day, in either the past (have happened) or future (could happen) in response to neutral cue words. Participants were told they were to self-select the neutral cue words from word lists provided, and that they could freely associate with the cue words. Following the generation of the past or future event, participants were then presented with a series of self-report phenomenological questions in relation to the event they had just described (i.e. vividness, sensory details, contextual details, emotional reaction). Participants also completed the DASS-21 (Lovibond & Lovibond, 1995), the PSWQ (Meyers et al., 1990) and a demographic questionnaire. Presentation of the DASS-21, PSWQ and demographic questionnaire was counterbalanced across participants, with participants completing them either before or after the MTT task.

The experimenter then explained the diary component of the study to the participant. Links to the diary questionnaires were sent to each participant via email. Participants saved the links (one link for past events and one link for future events) to their phones. The experimenter then walked the participant through the questionnaires, which were to be completed when a specific thought about the past or the future came to mind over the next two weeks. Participants were not to complete more than two past or two future events questionnaires per day. Participants received 1.5 hours of course credit for their participation

in part 1. Further, to encourage participants to complete the full experiment (all three parts) they were informed that all participants who completed the experiment would go in the drawer to win an iPad mini™. Participants were only informed of the iPad mini™ draw after they had completed the first laboratory testing session, to prevent the draw being coercive in the decision to give consent.

During the two-week period outside the laboratory, participants received two reminder emails to encourage them to complete the diary task and to remind them not to complete more than two past or two future events per day. The emails also encouraged the participants to contact the experimenter if they were having difficulty with the phone app.

After the two-week period, participants returned to the laboratory to complete the second half of the voluntary MTT task. The experimental phase of the session was identical to the first stage, however different cue words were used. Participants also completed the DASS a second time. Demographic characteristics and the PSWQ were not re-administered. The experimenter discussed with participants any difficulties they experienced in completing the home diary component of the experiment. Participants were then debriefed and given an additional hour of course credit. Following the completion of the experiment, all eligible participants went into the draw for the iPad mini™.

Scoring. A single rater blind to test type, group allocation and hypotheses scored all events from participants included in the final analysis. Additionally, a second independent rater who was blind to group allocation, test type, or hypotheses, scored 20% of the events for overgenerality and episodic detail coding. These scores were subjected to intra-class correlation analysis to determine inter-rater reliability.

Overgenerality Coding The same coding protocol for Study 1 was used rating specific events with a numerical value of 3, categoric/intermediate events with a numerical value of 2 and general events with a numerical value of 1. A minimum score of 8 was possible for

overgenerality scoring and a maximum score of 24 was possible. A second independent rater blind to group membership and the hypotheses of the study coded 20% of the mAMT responses and high inter-rater reliability was achieved using intra-class correlations (Cronbach's α = .84).

Episodic Detail Coding. The same coding protocol for Study 1 was used. A second independent rater blind to group membership and the hypotheses of the study coded 20% of events. Scorer inter-rater reliability using intra-class correlations was moderate for internal details (Cronbach's α =.75) and high for external details (Cronbach's α =.94).

Phenomenological Scoring. Participants rated their memories and future events on several 7-point Likert rating scales, adapted from the literature (D'Argembeau & Van Der Linden, 2004; Berntsen & Bohn, 2010; Johnson et al., 1988). Both voluntary and involuntary past and future events were rated on 14 separate scales which asked participants to provide ratings related to event specificity, coherence, vividness, feeling of re/pre-experiencing, sensory details, contextual detail and perspective the event was experienced (observer or field). In addition, ratings for emotional experience (i.e. positive or negative), reaction to the event (physical reaction and level of emotional intensity), importance of event, relation to identity and how the event left their mood were rated. There were eight additional questions specific to involuntary events including where participants were when the event came to mind the level of concentration prior to the event coming to mind and the cue (i.e. environmental / thought) that triggered the event (see Appendix E for specific questions). For the sake of brevity within this chapter, only the central to identity rating and the eight phenomenological ratings consistent with the previous studies within this thesis will be discusse. Before conducting analyses, the two sensory ratings for visual details/sounds and smells/tastes were averaged into a single sensory detail measure (e.g. D'Argembeau et al.,

2006; Suengas & Johnson, 1988). Similarly, a combined reaction score was created by averaging the ratings for emotional intensity and physical reactions. A ratio rating for perspective was created by dividing the results for the two perspective scales including "seen through my own eyes" and "as if I was a fly on the wall" to whether determine field or observer perspective was experienced; higher ratings indicated field perspective and lower ratings indicated observer perspective. All phenomenological ratings were then averaged for past events, such that each participant had a single phenomenological rating for vividness, pre/re-experiencing, sensory, context, perspective, reaction, coherence, importance and identity for each event setting (i.e. past voluntary, past involuntary). Similarly, phenomenological ratings were averaged for future events so that participants had single phenomenological ratings for each future event setting (i.e. future voluntary, future involuntary).

Analyses

Pearson correlations between the DASS anxiety subscale and the PSWQ were conducted to validate the use of the anxiety subscale to assign participants to groups. A paired samples t-test was also conducted on anxiety subscale scores of the DASS obtained from laboratory session 1 and laboratory session 2 to determine if anxiety levels differed across the two-week testing period. Chi-squared analyses was conducted to ensure that the frequency of demographic characteristics did not differ as a function of group.

Overgenerality scores from the voluntary MTT task was first analysed using a within-subject 2 (Laboratory testing session: Time 1 / Time 2) x 2 (Temporal direction: Past / Future) mixed design ANOVA to determine whether that specificity of events provided differed across sessions and to rule out the possibility that practice effects impacted the results. In addition, separate 2 (Temporal Direction: Past, Future) x 2 (Task Type: Voluntary,

Involuntary) x 2 (Group: Low, Elevated) mixed design ANOVAs were conducted for analysis of overgenerality, episodic detail and for phenomenological ratings. Gender was included as a covariate. Note that for ANOVA, if the assumption of sphericity was violated (as indicated by a Greenhouse–Geisser estimate of sphericity, epsilon, of less than .90), the degrees of freedom were adjusted using Greenhouse– Geisser correction (Geisser & Greenhouse, 1958). Effect sizes of ANOVAs were expressed in partial eta squared (η_p^2) and values of .02, .13, and .26 were considered small, medium and large effects respectively (Cohen, 1988). Interactions were followed up using paired-sample and independent-sample t-tests. Effect sizes of independent samples t-tests were expressed in Cohen's d (*d*) and values of .20, .50 and .80 were considered small, medium and large effects respectively (Cohen, 1988).

Results

Participant Characteristics

Unlike previous experiments in which some participants endorsed ratings on the DASS Anxiety subscale of 0, there were no participants within this experiment that reported anxiety scores of 0. This may be attributed to the experiment occurring during the last three weeks of university semester. As such, only 'Low' and 'High' anxiety groups were formed for this experiment. Scores on anxiety subscale of the DASS were strongly correlated with scores on the PSWQ (r =.50, p =.00). As the DASS anxiety subscale showed good convergent validity, it was used to assign participants to two groups (low anxiety, elevated anxiety). There was no significant difference in the level of anxiety reported between laboratory session 1 and laboratory session 2 (t (1,51) = -.35, p = .11 , d =.01), with all participants in the elevated anxiety group meeting criteria for the elevated anxiety group at session 2 using the same clinical cut-offs as Chapters 3 & 4. Chi-square analysis of group demographics

indicated there were no difference in the distribution of males and females, χ^2 (1, N = 52) = 1.33, p = .25. Chi-squared analysis of ethnicity indicated that there was no difference in the ethnic distribution of participants, χ^2 (2, N = 52) = 2.60, p = .27.

Overgenerality Analysis

Preliminary analysis investigating potential practice effects determined that there was no significant difference between the overgenerality of events elicited at the two separate laboratory time points, F (1,51) = .02, p = .88, η_p^2 = .00, suggesting that the specificity of past and future events did not change between laboratory session 1 and laboratory session 2.

For the overgenerality analysis, a mixed design ANOVA using the dummy-coded overgenerality scores ranging from 8 to 24 was conducted to determine whether there was any difference in the overgenerality of events produced as a function of temporal direction (past/future), test type (voluntary/involuntary) and group (elevated anxiety, low anxiety). Gender was included as a covariate. There were no main effects or interaction for overgenerality (all ps > .05).

Episodic Detail Analysis

A mixed design ANOVA was conducted to determine whether there was any difference in the episodic details of events that participants produced as a function of temporal direction (past/future), test type (voluntary, involuntary) and group (anxiety, control). There was a significant interaction between test type and group, F (1,49) = 4.26, p =.04, η_p^2 = .08 (see Figure 25). Follow-up independent sample t-test indicated that groups differed significantly in the production of episodic details for events elicited involuntarily but not for events elicited voluntarily (t (1,50) = 1.97, p =.05, d = 0.6 ; t (1,50) = -0.87, p = .39, d = -0.25 respectively). Those with elevated anxiety provided significantly fewer episodic details for their involuntary events relative to low anxiety participants, but participant groups

did not differ in the episodic detail produced for voluntary events. There were no observed main effects or other interactions (*ps* >.05)

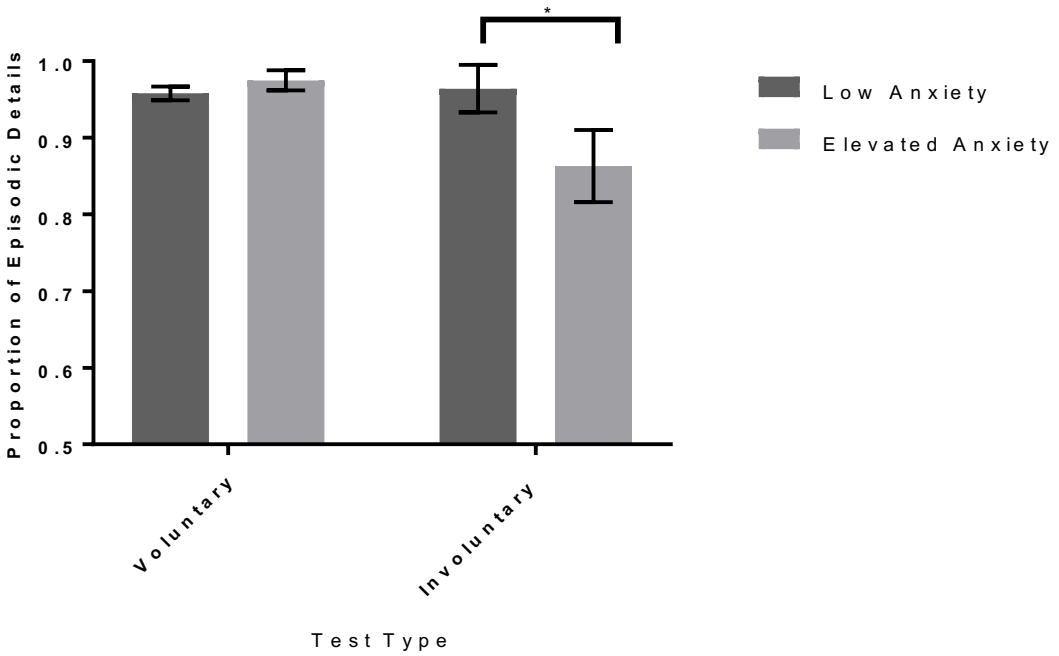

Figure 25. Mean (+SEM) episodic detail produced in both test type for each group, collapsed across group

Phenomenological Analysis

Preliminary investigation of the phenomenological data showed that 62.6% of self-report ratings were missing from the involuntary task across the sample. To make the mobile platform reflect traditional diary methods, the home involuntary diary task completed on mobile phones did not have any in-built programming restrictions, which are typically used in laboratory testing to prevent participants from skipping answers. However, this meant participants did not always complete all questions when they entered involuntary event information resulting in a large amount of missing data. Consequently, there was not enough data to conduct phenomenological analysis comparing voluntary and involuntary phenomenological ratings.

Summary

In a study comparing how individuals with elevated anxiety construct past and future events in a voluntary lab based paradigm and an involuntary naturalistic based paradigm, I did not find any evidence of group differences in overgenerality in either voluntary or involuntary MTT as a function of anxiety level. However, while differences in episodic detail production were not evident in voluntary MTT, individuals with elevated anxiety levels did show a reduction in the level of episodic detail provided for specific events in involuntary MTT, suggesting that there are differences in day-to-day MTT in individuals with elevated anxiety. I was unable to analyse the experiential ratings because a considerable proportion of involuntary phenomenological questionnaires were incomplete.

Study 5b: Voluntary & Involuntary MTT in a Clinical Anxiety Sample

The aim of Part B was to determine whether voluntary and involuntary MTT in individuals with an Axis-I anxiety disorder differed from healthy controls. This study aimed to extend the findings from Part A to a clinically anxious population. More specifically, the study aimed to determine whether the results from the sub-clinical university population, that indicated differences in episodic details in involuntary MTT, were specific to the university population or if they extended to a clinical population. The study is the first to compare MTT generated voluntarily in a laboratory environment to MTT generated involuntarily in a naturalistic setting using mobile phone technology in a clinical transdiagnostic anxiety population.

I hypothesized two possible outcomes. The first, if the results of Part A were due to sample characteristics, then in line with the literature there would be no group differences in involuntary MTT between clinical anxiety and controls. On the other hand, if the results of Part A were a function of anxiety levels, then participants with clinical anxiety disorders

would differ in their production of both voluntary and involuntary MTT relative to healthy controls.

Method

Participants

Participants (N=38) were adults recruited from the University of NSW paid participant pool and from the Sydney community via advertisements in the local area paper. Anxiety group participants were recruited using advertising materials seeking individuals with an anxiety disorder. A pre-screen phone call was completed to determine eligibility. Participants were eligible if English was their first language, they had no history of head trauma, no history of schizophrenia, no history of a substance use disorder, were not currently experiencing a Major Depressive Episode, were below the age of 45 and had access to a smart phone with internet connection. Eligible participants were invited to the laboratory where they provided written informed consent. A provisionally-registered clinical psychologist conducted the Anxiety Disorder Interview Schedule for DSM-V (ADIS-V; Brown & Barlow, 2013) with all potential participants to determine the presence of an Axis-I anxiety disorder and to screen for current Major Depressive Episode (MDE) or the presence of another psychiatric disorder. Individuals were excluded and debriefed if they met criteria for MDE or another psychiatric disorder. Additionally, participants were excluded if they failed to complete all components (both laboratory sessions and diary exercise) of the experiment (n=12; 6 anxiety, 6 control).

Ten participants met DSM-V criteria for an anxiety disorder, and sixteen did not. Participants ranged in age from 18 to 45 years of age. Chi-squared analysis was not conducted on ethnicity or gender as the number of expected frequencies was less than five, making chi-square an inappropriate statistical test and likely to overestimate statistical significance in small samples (Yates et al., 1999). 88.9% of the anxiety group were female

compared to the 64.7% in the control group. While epidemiological studies have demonstrated that prevalence of anxiety disorders is higher in women with a prevalence male: female ratio of 1:1.7 (McLean et al., 2011), the gender distribution of women seen within this sample is higher than expected. See Table 9 for demographic characteristics. The study was approved by the UNSW Higher Ethics committee.

Table 9.

Demographic characteristics of participants included in the sub-clinical university sample for Study 5a

	Anxiety	**Control**	**Total sample**
n	10	16	26
Age	26.3 (9.0)	23.0 (5.3)	24.2 (6.8)
% Female	88.9	64.7	73.1

26.9% Caucasian, 73.1% Asian, 0% other

Materials

The Anxiety and Related Disorders Interview Schedule Fifth Edition. (Brown & Barlow, 2013). A gold-standard semi-structured, clinician administered diagnostic interview that assesses for the presence of anxiety related psychological disorders according to the DSM-V (American Psychology Association, 2013). A provisionally registered psychologist conducted the interview.

Voluntary (Laboratory) MTT Task. The same voluntary MTT task used in Part A of this study was used.

Involuntary (Naturalistic Setting) MTT Task. The same involuntary MTT task used in Part A of this study was used, with a single amendment. The hosting platform was changed from Google Docs™ to Qualtrics® for a more streamlined user interface.

Procedure

Informed consent was obtained after participants were presented with a written and verbal description of the three-part experiment. The first part included an initial laboratory session comprised of the clinical interview and a 1-hr computerized MTT task which would ask them to generate past and future thoughts to cue words. The second, a two-week diary task in which they would be asked to monitor their past and future thoughts in their everyday lives. The third, a second laboratory session after the two-week period, which was another 1-hr computerized MTT task. Referral options and available mental health services was provided in the consent information to all participants. The clinical assessment interview was counterbalanced, such that it was conducted either before or after experimental phase of session 1. The experimental phase for session 1, session 2 and the diary task were identical to those used in Part A, including the draw for the iPad mini™. However, participants did not receive course credit rather, upon completion of session 1, participants received $40 gift-cards as remuneration, all participants received $20 gift-cards as remuneration at the conclusion of session 2. Further, information for available referral options and mental health services were provided for a second time to all participants upon completion of the experiment.

Scoring. Due to technical error with programming logic, the data from laboratory session 2 (part two of the voluntary MTT task) was not able to be analysed, leaving data from only four past and four future events generated by participants in the voluntary condition suitable for scoring and analysis. To maintain symmetry between the voluntary and involuntary MTT tasks, only the first four past and first four future events elicited by

participants during the involuntary MTT task were used. Given the small sample size, a single rater blind to test type, group and hypotheses coded all events from participants included in the final analysis.

Overgenerality Coding. The same coding protocol for Study 1 was used rating specific events with a numerical value of 3, categoric/intermediate events with a numerical value of 2 and general events with a numerical value of 1. The reduction in number of events included in the analysis resulted in a change in overgenerality scoring such that a minimum score of 4 and a maximum score of 12 was possible. A second independent rater blind to group membership and the hypotheses of the study coded 20% of the mAMT responses and good inter-rater reliability was achieved using intra-class correlations (Cronbach's α = .83).

Episodic Detail Coding The same coding protocol for Study 1 was used. A second independent rater blind to group membership and the hypotheses of the study coded 20% of events. Scorer inter-rater reliability using intra-class correlations was high for internal details (Cronbach's α =.90) and high for external details (Cronbach's α =.91).

Phenomenological Scoring. The same scoring protocol used in Part A of the current study was used.

Analyses

Separate 2 (Temporal Direction: Past, Future) x 2 (Task Type: Voluntary, Involuntary) x 2 (Group: Low, Elevated) mixed design ANOVAs were conducted for analysis of overgenerality, episodic detail and for phenomenological ratings. Gender was included as a covariate. Note that for ANOVA, if the assumption of sphericity was violated (as indicated by a Greenhouse–Geisser estimate of sphericity, epsilon, of less than .90), the degrees of freedom were adjusted using Greenhouse– Geisser correction (Geisser & Greenhouse, 1958). Effect sizes of ANOVAs were expressed in partial eta squared (η_p^2) and

values of .02, .13, and .26 were considered small, medium and large effects respectively (Cohen, 1988). Interactions were followed up using paired-sample and independent-sample t-tests. Effect sizes of independent samples t-tests were expressed in Cohen's d (*d*) and values of .20, .50 and .80 were considered small, medium and large effects respectively (Cohen, 1988).

Results

Participant Characteristics

A total of sixteen control and ten clinical participants were included in analysis. The co-morbidity of anxiety diagnosis is presented in Table 10.

Table 10.

Clinical diagnoses according to the DSM-V criteria for those in the anxiety group for Study 5b

Participant	Clinical Diagnoses
1	PTSD / Social Anxiety / GAD /Specific Phobia
2	Specific Phobia
3	Panic with Agoraphobia / Social Anxiety /Specific Phobia
4	Social Anxiety
5	Social Anxiety / Specific Phobia
6	Panic with Agoraphobia / Social Anxiety
7	Body Dysmorphic / Health Anxiety
8	PTSD / OCD
9	Panic with Agoraphobia / OCD
10	OCD

N.B. 60% of the clinical group meet criteria for multiple Axis-I anxiety diagnoses.

Overgenerality Analysis

For overgenerality analysis, a mixed design ANOVA using the dummy-coded overgenerality scores ranging from 4 to 12 was conducted to determine whether there was any difference in the overgenerality of events produced as a function of temporal direction (past/future), test type (voluntary/involuntary) and group (elevated anxiety, low anxiety). Gender was included as a covariate. There was a main effect of group, F (1,23) = 7.07, p = .01, η_p^2 = .20 (see Figure 26). Individuals with an anxiety disorder produced more overgeneral events irrespective of temporal direction and test type. There was also an interaction of test type x gender, F (1,23) = 426, p = .05, η_p^2 = .16 (see Figure 27). Follow-up t-tests revealed that males produced significantly more overgeneral voluntary events than females, a difference not shown for involuntary events (t (1,24) = -2.43, p = .02, d = -.10; t (1,24) = .71, p = .48, d = 0.29). There were no other main effects or interaction for overgenerality (all ps > .05).

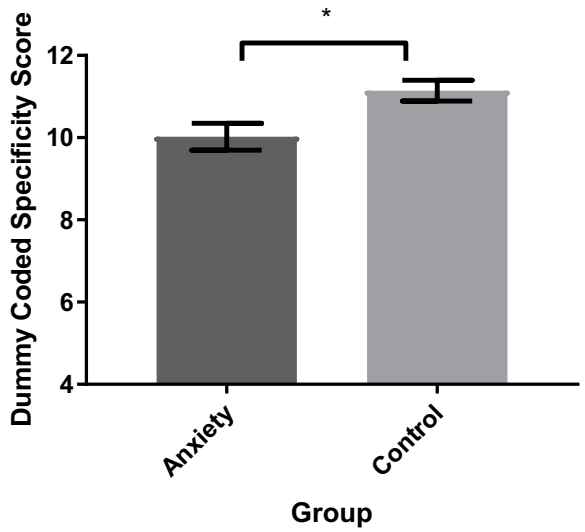

Figure 26. Mean (+SEM) dummy-coded specificity score as a function of group, collapsed across temporal direction and test type (voluntary/involuntary) Higher scores indicate production of more specific events, lower scores indicate production of more categoric/intermediate and general events

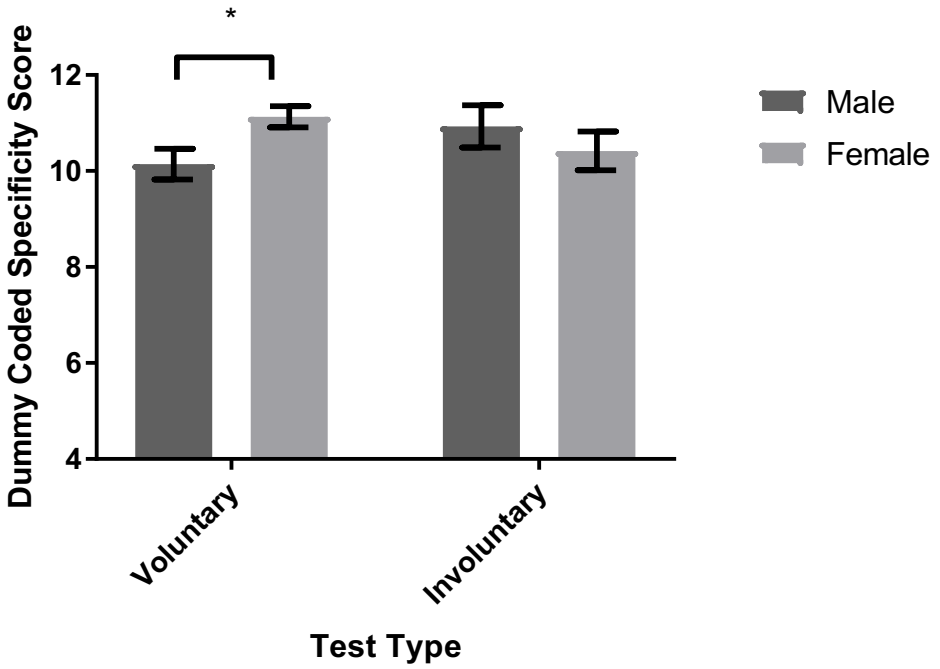

Figure 27. Mean (+SEM) dummy-coded specificity score produced for each setting by each gender, collapsed across temporal direction and group (anxiety, control). Higher scores indicate production of more specific events, lower scores indicate production of more categoric/intermediate and general events.

Episodic Detail Analysis

A mixed design ANOVA was conducted to determine whether there was any difference in the proportion of episodic details that participants produced as a function of temporal direction (past/future), test type (voluntary, involuntary) and group (anxiety, control). There was a significant main effect of group, F (1,19) = 5.19, p =.03, η_p^2 = .21 (see Figure 28). Individuals with an anxiety disorder produced fewer episodic details than controls, irrespective of test type or temporal direction. There was also a main effect of test type, F (1,19) = 4.60, p =.05, η_p^2 = .20 (see Figure 29). Across the sample, individuals produced more episodic details for involuntary events than for voluntary events. There were no other main effects or other interactions (*ps* >.05).

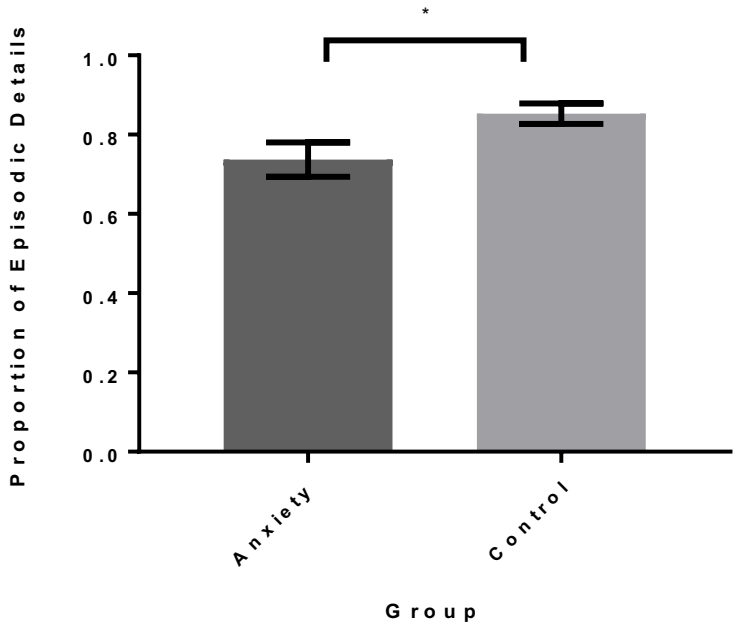

Figure 28. Mean (+SEM) proportion of episodic details produced by group, collapsed across temporal direction and test type

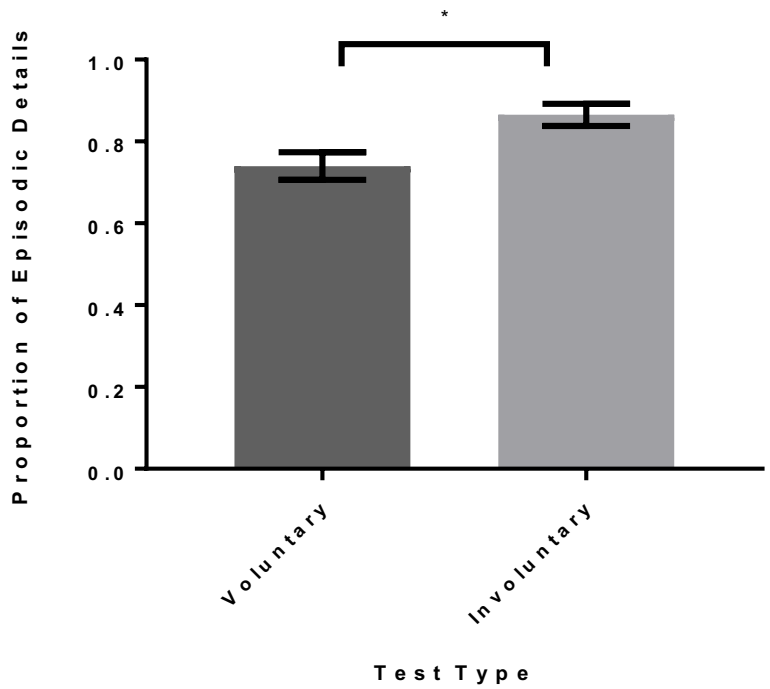

Figure 29. Mean (+SEM) proportion of episodic details produced by setting, collapsed across temporal direction and group

Phenomenological Analysis

Mixed design ANOVAs were conducted on the phenomenological measures to determine whether there was any difference in subjective experience of events that participants produced as a function of temporal direction (past/future), test type (voluntary/involuntary) and group (anxiety, control).

Vividness. There were no main effects or interactions for self-report ratings of vividness (all *ps* > .05).

Pre-Re/Experiencing. There were no main effects or interactions for self-report ratings of pre-re/experiencing (all *ps* > .05).

Sensory Details. There were no observed main effects for sensory details (all *p*s >.05). However, there was a test type x group interaction F (1, 23) = 7.34, p = .01, η_p^2 = .24 (see Figure 30). Follow-up independent sample t-tests indicated that individuals with anxiety rated voluntary events as containing marginally more sensory details than controls (t (24) = 1.97, p = .06, d =.80). However, there was no group difference in the ratings of sensory details for involuntary events (t (24) = -1.49, p = .15, d = -.60). There were no other main effects or interactions for sensory details (*p*s > .05).

Contextual details. There was a main effect of temporal direction for contextual details F (1, 23) = 4.90, p = .04, η_p^2 = .18 (see Figure 31). Participants rated past events as having more contextual details than future events. There were no other main effects or interactions for self-report ratings of contextual details (all *p*s > .05).

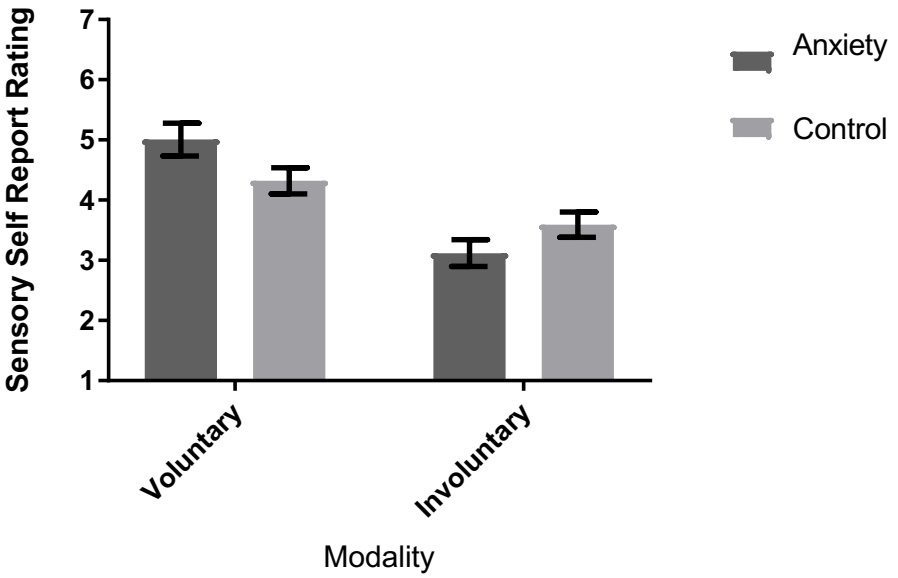

Figure 30. Mean (+SEM) self-report rating for Sensory details produced by group for each test type, collapsed across temporal direction

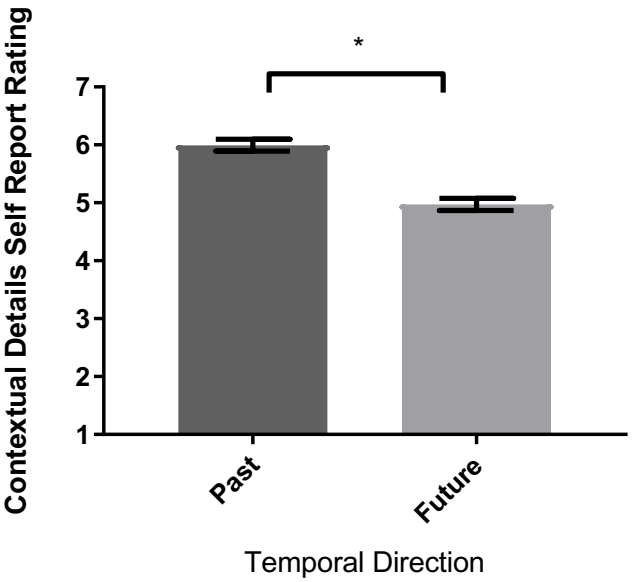

Figure 31. Mean (+SEM) self-report rating for Contextual details produced for each temporal direction, collapsed across test type and group

Perspective. There was a significant interaction of temporal direction x test type F (1 , 23) = 5.97, p = .02, η_p^2 = .20 (see Figure 32). Paired sample t-tests showed that across

groups, participants experienced future voluntary events more from an observer perspective ("like a fly on the wall") than future involuntary events (t (25) = -5.104, p <.00). There was no difference in the extent to which participants took an observer perspective when rating past events (t (25) = -5.104, p <.00). No other main effects or interactions were found (all ps > .05).

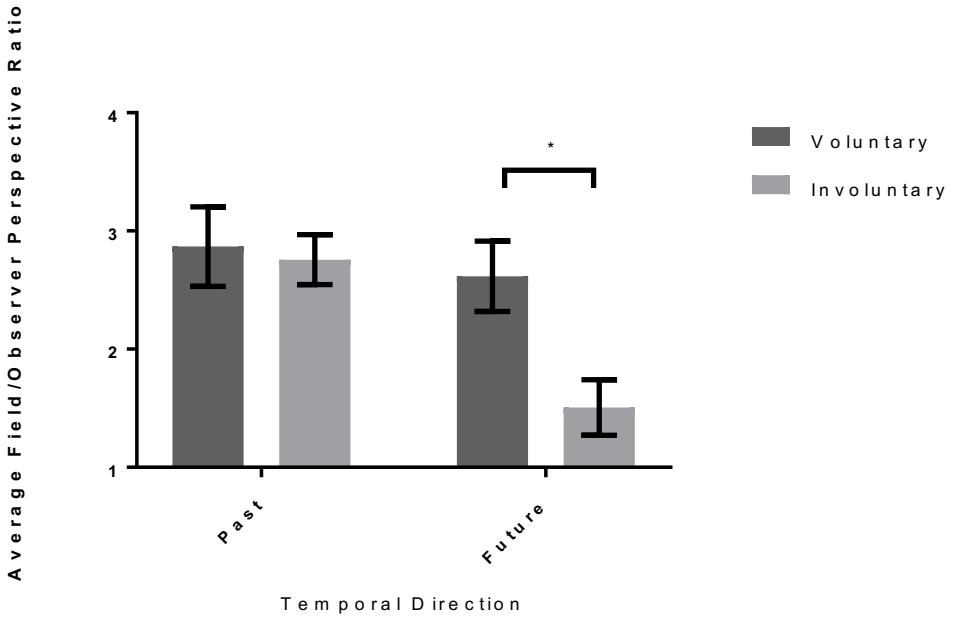

Figure 32. Mean (+SEM) ratio rating of Field / Observer perspective ratings produced by each temporal direction and test type, collapsed across group

Reaction. There was an interaction of temporal direction x group, F (1, 23) = 5.08, p = .03, η_p^2 = .18 (see Figure 33). Follow-up independent sample t-tests illustrated a tendency for anxiety participants to report higher reaction ratings for future events than controls (t (24) = 1.75, p =.08, d =.70). Groups did not differ in their reaction ratings for past events (t (24) = -.08 , p = .92, d =.33) . There was also an interaction of test type x group, F (1, 23) = 4.73, p = .04, η_p^2 = .17 (see Figure 34). Follow-up independent sample t-tests showed that anxiety participants reported higher reaction ratings for voluntary events than controls (t (24) = 2.37, p =.03, d =.97). Whereas groups did not differ in their reaction ratings for involuntary events

(t (24) = -.79, p = .44, d =-.32). No other main effects or interactions were indicated (all ps > .05).

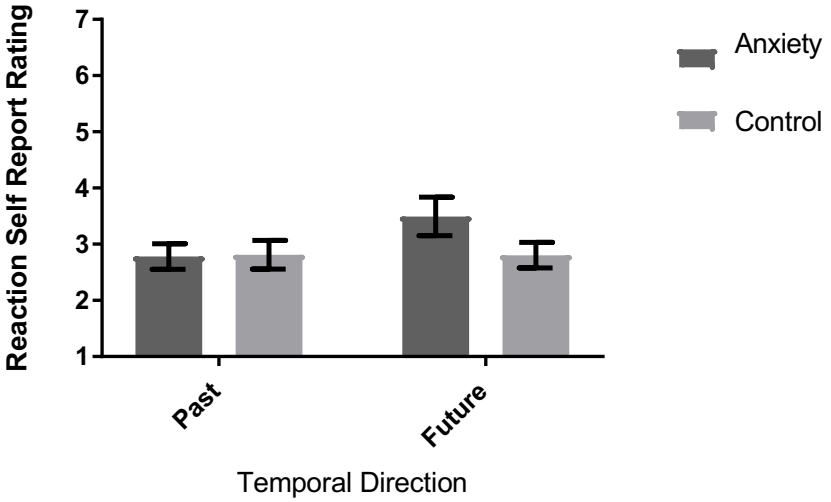

Figure 33. Mean (+SEM) Reaction self-report ratings produced by each group for each temporal direction, collapsed across test type

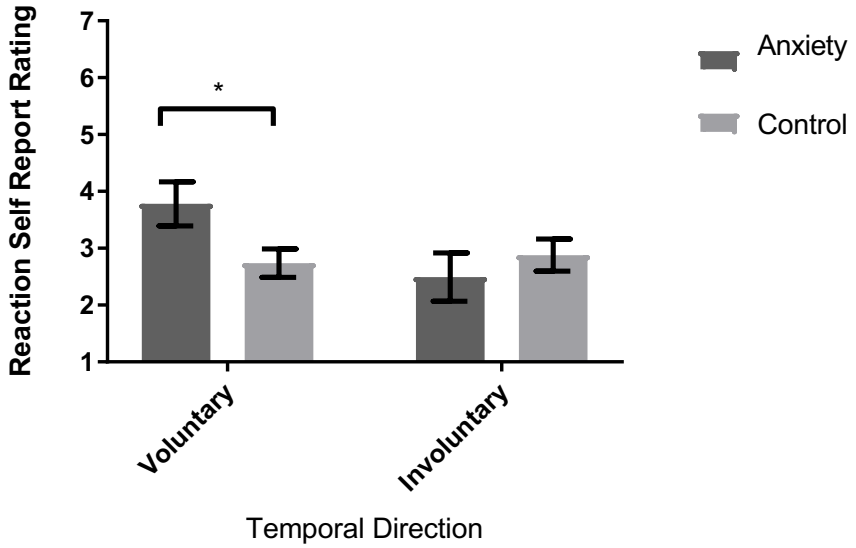

Figure 34. Mean (+SEM) Reaction self-report ratings produced by each group for each test type, collapsed across temporal direction

Coherence. There were no main effects or interactions for self-report ratings of coherence (all ps > .05).

Importance. There was an interaction of test type x group, F (1, 23) = 5.60, p = .03, η_p^2 = .20 (see Figure 35). Follow-up independent sample t-tests showed that anxiety participants tended to report voluntary events as being more important to their life-story than controls (t (24) = 1.78, p =.08, d =.73). Groups did not differ in their reaction ratings for involuntary events (t (24) = -1.58, p = .13, d =-.65). No other main effects or interactions were indicated (all ps > .05).

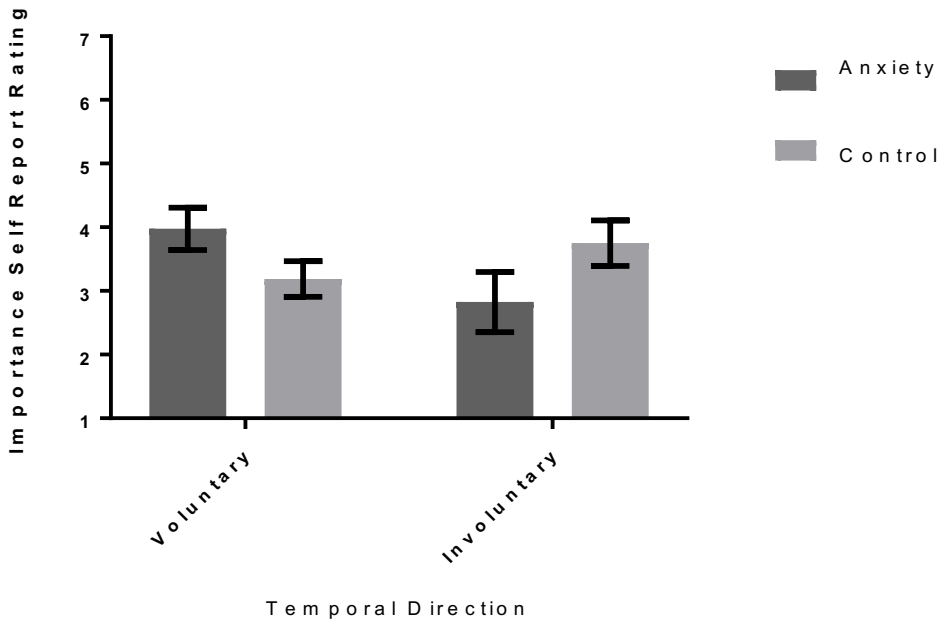

Figure 35. Mean (+SEM) Importance self-report ratings produced by each group for each test type, collapsed across temporal direction

Identity. There was an interaction of test type x group, F (1, 23) = 10.26, p < .00, η_p^2 = .30 (see Figure 36). Follow-up independent sample t-tests showed that anxiety participants reported voluntary events as being significantly more central to their identity than controls (t (24) = 2.32, p =.03, d =.95). Groups did not differ in their ratings in the extent to which events were central to their identity for involuntary events (t (24) = -1.64, p = .12, d =-.67). No other main effects or interactions were indicated (all ps > .05).

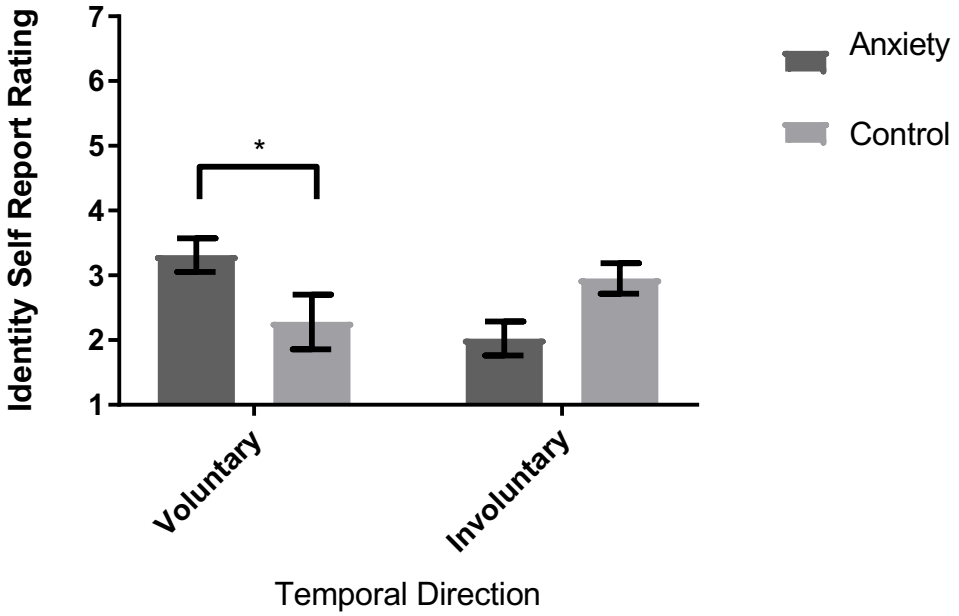

Figure 36. Mean (+SEM) Central to Identity self-report ratings produced by each group for each test type, collapsed across temporal direction

Discussion

In this chapter, I compared voluntary MTT in the laboratory and involuntary MTT in a naturalistic setting in both a university population and clinical population, using both objective and subjective measures to investigate differences in overgenerality, episodic details, and self-reported experience of MTT. I hypothesized that involuntary events would be more specific and contain more episodic detail than voluntary events across groups. My hypothesis was only partially supported. There were no differences between voluntary and involuntary MTT in either measures of overgenerality or episodic details within the university sample (Study 5a). However, in the clinical anxiety sample, across the sample involuntary MTT did contain more episodic details than voluntary MTT (Study 5b).

Recent work investigating involuntary MTT has shown that events tend to be more specific than voluntary MTT elicited in the laboratory in response to cue words, both when participants rate the specificity of their involuntary events (Berntsen & Jacobsen, 2008) and

when those events are objectively coded (Watson et al., 2013). Although the findings here are somewhat inconsistent with this literature, it is possible that the variation across the literature is due to how specificity is measured across different studies (i.e. self-report, dichotomous yes/no, overgenerality coding). It is also possible that the events produced by participants during voluntary MTT in the laboratory were accessed in a similar manner to those during involuntary MTT. Recent research has demonstrated that MTT generated in word cueing paradigms in both past and future directions are not necessarily modulated by generative retrieval processes that are characteristic of voluntary MTT. Rather, even in the laboratory context, events can come to mind via direct, associative retrieval processes with minimal search effort and with minimal manipulation; this is particularly true for events that have been thought about on a previous occasion (Jeunehomme & D'Argembeau, 2016; Uzer, Lee & Brown, 2012). Therefore, the finding in the current study that voluntary and involuntary events did not differ in specificity across groups may be due to a high percentage of specific events being retrieved in a direct associative way in *both* the laboratory and naturalistic setting.

Alternatively, it is possible that the overgenerality coding (i.e. Williams et al., 1996) is not sufficiently sensitive to detect differences between voluntary and involuntary events across groups. When I used a more sensitive measure of specificity (i.e episodic details) involuntary events were more specific, in that they contain more episodic details than voluntary events as (Study 5b). However, participants only produced more episodic detail for involuntary events (irrespective of anxiety level) when a community sample (healthy controls in the clinical experiment) was used (Study 5b). It may be that the differences in episodic detail production for involuntary MTT seen between Study 5a and Study 5b is related to underling sample characteristics between a university population (5a) and a community population (5b). There is some evidence that undergraduate university students report fewer

involuntary memories and differ in their ability to recognise involuntary memories relative to graduate students (Mace, Bernas and Clevinger, 2015). Mace and colleagues suggest that graduate students are more motivated to record involuntary memories than undergraduates are, and graduates are more astute observers of their own mental experience. It is possible that within the current study, participants from the community were more motivated to complete the task than undergraduate participants, and the poor completion rate for phenomenological questions within the university sample compared to the community sample provides support for this argument. Similarly, it is also possible that community members are more astute observes of their mental experience and this could be related to the community population being older than the university sample, and having more life experience. Nevertheless, the results of the clinical sample (Part B) are consistent with previous work that has shown involuntary memories and involuntary future projections are more detailed than voluntary events (Berntsen & Jacobsen, 2008).

Given previous work showing higher levels of pre/re-experiencing and higher emotional reaction ratings for involuntary MTT relative to voluntary MTT (Berntsen & Jacobsen, 2008; Finnbogadóttir & Berntsen, 2011), I predicted that involuntary MTT would be phenomenologically different to voluntary MTT across groups. While phenomenological analysis was not conducted on the university sample data due to a large proportion of participants not completing phenomenological questionnaires, within the clinical sample, my hypothesis was partially supported. Participants in both the anxiety and control group rated future involuntary events more frequently from a field perspective ("I can see it from my own eyes") than voluntary events. However, there were no other significant group differences between other voluntary and involuntary phenomenological ratings.

In line with clinical research in depression (Watson et al., 2013) and in sub-clinical worriers (Finnbogadóttir and Berntsen, 2011) I predicted that involuntary MTT in individuals

with elevated anxiety or an anxiety disorder would not differ significantly from controls. My hypothesis was not supported. While voluntary and involuntary MTT did not differ in individuals with elevated anxiety levels relative to low anxiety levels when event overgenerality was measured, those with elevated anxiety generated proportionally fewer episodic details in the involuntary MTT condition relative to low anxiety participants (Study 5a). The finding suggests that while events generated by individuals with elevated anxiety may be similar to those with low anxiety in that they are personally relevant and occur in a 24-hour period, there are significant reductions in the quality of the information provided about involuntary events. Extending this finding further, those with an anxiety disorder produced more overgeneral events with proportionally fewer episodic details irrespective of retrieval condition (i.e voluntary or involuntary) (Study 5b). The results of this study therefore suggest that in contrast to previous research in depressed individuals (Watson et al., 2013) and sub-clinical worriers (Finnbogadóttir & Berntsen, 2011), the deficits of overgenerality and episodic detail reduction seen in voluntary MTT are also found in involuntary MTT in anxiety within a naturalistic setting.

Finally, I predicted that involuntary MTT phenomenological ratings from individuals with elevated anxiety or clinical anxiety would not differ significantly to those with low levels of anxiety or healthy controls. The results of the clinical sample supported the hypothesis. More specifically, while individuals with anxiety disorders reported higher levels of sensory details, higher reaction to events, greater ratings of importance and rated the events as more central to their identity than controls in voluntarily generated past and future events, there were no differences in phenomenological ratings between groups for involuntary events.

The similarity in phenomenological ratings for involuntary events between controls and those with an anxiety disorder is particularly interesting given the observed reduction in

objective specificity measures. One possibility is that individuals with anxiety disorders have elevated sensitivity to experiential qualities of both voluntary and involuntary events, but for healthy controls, higher experiential ratings only occur for involuntary events. It may be that for healthy controls, voluntary MTT elicited within the laboratory is insufficient to affect phenomenological ratings (Talarico et al., 2004). Additionally, as involuntary MTT has more of an emotional impact than voluntary MTT (Cole, Staugaard & Berntsen, 2016) it is possible that phenomenological ratings for healthy controls are elevated during involuntary MTT to similar levels experienced by those with an anxiety disorder. However, on investigation of the data, it appears that those with an anxiety disorder have a reduction in phenomenological ratings during involuntary MTT rather than an increase in phenomenological ratings relative to controls. Therefore, it is more likely that avoidance strategies are successful in reducing affective responses that impact on the phenomenological qualities of MTT within a naturalistic setting. This will be discussed further in the general discussion.

While direct comparison to the results from previous studies within this thesis are made cautiously due to changes in methodology and removal of emotional valence instruction, there are consistencies in the results that are worth noting. For instance, there were no observed differences in the overgenerality or episodic detail of events between elevated anxiety participants and low anxiety participants when using voluntary MTT methodology in both Study 3 and Part A of the current study. Yet when the level of anxiety increased to clinical levels (i.e. in Study 4 and Part B of the current study) there is evidence that individuals with an anxiety disorder produce fewer episodic details in their MTT when elicited voluntarily. Further, in both clinical samples there was indication of phenomenologically different MTT for voluntary events.

The findings have important theoretical implications. The CaR-Fa-X model (Williams et al., 2007) posits that overgenerality is likely to occur only during generative, voluntary

retrieval processes due to the interplay between executive function, rumination and functional avoidance that is involved in accessing memory via a top-down search process, but not in direct involuntary retrieval. However, the current findings indicate impairments in both voluntary and involuntary MTT within anxiety disorders. These findings support the view that generative and direct retrieval may access the same underlying mental structures (Berntsen, 2009; 2012; Berntsen, Rubin & Salgado, 2015). The findings suggests that impairment for anxiety is not restricted to the top-down schema-driven processes of voluntary MTT but is also evident in associative bottom-up direct retrieval in involuntary MTT. Some argue that long-term functional avoidance of retrieving specific memories to reduce the potential impact on emotional functioning can lead to habitual general or abstract thinking styles (Conway & Pleydell-Pearce, 2000; Hermans et al., 2005). There is even some evidence suggesting that the orientation to threat observed in anxiety disorders may be due to an imbalance in bottom-up and top-down processes (see Mogg & Braddley, 2016). In light of this, the results of the current study, which shows overgenerality and reduced detail in both voluntary and involuntary MTT, may reflect habitual overgeneral thinking due to long-term cognitive avoidance. Future research investigating the correlations between specific cognitive avoidance strategies and overgenerality is needed to further elucidate this possibility.

The current study is not without limitations. Importantly, interpretative caution is required due to the small sample sizes in the sub-clinical anxiety (n = 16) and clinical population (n = 10) within the current two-part study. The interpretation of the null effects and reasoning provided for accepting the null hypotheses are made with the belief that the small sample size has likely contributed to the lack of findings. However, it is also possible that differences between voluntary and involuntary MTT are minimal. Additionally, the results may be affected by experimental constraints such as complexity of the design, uneven gender distribution, and difficulties with attrition and completion of the diary study

phenomenological ratings. Accordingly, the results are preliminary and replication using a larger sample with gender matched controls and modifications to the experimental design that improves completion rates (i.e. inbuilt program logic) and prevents incomplete questionnaires are needed.

Despite its limitations, the current study represents the first direct comparison between involuntary and voluntary MTT in sub-clinical and clinical anxiety using using novel mobile phone technology and combined objective and subjective measures. I showed that individuals with a clinical anxiety disorder have overgeneral episodic memory and episodic future thought that contains proportionally fewer episodic details relative to controls. Importantly, this difference was not specific to voluntary MTT elicited in the laboratory but was also evident in involuntary MTT elicited in day-to-day life. In addition, I found differences in the participants' experience of voluntary MTT with individuals with anxiety disorders providing higher ratings relative to healthy controls on a number of measures including sensory experience, reaction, importance and centrality to life story, however these differences were not observed between groups for involuntary events occurring in day-to-day life. These results contribute to a growing literature of future-oriented about cognitive processing in anxiety disorders and have potential implications for clinical interventions of a transdiagnostic nature. Exploring the differences in MTT between anxiety disorders and healthy individuals within naturalistic settings outside the laboratory will contribute to our understanding of the cognitive mechanisms maintaining anxiety disorders and have implications for potential treatment options in the shift towards transdiagnostic treatments of anxiety disorders.

CHAPTER 7

General Discussion

In this thesis, I investigated objective and subjective differences in mental time travel, that is our ability to think about the past and the future, in anxiety disorders. I specifically focused on overgenerality, that is a participant's tendency to generate fewer specific, personally relevant, past and future thoughts. Overgeneral MTT is associated with impaired functioning in clinical samples such as depression and PTSD (Williams, 2006; Williams et al., 2007). However there is a debate about whether anxiety disorders are also associated with overgeneral memory (Harvey, Watkins & Shafran, 2004). In addition, I focused on whether specific memories and future thoughts in anxiety were constructed differently (i.e. in terms of the amount of episodic detail), and whether anxious individuals reported differences in how they experience MTT relative to healthy controls. The motivation for this thesis came from a lack of empirical work in MTT in anxiety disorders, despite the fact that anxiety disorders are disorders with problematic future thought. Only a handful of studies have investigated elements of MTT in individual anxiety disorders, and until now, no single study has investigated objective and subjective differences in a transdiagnostic clinical anxiety population. This thesis makes a novel and substantive contribution to our understanding of episodic memory, episodic future thinking and anxiety disorders in adults.

Study 1 investigated whether methodological changes, namely implementing a verbal vs. written protocol, impacted the extent to which participants generate overgeneral memories and future thoughts, and episodic details in an autobiographical memory task. While previous research had compared results produced from verbal and written protocols separately (i.e. Henderson et al., 2002), this was the first study to directly compare verbal and written AMT protocols, showing that participants generated more specific events and with more episodic detail in the written version of a modified Autobiographical Memory Task when compared to

a verbal version of the task. The findings highlight a potential benefit of using written protocols in the investigation of MTT.

Study 1 demonstrated that using a written version of the AMT is an appropriate method of studying MTT. However, given the modifications made, it was prudent to conduct a feasibility study in a large sample to identify whether there were differences in MTT across elevated levels of anxiety, prior to commencing laboratory-based testing. Therefore, Study 2 explored the effects of increasing levels of anxiety on overgenerality and episodic detail in MTT within a large online sample. Additionally, given the suggestion that emotional valence might affect past and future MTT differently in individuals with anxiety, I explored whether there were quantitative differences in how people with anxiety form MTT narratives when given emotion valence instructions for past and future events (Samson-Daly et al., 2014; Miloyan et al., 2014; Miloyan et al., 2015). The results of this large online experiment showed that individuals with elevated anxiety had an overgeneral thinking style and produced past and future events that contained fewer episodic details than did controls. Moreover, there was a particular deficit in constructing detailed positive events in the future. The results of Study 2 suggest that is impaired MTT may contribute to reduced wellbeing in individuals with anxiety, given that the ability to produce specific and detailed simulations of the future is essential for wellbeing (Jing et al., 2016; Taylor & Schneider, 1989; Taylor et al., 1998; Williams et al., 2007). However, replication within a university sample was needed to address the limitations of using an online sample, prior to investigating the possibility of MTT deficits in a clinical population.

Study 3 aimed to determine whether the online findings of Study 2 generalised into a laboratory setting. Further, I aimed to investigate both the quantitative (objective) and qualitative (subjective) profiles of MTT within a sub-clinical anxiety sample to provide a clearer conceptualisation of how individuals with elevated anxiety construct and experience

emotionally-valenced past and future thought (the first study of its kind). The differences observed in MTT in the online sample (Study 2) were not replicated in the laboratory sample (Study 3). In the laboratory sample, there were no objective differences (overgenerality or episodic detail) seen between individuals with varying levels of anxiety. However, those with elevated anxiety reported different experiential qualities of their MTT relative to controls. In particular, individuals with elevated anxiety rated their MTT as less vivid, with less contextual details, particularly for past negative events, yet reported greater emotional reactivity relative to their non-anxious counterparts.

On review, methodological differences (i.e. amendments to instructions, laboratory setting/naturalistic setting for task completion) and differences in sample characteristics (i.e. university students vs. online community) between Study 2 and Study 3 are likely to have contributed to the inconsistency in the results. Nevertheless, the objective differences in Study 2 and subjective differences in Study 3 in individuals with elevated anxiety provided sufficient reason to replicate the study in a clinical anxiety population. Study 4 was designed to test whether individuals with clinical levels of anxiety had both objective and subjective differences in their MTT relative to healthy controls, or if there was a dissociation between the objective and subjective experience of MTT, like that observed in the university sample in Study 3. Study 4 used a transdiagnostic approach to investigate MTT in clinical anxiety. I chose to test transdiagnostic sample because there is significant comorbidity, a similar genetic framework, and treatment response overlap in anxiety disorders (Kendler, 1996; Kessler et al., 2005; Newby et al., 2015). Study 4 was the first transdiagnostic study to use both objective and subjective measures to compare MTT in individuals with an anxiety disorder with healthy controls. It found that individuals with clinical anxiety disorders produced past and future event narratives that contained fewer episodic details; this was particularly true for negative events. I also found that those with a clinical anxiety disorder

reported that their MTT produced greater feelings of pre-experiencing, more emotional reaction, greater levels of coherence and was more likely to be viewed through their own eyes, distinctions not seen in their non-anxious counterparts. Those with clinical levels of anxiety had both objective and subjective differences in their MTT relative to healthy controls, there was not a dissociation between objective and subjective MTT experience like that observed in the university sample.

Recent work has suggested that the way MTT is elicited in laboratory settings is different to how it is elicited in naturalistic settings, which is a particularly important consideration in clinical work (Addis et al., 2016). Laboratory-based studies assess *voluntary MTT,* that is memories and future thoughts which are retrieved or simulated via a generative deliberate and strategic process. In naturalistic settings, studies assess *involuntary MTT,* that is memories or future thoughts that come to mind via direct retrieval, spontaneously with no conscious attempts at retrieval (Berntsen, 1996; Berntsen & Jacobsen, 2008). Research investigating involuntary MTT has failed to replicate MTT differences in clinical populations that were previously reported using voluntary methods (Finnbogadóttir & Berntsen, 2011; 2013; Watson et al., 2013). Accordingly, Study 5 investigated whether the deficits in MTT observed in Study 3 and Study 4 were specific to the laboratory environment or could be replicated in a naturalistic environment.

Study 5 compared voluntary MTT in the laboratory and involuntary MTT in a naturalistic setting using mobile phone technology in both a sub-clinical university population and clinical anxiety population. Study 5a showed that individuals with elevated anxiety levels produced past and future event narratives that contained fewer episodic details, and this was the case both in voluntary and involuntary MTT. Study 5b showed that individuals with a clinical anxiety disorder produced fewer specific episodic memories and episodic future thoughts, the events that were specific contained proportionally fewer

episodic details relative to controls and this was the case both in voluntary and involuntary MTT. These results differed from Study 5a in that sub-clinical levels of anxiety did not affect the production of specific events, whereas with clinical levels of anxiety participants provided fewer specific episodic memories and episodic future thoughts. Additionally, the experiential quality of voluntary MTT differed for those with a clinical anxiety disorder relative to controls, providing higher ratings on a number of items including sensory experience, reaction, importance and centrality to life story. However, these experiential differences were specific to voluntary MTT. The findings suggest MTT impairment for anxiety-disordered individuals is not restricted to laboratory-based voluntary MTT, but is also evident in involuntary MTT in a naturalistic setting. Rather it also occurs when personal past or future events come to mind spontaneously, via direct retrieval processes, which involve little executive control. However, in a naturalistic setting there appears to be a dissociation between the objective and subjective differences. In the laboratory, people with anxiety disorders produce more overgeneral events with fewer episodic details and experience these events differently relative to controls. However, in a naturalistic setting those with anxiety produce more overgeneral events with fewer episodic details yet the subjective experience is rated similarly to that of controls.

Taken together, the data from this thesis demonstrates that deficits in objective vs. subject MTT manifest differently at different anxiety levels. The studies within this thesis have illustrated that anxiety impacts the overgenerality, episodic detail and the experiential qualities of MTT. Critically, the findings highlight that deficits in MTT in individuals with anxiety disorders are not restricted to laboratory settings. The data contributes to our understanding of MTT in clinical anxiety in five key ways. First, the findings suggest that impairment in MTT is evident in individuals with anxiety disorders, a group of disorders not traditionally associated with memory impairment. Second, the impairment is observed in

relation to both remembering the past and imagining the future. Third, the findings demonstrate that the subjective experience of MTT differs for individuals with anxiety when they deliberately think about personally-relevant past and future events. Fourth, the observed differences were not specific to negative events only, but also seen in neutral events. Fifth, the findings indicate that irrespective of environmental setting (laboratory or naturalistic) there are objective differences in the quality of MTT produced by individuals with anxiety disorders.

Individuals with anxiety disorders have impaired MTT.

The future thinking literature suggests that individuals with anxiety exhibit an increased anticipation for negative future experiences (Macleod & Byrne, 1996) and reduced capacity to imagine personal positive events (Macleod & Conway, 2007). The results of this thesis extend the literature further providing a nuanced profile of *how* individuals with anxiety think about their personal past and future, and the perceived qualities of those experiences.

Overgeneral thinking, or the reduction in the ability to generate a specific personally relevant event, is a key characteristic of MTT impairment in clinical populations. For instance, people with depression (Addis et al., 2016; Anderson & Evan, 2015; Szollosi et al., 2015; Williams et al., 1996) in individuals with PTSD (Brown et al., 2014; 2013; McNally et al., 1995; 1994) exhibit overgeneral memory and future thinking. Typically, MTT research has been restricted to populations with known episodic memory deficits, because here are common neural pathways involved in remembering the past and imagining the future (for review see Szpunar, 2010; Szpunar et al., 2014; Williams et al., 2007). The findings of this thesis extend the literature highlighting that anxiety disorders, which do not typically present with reduced memory function, also exhibit overgeneral episodic memory and episodic future thinking (see Zlomizuca, 2014). Given that people with anxiety intact memory function, researchers suggested that MTT in anxiety disorders would occur only in a future direction

(Miloyan et al., 2014). This thesis thoroughly tested this assumption. The results presented here show that impairments in MTT are evident in relation to both remembering the past and imagining the future, much like previous work in PTSD (Brown et al., 2013; 2014). Moreover, like those with PTSD, a transdiagnostic sample of clinical anxiety individuals produced more overgeneral MTT, and their specific events contained fewer episodic details. The findings of this thesis contrast with the MTT data from a sub-clinical health anxiety sample who reported more specific past events and overgeneral future events when threat cues were used (Samson-Daly et al., 2014).

In addition, MTT for individuals with clinical anxiety was phenomenologically different to healthy controls, but only when participants were required to deliberately generate past or future events. D'Argembeau and Van der Linden (2006) showed that individual differences in visual imagery and suppression influences the phenomenological experience of MTT. The research presented here extends those findings. Across the studies within this thesis, differences in participant's experience of MTT were observed when anxiety levels increased above a certain threshold. The specific phenomenological differences and direction of difference were different across each sample suggesting that self-report measures may be particularly sensitive to differences in experimental conditions and sample characteristics (Paulhaus & Vazire, 2007). Inconsistency in phenomenological findings is characteristic of the current literature on MTT experience in anxiety disorders, which includes both increases or decreases in self-reported ratings and specific phenomenological differences.

The inconsistencies in phenomenological findings across the literature hamper our understanding of the experiential nature of MTT in anxiety disorders. For example, it is puzzling that within this thesis there was evidence of both decreased levels of vividness and contextual details (Study 3), and increased ratings of pre-experiencing, sensory ratings, field

perspective, coherence, importance and centrality for identity (Study 4; Study 5). This investigation found increases in self-report ratings in the clinical anxiety groups, however, these contrast with previous work reporting lower ratings in individuals high in suppression (D'Argembeau et al., 2006). Similarly, the results obtained here contrast with studies investigating high trait anxiety (D'Argembeau et al., 2003) and sub-clinical high worriers (Finnbogadóttir & Berntsen, 2013); which did not find phenomenological differences relative to controls. Ratings of reaction (physiological and emotional) were the only phenomenological variable that was found to be consistently elevated in anxiety relative to controls. This finding is consistent with the models of anxiety that indicate exaggerated (or hypersensitive) physiological and subjective emotional responses (Clark & Beck, 2011; Clark & Watson, 1991). Exaggerated physiological and subjective responses are attributed to alterations in neurological pathways within anxiety disorders (see Grupe & Nitschke, 2013), and these elevated responses are likely to contribute to differences in the perceived qualities of MTT. Overall, the results show that individuals with sub-clinical and clinical levels of anxiety experience MTT differently relative to healthy controls.

Across the studies reported here, emotional valence differentially affected both episodic detail and the phenomenological experience of MTT in anxiety disorders. Episodic details and self-report ratings of contextual details differed for negative events relative to positive or neutral events. These findings are consistent with research suggesting that emotional arousal can impair memory (Holland & Kensinger, 2010; Mickley & Kensinger, 2009; Matier & Sutherland, 2011) and impact phenomenological response (D'Argembeau, Comblain & Van der Linden, 2003; D'Argembeau & Van der Linden, 2004; D'Argembeau et al., 2011; De Vito et al., 2014). Previous research has indicated that patients with anxiety disorders generate more vivid imagery for negative futures relative to both healthy controls and individuals with depression (Morina et al., 2011). In contrast, within this thesis, participants

with anxiety disorders were impaired in both neutral and negative events, producing fewer episodic details than controls. Why would anxiety participants provide fewer episodic details about both neutral and negative events? It is possible that clinically-anxious individuals do not frequently experience neutral mood states due to the nature of the disorder (i.e. increased hyperarousal, increased emotional reactivity), reducing the likelihood that they have detailed neutral memories to draw upon for event construction. It is also possible that neutral events contain negative or threatening cues in anxiety disorders, resulting in the engagement of similar avoidance mechanisms. It is important to note, that a limitation of the research presented here is that the content of each event was not checked to determine if it was consistent with the instruction valence. Participants were requested to come up with positive or negative events, however, I did not code whether the content of the events were in fact positive or negative. Similarly, while neutral events did not have any instructional valence, it is possible that the content of neutral events generated were positive or negative. Future research should code the anxiety content of neutral past and future events, much like has been done previously in PTSD research (see Brown et al., 2013), in order to clarify the affective valence of events provided. Further the example of a specific event provided within the instructions (i.e. an experience on holiday in Thailand) may have primed participant generated events towards a particular emotional experience. Future research would benefit from using multiple instructional examples or to investigate the possibility that the valence of the specific episodes provided as example could potentially impact on the events provided by participants Ultimately, the findings here support the suggestion from Conway & Pleydell-Pearce (2000) that engaging in overgeneral memory functions to reduce negative affect. However, the fact that positive events were not impaired conflicts with the CaR-FA-X model, which proposes that overgenerality should be seen across emotional valences, and predicts that deficits would not be specific to negative events (Williams, 2006; Williams et al., 2007).

The observations from this body of work therefore highlight that continued research about the impact of emotion on MTT is necessary, both for replication of the current findings and to confirm our understanding of impairment of MTT in anxiety disorders.

The data presented here extends the literature illustrating, for the first time, that in anxiety disorders, impairment in MTT is not specific to laboratory research. This contrasts with previous studies that have investigated MTT in naturalistic settings and failed to replicate reductions in MTT ability observed within the laboratory (Berntsen, 2009; Finbodagottir & Berntsen, 2011; Watson et al., 2013). It is likely that methodology differences can account for the discrepancy between my work and previous studies comparing laboratory and naturalistic settings. Previous studies have investigated specific anxiety constructs in non-clinical samples (i.e. worry; Finnbogadóttir & Berntsen, 2011) rather than specific anxiety disorders. The studies have used diary methodology which asks participants to carry around a diary which they use to write to write a brief description of an involuntary events. Only at a later during do the participants write a full description of the event and complete a follow up questionnaire later (see Berntsen & Hall, 2004). The problem with this methodology is that the involuntary future thought is not captured in real-time, the generation of the event is in essence retrieved twice, and the future event becomes 'a memory of the future' (Szpunar & Schacter, 2013), because it has already been simulated. Given that there is increased detail associated with repeat simulations of events in healthy and clinical populations (Szpunar, Addis & Schacter, 2012; Szpunar & Schacter, 2013; Wu et al., 2015) it is possible that during the second retrieval, participants are able to be more specific and provide more detail than the initial involuntary thought, obscuring group differences. This is the first study to directly compare voluntary MTT elicited in a laboratory setting using the laboratory methodology used throughout the literature (i.e. a modified AMT task) to involuntary MTT elicited spontaneously in a naturalistic setting captured in real-time. Here I report impairments in both

voluntary and involuntary MTT in anxiety, however, the findings indicate that the impairments were identical across settings. For example, overgeneral thinking and reduced episodic details were seen in both the laboratory setting and naturalistic settings, however phenomenological differences were seen in the laboratory but were not seen in a naturalistic setting.

The finding that those with anxiety disorders produce fewer specific past and future events when tested in a naturalistic setting, despite reporting no differences in phenomenological experience is puzzling. One possibility is that functionally avoiding affective experiences through overgeneral thinking is only successful when participants engage in MTT in a naturalistic setting (Conway & Pleydell-Pearce, 2000; Williams, 2006; Williams et al., 2007). Why would engaging in overgeneral thinking in a laboratory setting be ineffective reducing a participants' affective experience associated with MTT? It is possible that overgeneral thinking and reduced episodic detail are more successful in reducing the phenomenological experience of remembering/imagining during involuntary MTT, when other environmental factors such as situational distractions, reduced executive function and attention are elevated.

In thinking about the CaR-Fa-X model (Williams, 2006; Williams et al., 2007), it is possible that all the elements required for successful overgeneral thinking are not present when participants are tested in the laboratory. The Car-FA-X model purports that overgeneral thinking occurs in the context of *three* underlying mechanisms, capture and rumination (CaR), functional avoidance (FA) and impaired executive control (X). Capture and rumination, that is where an individual's attention is captured by a repetitive and passive thinking style, reduces attention and results in the interruption of on-task processing. The reduced attention in turn disrupts the retrieval process required to access specific episodic memories or generate specific episodic future thoughts. Functional avoidance refers to the

mechanisms employed by an individual to reduce possible changes in affect, and impaired executive control refers to reduction in executive resources, which also play an important role in the retrieval of specific memories. It is unlikely that the laboratory setting reduces attentional and executive functioning resources akin to that of the real world. Therefore, in the laboratory the process of generating more overgeneral and less detailed events may be insufficient to allow the participant to disengage with the emotional content of the events and reduce affective response to the events generated. It may also be that involuntary MTT is like the intrusive involuntary images and visual memories reported frequently in anxiety disorders (Brewin, Gregory, Lipton & Burgess, 2010). The similarity between involuntary MTT and other involuntary/intrusive imagery may result in individuals with anxiety disorders employing habitual avoidance strategies to prevent affective responses to the involuntary MTT, strategies which are likely more refined and successful than overgenerality per se. Future research that measures rumination, executive function and avoidance across contexts in addition to specificity / episodic detail is needed to explore this possibility.

Theoretical Implications

Why might MTT be impaired in Anxiety disorders?

The data reported here contributes to our understanding of how people with anxiety disorders construct past and future thought, and the impact these thoughts have on their subjective experience of MTT. Several factors likely contribute to the MTT profile seen within this body of research; I will focus on impaired MTT as an avoidance strategy and in relation to specific neural mechanisms.

Impaired MTT as an avoidance strategy. According to the classic dual-model of anxiety, elevated fear to environmental cues results in the operant learning of specific avoidance behaviours to reduce fear (Bouton, Mineka & Barlow, 2001; Mowrer &

Lamoreaux, 1946). Attentional biases that facilitate threat detection (see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & Van Ijzendoorn, 2007 for review) and increased belief in negative events happening (Åström et al., 2014; Macleod & Byrne, 1996) contribute to the maintenance of fears of the future and the active avoidance of them. With evidence that repeated simulation of future events increases the belief that the event will occur (Szpunar & Schacter, 2013), in the context of anxiety it is likely that continued negative thoughts about the future increase the belief that negative event will happen, which contributes to a perpetuating cycle of negative thoughts and beliefs that negative events will occur. This may in turn contribute to the activation of avoidance strategies, including reductions in specificity. It is possible that by imagining the future in a less detailed way, those with anxiety disorders seek to reduce fear related to the future and the subjective experience (i.e. negative affect) associated with specific future thoughts (Behar, Di Marco, Hekler, Mohlman & Staples, 2009; Borkovec et al., 2004; Jing et al., 2016; Williams et al., 2007). The findings presented here illustrate that this avoidance strategy is applied to thinking about both the past and future.

Critically, evidence of overgeneral memory and reduced episodic detail as an avoidance strategy emerges from the mental imagery literature. It is thought that overgeneral memory reflects a deficit in generating mental imagery (Holmes, Blackwell, Heyes, Renner & Raes, 2016; Raes et al., 2006; Williams et al., 2007) as having a specific retrieval/simulation style encourages imagery-based event generations (Holmes et al., 2016). Holmes and Mathews (2010) propose that mental images of events are akin to real-life events with imagery activating many of the brain systems involved in perception. The fact that similar areas of the brain are activated when people generate visual imagery and perceive different objects (see Ganis, Thompson & Kossyln, 2004). The shared perceptual qualities of imagined events and real-life events result in mental images act as emotional amplifiers

(Holmes and Mathews, 2010; Kosslyn, Ganis, Thomson, 2001). Therefore, in the context of anxiety where avoidance of experiencing affect is typical (Amstadter, 2008; Borkovec et al., 2004; Clark & Beck, 2010; Moses & Barlow, 2006; Riskind & Williams, 2006; Wells, 2013) people are likely to implement strategies that reduce mental imagery. There is some evidence supporting this idea with reported reductions in mental imagery seen in anxiety disorders correlated with reductions in emotional processing towards threating stimuli (Borkovec et al., 2004). It is therefore likely that the intentional reduction of mental imagery and the corresponding reduction in emotional affect is a strategy activated during overgeneral thinking.

Ultimately, avoidance strategies are maladaptive in the long-term. Individuals who engage in avoidance are unable to disconfirm their negative future predictions and their avoidance behaviour is negatively reinforced (Borkovec et al., 2004; Foa & Kozak, 1986; Lovibond, Mitchell, Minard, Brady & Menzies, 2009). Barsic and colleagues (2015) suggest that the repeated suppression of negative future thoughts can induce negative mood states, leading to an increased accessibility of negative thoughts and a reinforcing negative mood/thought cycle. Further, engaging in overgenerality is thought to exacerbate existing clinical features in anxiety such as avoidance, making it more difficult for the individual to imagine specific futures that can help them plan, make decisions and reason about the world (Miloyan et al., 2014; Williams, 2006; Williams et al., 2007). More generally, overgeneral thinking as an avoidance strategy is particularly maladaptive as it is associated with reduction in preparatory behaviour, depressive expectations of the future, poor planning strategies and reduced problem solving abilities (Lyons et al., 2015; Miranda & Mennin, 2007; Strunk et al., 2006).

Limitations and Future Directions

The findings reported here contribute to our understanding of MTT in anxiety disorders, showing that, despite no clear evidence of memory deficit, individuals with anxiety have impaired MTT, similar to other clinical populations. Here I will discuss some general limitations of the data and broader methodological considerations for the study of MTT. Additionally, I discuss future research directions.

General Limitations

There are several limitations in each study that likely affected the findings of this thesis. Many of the effects seen were small to medium in magnitude, with only a few large in magnitude; we can attribute these effect sizes to small sample sizes used within the clinical groups. Future research is needed to replicate the findings of this thesis using larger samples to determine if larger effects, which would have greater clinical relevance, are obtained. Small methodological differences across studies (i.e. adjustments to instructions, missing data replacement techniques, removal of emotional valence instructions) and experimental error may have contributed to the variation in objective and subjective findings between each study. Similarly, sample characteristics (i.e. university students vs. online sample vs. clinical sample) and unequal gender distribution are likely to have affected the experimental outcomes. For instances the findings presented here indicate potential gender differences in the subjective experience (i.e. pre-experiencing and reaction) of MTT and in the production of voluntary MTT. Gender differences are particularly important to consider in clinical research given that there is often a gender imbalance in the prevalence of clinical disorders, this is particularly true in anxiety disorders with a prevalence male: female ratio of 1:1.7 (McLean et al., 2011). The results here are consistent with other research that has found females report more detailed and emotionally intense autobiographical memories than males (Davis, 1999; Fujita et al., 1991; Grysman, 2016). Additionally, there is evidence that

females have an advantage in verbal episodic memory whereas males have an advantage in spatial visualisation (Siedleck, 2016) which might explain the finding that males produce more overgeneral voluntary events. It is interesting to note the difference in the number of participants who successfully produced specific events for all events between the undergraduate/online samples compared to the clinical samples. For instance, undergraduate and online samples in studies 1, 2 & 3 required data replacement techniques for episodic detail scoring analysis. Whereas the same data replacement techniques were not required for the clinical sample data in study 4 nor in study 5. It is possible that the participants in the clinical studies were adhering to instructions more acutely as they were recruited from the community and participants were being paid for their participation. In contrast, in Study 3 most of the participants were undergraduate students who were participating in psychology experiments for course requirements. Additionally, it is possible that individuals meeting criteria for anxiety disorders in the clinical studies (Study 4 and Study 5b) may have adhered to the instructions more intently as a consequence of their psychological presentation (i.e. engaging in self-checking behaviours, elevated awareness of social judgment, elevated worries to complete the task accurately). Fundamentally, variation in methodology in the investigation of MTT, in the dependent variables of measurement and the populations used, contribute to the lack of consistency in outcomes. The variability across the literature highlights the need for a gold standard measure of MTT and specific measures to be used consistently and with methodological stringency within this field of research.

Methodological Considerations

The way in which overgeneral thinking is conceptualized within the literature deserves consideration. One particular question that arises is whether the two objective measure protocols (detail coding, Levine et al., 2002; overgenerality coding, William et al., 1996), which are used somewhat interchangeably throughout the literature, in fact index the

same MTT processes. Both measures are used to draw conclusions related to the specificity of past and future events. However, when measured in the same person, the data in this thesis shows that the number of personal events identified as occurring within a 24-hour period (overgenerality coding) provides an index of MTT ability that is very different from the content details provided within specific events (detail coding). The significant group differences observed in episodic detail coding but not overgenerality coding (i.e. Study 4) provide support for this argument. It is possible that overgenerality coding simply provides an index of a participant's ability to follow instructions. Previous research has shown that manipulating the instructions can impact on the specificity of events (Williams et al., 1996), whereas providing minimal instructions can increase the sensitivity with which the AMT task is able to detect reductions in memory specificity in non-clinical samples (Debeer et al., 2009). Further, some researchers argue that participants are able to overcome habitual tendencies towards overgenerality when they are given detailed instructions and prompting throughout the experiment to provide specific events (Anderson et al., 2015). As such, it may be that the lack of overgeneral findings observed in the university samples in Study 4 and Study 5a, is simply a function of participants following the detailed instructions and screen prompts to provide specific personal events occurring within 24 hrs for each event.

Zlomuzica (2014) argues that the coding systems associated with AMT protocols (i.e. Williams et al., 1996) oversimplify the complexity of remembering and imagining events. Some researchers use a binary view of memories as specific or not, which excludes the possibility of partially accessible episodic past and future thoughts (i.e. categoric/intermediate events) (Dalgleish et al., 2007; Williams & Broadbent, 1986). Williams et al., (1996) coding protocol forces experimenters to arbitrarily categorise memories or future thoughts as either specific, categoric/intermediate or general. The over-simplification of memory categorisation is problematic for two reasons. First, it may be difficult for participants to grasp the

differences between general, categoric/intermediate and specific events when presented with instructions asking for specific events. Second, the simple classifications may not accurately reflect how we remember or imagine events. A large proportion of participants in the current thesis provided categoric/intermediate and general events despite instructions to provide specific events. It may be that participants struggle to understand the difference between specific and categoric/intermediate, general. Recent MTT research using real-time experience sampling in a healthy population highlighted similar methodological difficulties (Busby-Grant & Walsh, 2016). The study asked participants to report episodic and non-episodic past and future thoughts in real-time, and to classify each experience as episodic or non-episodic. Participants were provided with instructions and examples of episodic/non-episodic events at the beginning the experiment. The results showed that 28% of the responses were not categorised correctly, suggesting that people had trouble understanding the distinction between episodic /non-episodic experiences. In addition to difficulty with participants understanding the distinction between specific and non-specific, the current gold standard measure may not accurately reflect the complexity of MTT. It may be more accurate to consider memory as a gradient from semantic to episodic (Moscovitch, Garvic, Merrifield, Bielak & Moscovitch, 2011; Szpunar et al., 2014). In line with this dimensional approach, coding the individual details generated as episodic or semantic (i.e. Levine et al., 2002) may offer a more sensitive measure because it identifies episodic information (or 'event specific knowledge' according to Conway and Pleydell-Pearce (2000) self-memory model) elicitied in specific past and future thought, thus reflecting the quality of the memory/future thought, rather than simply grouping events into arbitrary categories.

Here I found that MTT in anxiety differs when participants are tested in the laboratory vs. in a naturalistic setting. These findings suggest that it may be necessary to shift the focus of the literature from laboratory research to research that uses experiential sampling to index

how MTT works in a more ecologically valid way. Experiential sampling methodology is an exciting avenue for MTT research, because it enables researchers to obtain and access information related to the environmental conditions that influence MTT, the emotional impact of MTT and the corresponding behavioural response in real-time (see Berntsen & Bohn, 2010; Berntsen & Jacobsen, 2008; Busby-Grant & Walsh, 2016; Chow et al., 2017; D'Argembeau et al., 2011). However, conducting research within naturalistic settings comes with its own set of challenges. For instance, here many participants did not complete the self-report ratings for their involuntary events, rendering the line of enquiry regarding phenomenological differences impossible. Recent experiential sampling research within the MTT literature suggests that striking a balance between rapid experience sampling and data loss is important; it may be necessary to incorporate both laboratory and naturalistic settings in an experimental design (Busby-Grant & Walsh, 2016). One possibility emerging from this thesis is the currently undervalued potential of clinical research in online communities. Some researchers argue that data obtained from online workforces is of equal reliability to that obtained from university sampling (Buhrmester et al., 2011) and is comparable to traditional methods (see Gosling, Vazire, Srivastava & John, 2004). It is possible in this thesis that the online MTurk sample (Chapter 3) is a more representative sample of the prevalence of anxiety in the general population than the university sample. Online recruitment might not just be a viable option but it is possibly a better option for future research than recruiting from sub-clinical university samples.

The current work calls into question the ecological validity of the constructive episodic simulation hypothesis (Schacter & Addis, 2007a). This model argues that memory and future thinking are subserved by the same network of brain areas during event construction. However, the model does not account for the role of affect in event construction and elaboration, nor does it include the neural pathways that may be implicated in these

processes. The emotions experienced both at the time an event occurs, as well as when the event is either remembered or imagined, significantly contributes to the quality and subjective experience of the event. Further, the constructive episodic simulation hypothesis does not consider how events are constructed in a naturalistic environment. The fast, spontaneous and effortless occurrence of involuntary MTT is thought to occur because of the commonalities between the current situation the participant finds themselves in and the content/thoughts of a past experience (Rasmussen & Berntsen, 2009). Involuntary episodic memory and episodic future thought challenges the widely-held view that successful episodic future thought requires the flexible manipulation of past episodic memory details. Further, laboratory MTT may be elicited more like involuntary MTT than previously thought. Recent evidence suggests that a large proportion of MTT, even in the laboratory, are elicited via direct "bottom-up" associative retrieval processes (de Vitto et al., 2015; see Jeunehomme & D'Argembeau, 2016). The findings suggest that the flexible recombination of events and activation of relational memory networks may not be required for all episodic memory and episodic future thought, but perhaps only for some, such as future thoughts simulated for the first time. The possibility that that other mechanisms connect episodic memory and episodic future thought, including affective experience and associative links related to environmental and internal cues, therefore deserves further consideration in theories of MTT mechanism.

Future Research Directions

MTT is essential for well-being, because it enables us to avoid threats, reduce risk, facilitate goal attainment, and promotes effective decision making and problem solving (Addis et al., 2007; Baumgartner et al., 2008; Miloyan et al 2014; Schacter et al., 2012; Suddendorf & Corballis 2007b). Episodic future thought is believed to be adaptive because it allows an individual to pre-experience future events and adjust behaviours in the present accordingly (see Schacter et al., 2012 for review). Therefore, it is likely that the differences

observed in MTT for individuals with anxiety contribute to both the development and maintenance of anxiety disorders.

Future research in the area should investigate the specific impact of impaired MTT in anxiety on behavioural functioning. Methods in which we can experimentally manipulate opportunities to draw on experiences and future thoughts may be particularly fruitful in this regard (Buckner & Carroll, 2007). For instance, behavioural research using a virtual reality paradigm has shown difficulties in imagining and constructing episodic future thoughts contributes to reduced preparatory behaviour and problem solving in individuals with schizophrenia, a population with impaired MTT (Lyons et al., 2016). The purpose-built virtual reality computerised board game indexed participants' ability to self-generate and execute future-directed task-relevant intentions. The research extended the current literature, highlighting that not only do individuals with schizophrenia have difficulty imagining and constructing future events, but this difficulty extends to problems with preparatory behaviour and problem solving. Conducting similar research in anxiety disorders would contribute to our understanding of how MTT impairment impacts behavioural functioning, and could lead to potential future treatment implications.

Generating specific detailed simulations enhances the ability to engage in emotion regulation and problem solving (Jing et al., 2016; Sheldon, McAndrews & Moscovitch, 2011; Taylor, 1998). For instance, Madore & Schacter (2014a) demonstrated that increasing the level of detail with which a participant recollects a recent experience improves problem solving ability both in young and old adults. Using an *episodic specificity induction task* which draws on the established procedures in eye-witness testimony, participants watched a short film and were subsequently guided though recalling specific episodic details with probes for specific details related to people, settings and actions. Problem solving ability was then measured using means-end problem solving (Platt & Spivack, 1975), in which

participants were asked to generate relevant steps to solve the specific problem. The specificity induction task was found to increase the number of specific details that participants generated and the number of relevant problem-solving steps that they engaged in (Madore & Schacter, 2014b). This specificity also improves memory performance, divergent thinking and imagination (Madore, Addis & Schacter, 2015; Madore, Gaesser & Schacter, 2014; see Schacter & Madore for review, 2016). It may be possible to improve behavioural functioning in individuals with clinical disorders, including anxiety, by applying interventions designed to increase specificity and episodic detail. Research has already shown that the episodic specificity induction task can improve means-end problem solving, increase ratings of well-being, and reduce anxiety related to personal worrisome events in a healthy adult sample (Jing et al., 2016). In this study, the specificity induction task not only improved problem-solving strategies but was also an effective modification to a reappraisal technique used in cognitive therapy. Jing and colleagues modified the reappraisal strategy which typically focuses on reframing a negative experience, such that they asked participants to think about the specific episodic details of the negative event (i.e. worried future experience) instead. They found that the episodic reappraisal task decreased anxiety ratings, decreased participants' perceptions of the likelihood of a bad outcome and the perceived difficulty to cope. Participants also reported increases in beliefs in positive outcomes. Therefore, specificity induction training and its impact on wellbeing is a promising avenue for future research in anxiety disorders, particularly in light of the impairment in specificity seen in this thesis.

The adaptive benefits of retrieving and simulating *positive* events for improving mood, increasing positive emotions such as happiness, and challenging perceptions related to the future (Garcia – Bajos & Migueles, 2016; Parrott & Sabini, 1990; Pictet, Coughtrey, Mathews & Holmes, 2011; Quoidbach, Wood & Hansenne, 2009; Szpunar et al., 2014) are

particularly relevant in the context of anxiety. In healthy adults, repeatedly simulating emotionally-laden specific future events increases the number of details generated and increases the expectation of the event occurring (Szpunar & Schacter, 2013). This would suggest that sustained simulations with a specific emotional valence could promote either happiness, in the case of positive events, or anxiety/depression, in the case of negative events. For instance, imagining positive future events over a two-week period lead to a significant increase in happiness ratings in healthy individuals while imagining neutral events lead to a decrease in anxiety (Quoidbach et al., 2009). Therefore, purposely engaging in positive future thinking may impact happiness and wellbeing. Evidence supporting the power of positive simulations has also emerged from the imagery rescripting literature. For instance, imagery rescripting is successful in modifying negative thoughts (Holmes, Arntz & Smucker, 2007) and effective in a number of clinical populations including PTSD (Arnts, Tiesema & Kindt, 2007; Grunert, Weis, Smucker, & Christianson, 2007), social phobia (Wild et al., 2007) and major depressive disorder (Wheatley et al., 2007). Accordingly, future clinical research investigating the impact of teaching anxious individuals how to engage in concrete and detailed positive future simulations is an important future avenue of research. This strategy has the potential to increase positive affect overall, activate positive autobiographical memories that would reduce the activation of negative events and challenge negative schema. Further, investigating imagery and increased specificity training could facilitate links between dysfunction and the importance of specific, episodic detail rich MTT in day to day lives.

The body of research reported in this thesis has contributed to the transdiagnostic literature by demonstrating that across various anxiety disorders there appears to be impaired MTT, even in individuals who do not also meet criteria for depression. Given the comorbidity of anxiety disorders with mood disorders (Bruce, Machan, Dyck, & Keller, 2001; Vasile et

al., 1997; Yonkers, Dyck, & Keller, 2001; Yonkers, Warshaw, Massion, & Keller, 1996), this research has implications for future transdiagnostic work. It may be that those with anxiety disorders do have impaired MTT similar to the impairment seen in depressed samples (Addis et al., 2016; Anderson & Evan, 2015; Szollosi et al., 2014; Williams et al., 1996). However, given that attentional and interpretive biases in certain anxiety disorders such as social phobia have been shown to be affected by comorbid depression (Musa, Lepine, Clark, Mansell & Ehlers, 2003; Wilson & Rapee, 2005), it is important to consider that these conditions are not entirely separate and are likely to interact in MTT impairment. It is possible the impairment reported here is different to that of impairment in individuals who have both anxiety and depression. Consequently, as D'Argembeau and colleagues propose (2006), future research would do well to investigate the joint and possibly interactive effects of these two clinical disorders rather than studying one while controlling for the other.

The research presented here highlights the utility of transdiagnostic research and transdiagnostic treatment. With evidence of impaired MTT in both temporal directions, the pattern of impairment in anxiety disorders more closely reflected depression than previously assumed (Miloyan et al., 2014). Comorbidity of the two disorders is the rule rather than the exception, and treatments suggested for emotional disorders such as depression, are similarly potential avenues for the treatment of anxiety disorders (Jenson, Cohen, Mennin, Fresco & Heimberg, 2016).

Clinical Implications

Anxiety disorders are often chronic with relatively low remission rates and variable relapse rates ranging from 23% to 50% after treatment (Barlow, 2002; Schuurmans et al., 2005; Yonkers et al., 2003). As such, research is needed to enhance our understanding of the mechanisms underlying anxiety disorders, and to provide new evidence-based treatment protocols. The data reported here showing that MTT is impaired in anxiety disorders,

contributes not only to the conceptualisation of this group of disorders, but also provides possible new avenues for clinical treatment.

The potential for specificity inductions to be used as an adjunct intervention in transdiagnostic samples is promising. Extending specificity induction tasks to clinical intervention settings is an important future direction, which will determine the translational utility of such interventions in improving event specificity and detail, along with the potential benefits when used in combination with exposure therapy (Addis et al., 2016). The preliminary evidence in individuals experiencing worry, supports the clinical utility of episodic specificity induction tasks. Specificity induction produced significant decreases in anxiety, which were related to episodic reappraisals of negative outcomes, increases in perceived ability to cope as well as improvements in problem solving strategy in healthy adults (Jing et al., 2016). Further research has shown that elaborately and vividly imagining episodes increases participants' willingness to interact and engage with unfamiliar others, and that more elaborately imagined events reduce anxiety (Crisp, Husnu, Meleady, Stathi & Turner, 2010; Husnu & Crisp, 2010). These effects have the potential to improve symptoms associated with social anxiety disorder. Further, recent work has shown that the episodic specificity of future events predicts performance on social problem-solving tasks, suggesting potential applications for increasing problem solving and aiding in recovery (Brown et al., 2012). Interventions designed to reduce overgenerality and increase episodic detail thus hold promise for future therapeutic interventions.

As with suggestions emerging from the depression literature (see Holmes et al., 2016), positive-specific future event simulations also hold promise for anxiety treatment innovation. Imagery re-scripting is one experiential technique that has been used in a range of disorders to train individuals who have overgeneral ruminative thinking to engage in a more experiential, specific mode of thinking (Brewin et al., 2009; Wheatley & Hackmann, 2011).

Applying such techniques could assist an individual in imagining a specific future event in a rich and detailed way, and create specific ways they could cope with the imagined anxiety provoking event. More specifically, focusing on increasing specificity for positive event simulation has been linked with symptom reduction following CBT in PTSD (Sutherland & Bryant, 2007) and the practice of retrieving specific autobiographical memories is correlated to reductions in depressive symptoms (Neshat-Doost et al., 2013; Raes, Williams, & Hermans, 2009).

Closing remarks

Anxiety disordered individuals display deficits in MTT that extend beyond their perceived subjective experience. Here I have shown that they generate quantitatively different MTT with increased overgenerality and reductions in episodic detail relative to healthy controls. Understanding the quantitative differences in the recollection of past episodes and the simulation of future episodes, in combination with the subjective experience of remembering and imagining the events is an important step in understanding the nature of memory and future thinking across anxiety disorders. It is possible that impaired MTT in anxiety disorders is a consequence of avoidance behaviours, attentional differences and retrieval biases. It is likely that these differences contribute to the development and maintenance of anxiety disorders, and future research investigating the behavioural impact of these differences is needed. Treatment aimed at improving MTT would likely improve treatment outcomes across anxiety disorders. Although the possibility that improving MTT abilities may alleviate maladaptive behaviour in anxiety awaits direct empirical investigation, the experiments reported here provide an important starting point for research that could be used to develop new treatment strategies that target increasing specificity and episodic detail with the goal of promoting wellbeing in anxiety disorders.

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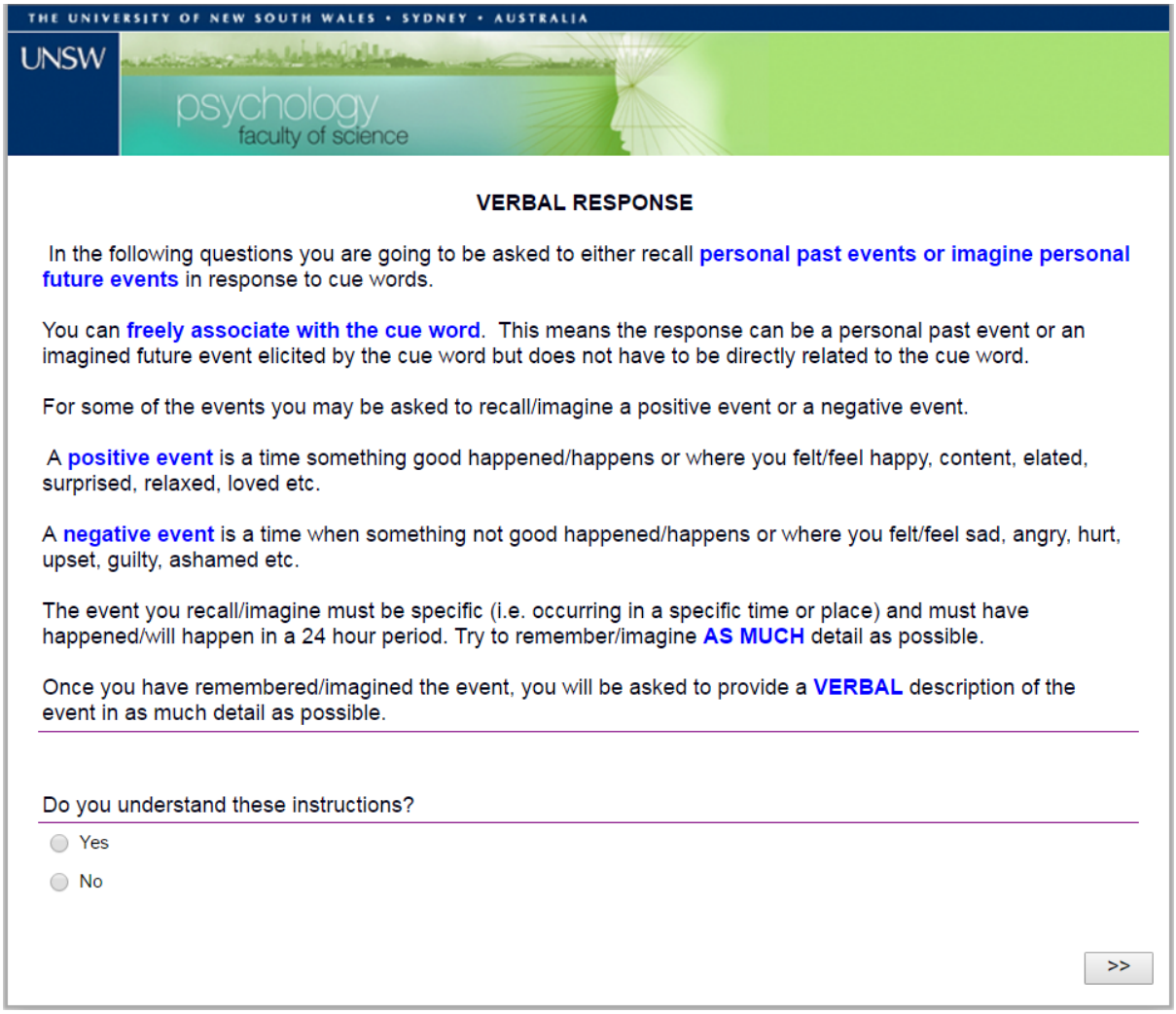
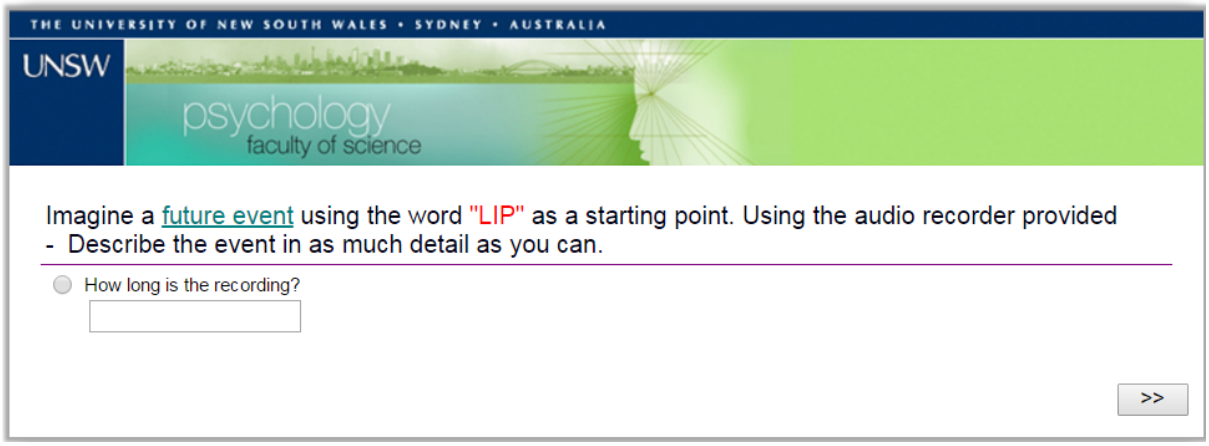
APPENDIX A

Screen shots of the verbal and written response instructions, emotional valence event description instructions and phenomenological questionnaire from the Qualtrics® platform for Study 1 (Pilot).

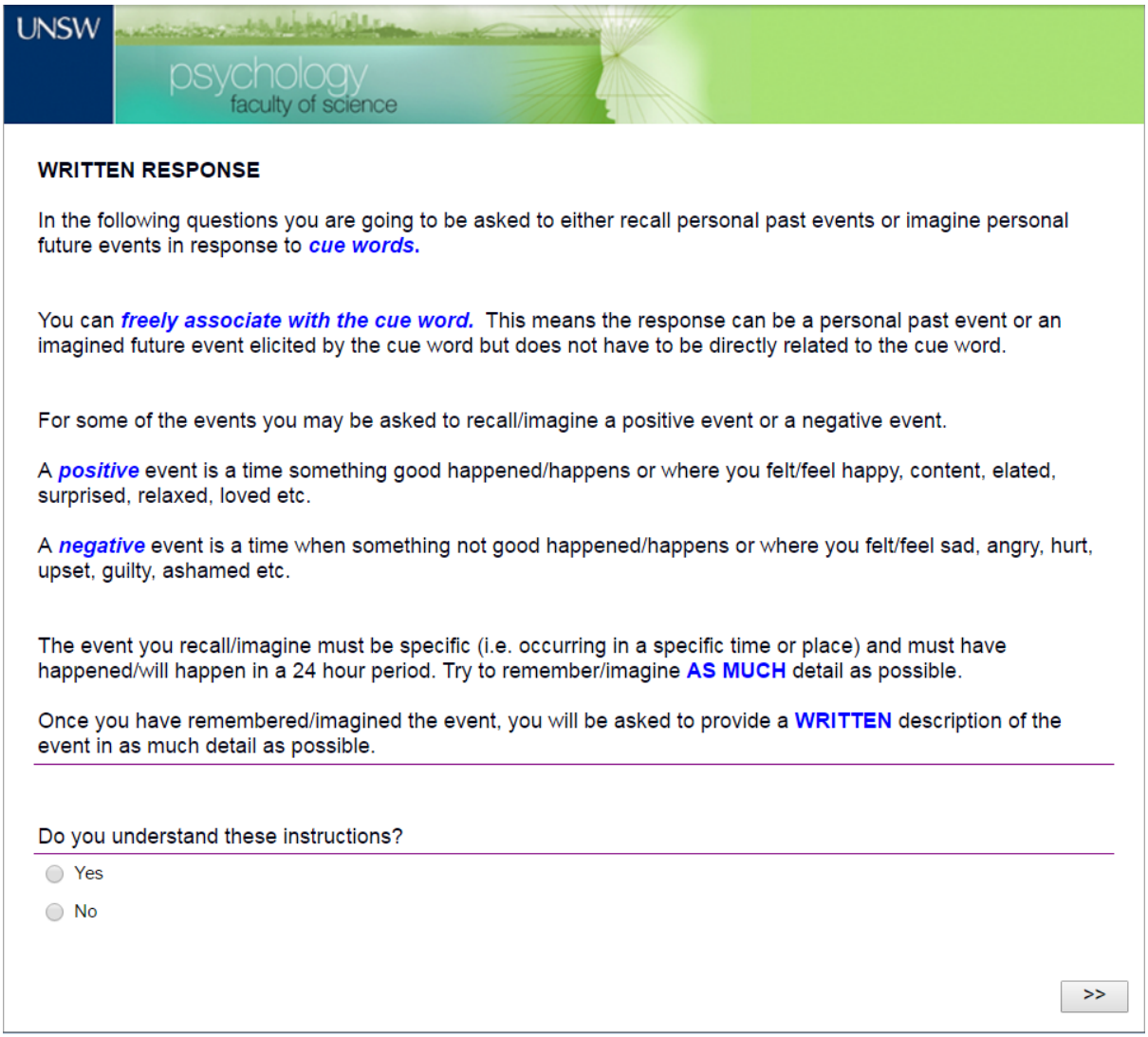
Verbal Instructions



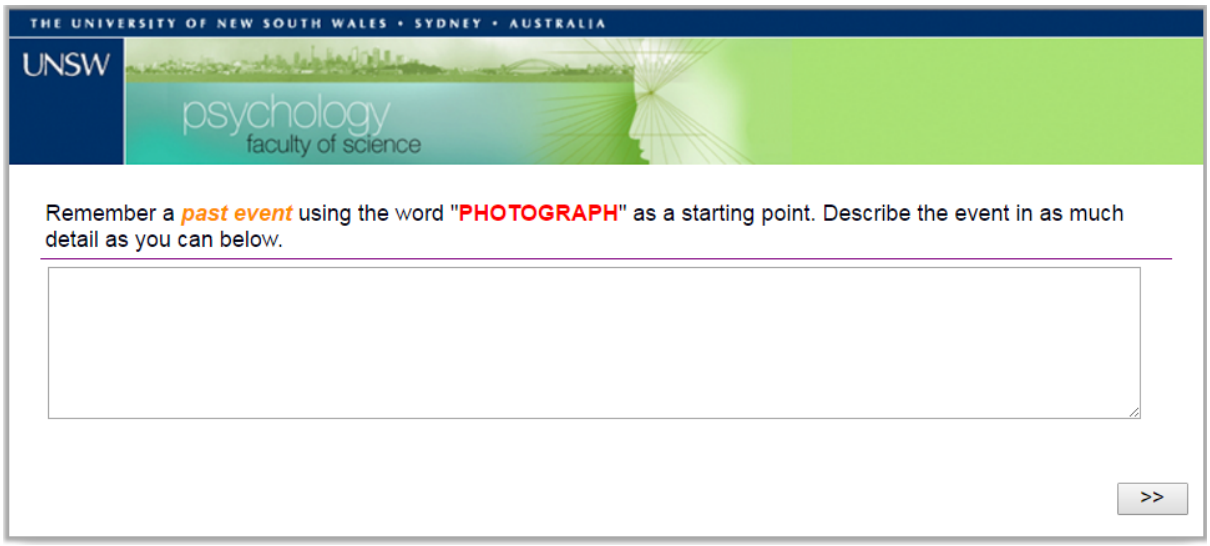
Example of a Neutral Future Event



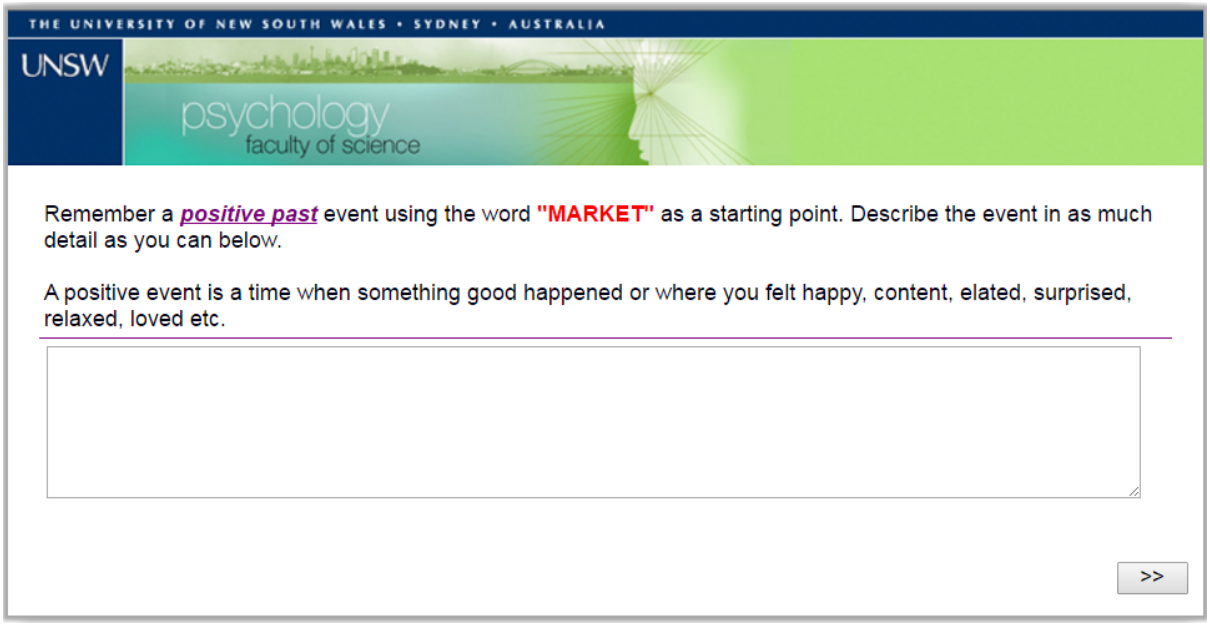
Written Instructions



Example of a Past Neutral Event



Example of a Past Positive Event

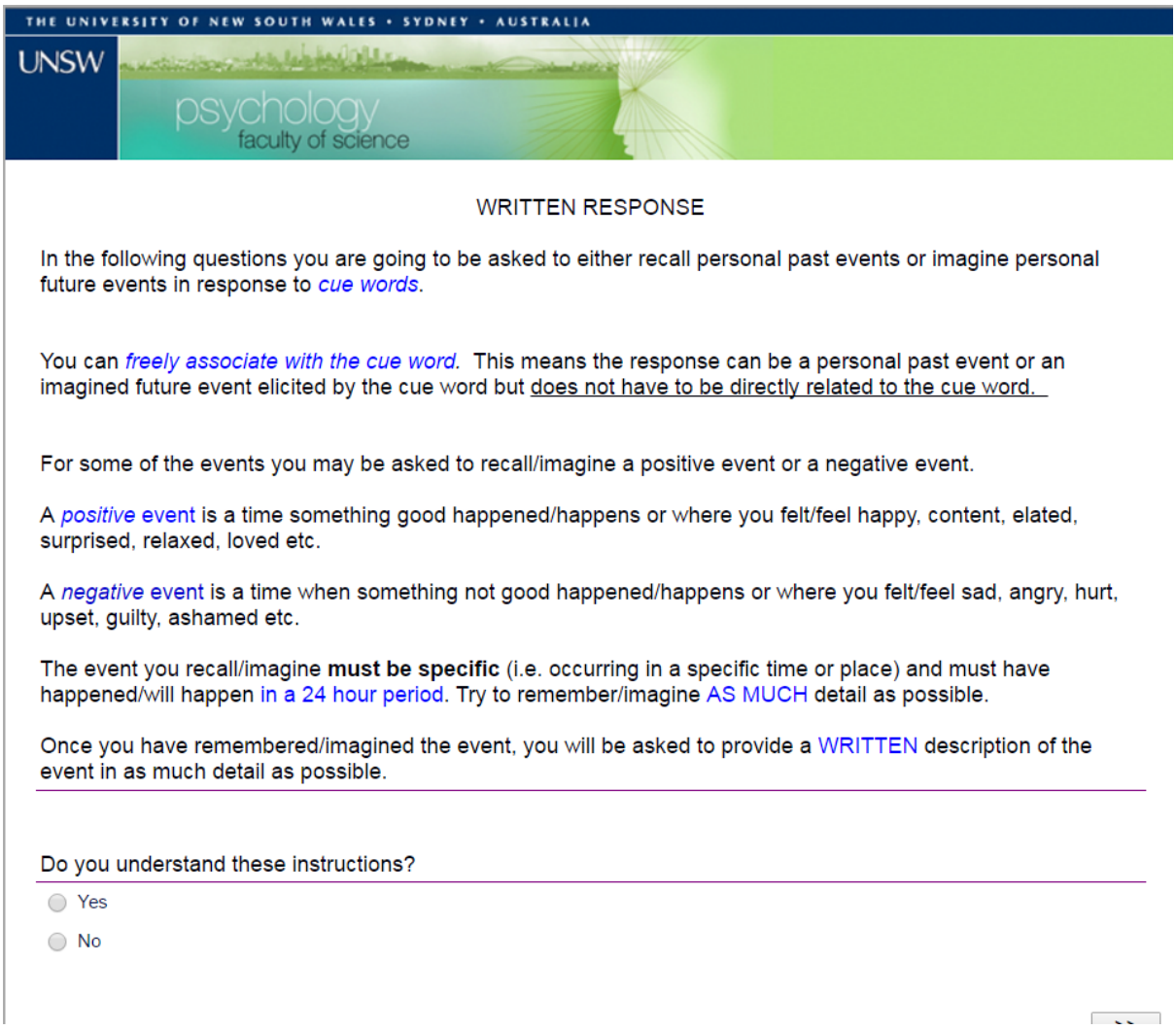


Example of a Past Negative Event

APPENDIX B

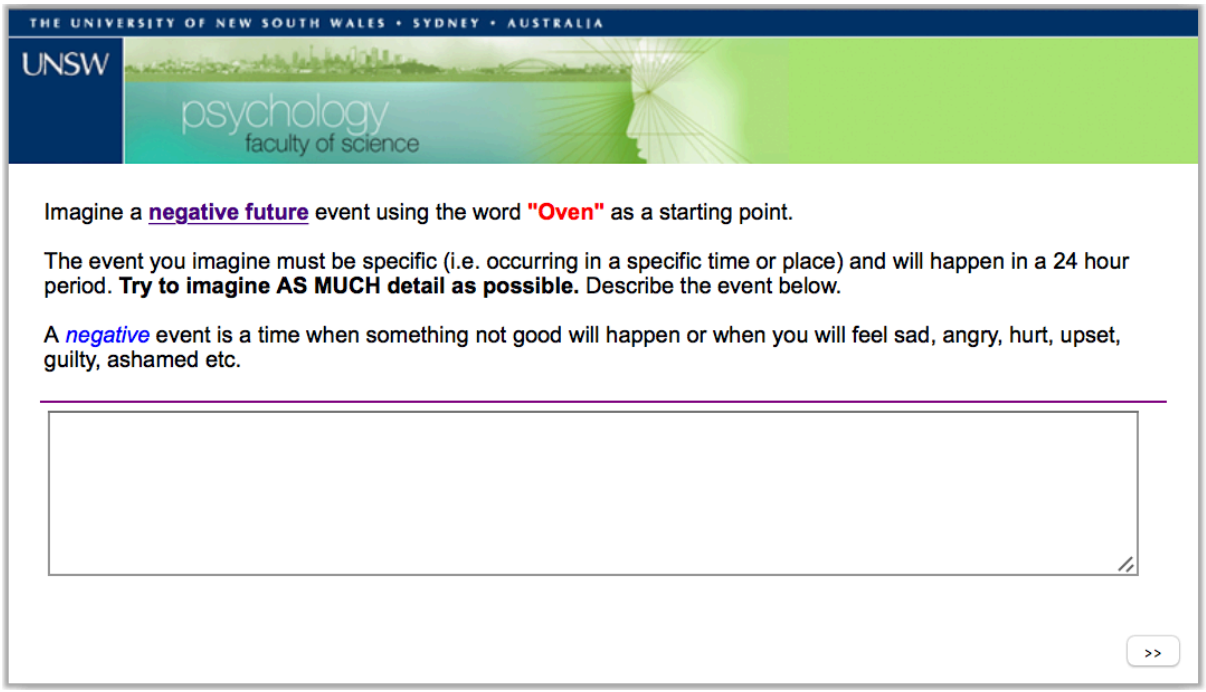
Screen shots of the written instructions, self-selection cues, event description entry and phenomenological questionnaire from the Qualtrics® platform for Study 3 (university sub-clinical anxiety sample).

Written Instructions for Study 3



Cue self-selection for event generation

Self-selected cue word “Oven” for Negative Future Event



Phenomenological Questionnaire from Study 3 (University Sample) For Future Events

Using the 7-point scale answer the questions below in relation to the event you just wrote about.

1 = Not at All

7 = To a very high degree

	1	2	3	4	5	6	7
This future event is vivid							
When I imagine the event, it is as if I am pre-experiencing it							
When I think of the episode, I can see and hear in my mind where it will take place							
When I think of the episode, I can smell and taste in my mind things around me							
When I think of the episode, I can clearly see the arrangements of the objects/people							
When I think of the episode, I can clearly see the location							
When I imagine the event, I primarily see what happened from a perspective of my own eyes							
When I imagine the event, I primarily see what happened as if I am a fly on the wall							
The emotions I have when I imagine the episode are intense							
I had a physical/bodily reaction to the imagined event (i.e talking to myself, crying, smiling, shivering, palpitations, laughing, hitting)							
This event is important to me (it involves an important themes or episode in my life)							
While imagining the event, it comes to me as a coherent story and not as an isolated scene							

APPENDIX C

THE UNIVERSITY OF NEW SOUTH WALES

PARTICIPANT HOME INFORMATION

VOLUNTARY AND INVOLUNTARY MENTAL TIME TRAVEL IN ANXIETY

Approval HC1655

Instructions

For this component of the experiment you are asked to write about 8 past and 8 future events as they happen to you at home, when you are out, that come spontaneously to mind across a period of 2 weeks. The link we have sent in the email (and then saved to your phone) allows you to write about your past or future thought and answer some questions about your experience. We ask that you do not complete more than 2 past and 2 future per day. You have two weeks to complete this task.

For everyone who successfully completes this component, you will go into the running to win a mini iPad that will be drawn on the 1st of November.

Inquiries

If you have any questions or concerns following your participation, please email EFTunsw@gmail.com or call 9285 2488. Alternatively call Sarah Robuck PhD / M.Psychol (Clinical) Candidate, UNSW on 0422 XXX XXX who will be happy to address any issues.

Your Next Participant Session

Time: _____

Date: _____

Experimenter:_____

Thank you for your time and participation!

Holly, Katarina, Alex & Sarah

The Memory Team

Richmond/Grisham Lab

UNSW

APPENDIX D

Voluntary Questionnaire For Future Events

Questionnaire completed in the experimental session. These questions were for events in a future direction. Past events had the same questions but were oriented for events that had already occurred i.e. "It was as if I re-lived the event." Please note the Likert scales radio buttons.

Using the 7-point scale answer the questions below in relation to the event you just wrote about. 1 = Not at All 7 = To a very high degree

	1	2	3	4	5	6	7
The event refers to a specific situation in your future	○	○	○	○	○	○	○
The future event is vivid (very detailed)	○	○	○	○	○	○	○
When the future event came to mind, I could see and hear in my mind what happened	○	○	○	○	○	○	○

	1	2	3	4	5	6	7
When the future event came to mind, I could smell and taste in my mind the things around me.	○	○	○	○	○	○	○
When I think of the future event, I can clearly see the location	○	○	○	○	○	○	○
When the future event came to mind it was as if I was pre-reliving the event.	○	○	○	○	○	○	○
When I imagine the event I primarily see it through my own eyes	○	○	○	○	○	○	○
When I imagine the event, I primarily see what happened through observer's eyes	○	○	○	○	○	○	○
I had a physical/bodily reaction to the future event (i.e talking to	○	○	○	○	○	○	○

	1	2	3	4	5	6	7
myself, crying, smiling, shivering, palpitations, laughing, hitting)							
The future event is about an emotionally intense event	○	○	○	○	○	○	○
The emotions I have when I think of the event are extremely negative	○	○	○	○	○	○	○
The emotions I have when I think of the event are extremely positive	○	○	○	○	○	○	○
The future event comes to mind in a coherent story.	○	○	○	○	○	○	○
This event is important to me (it involves an important theme or episode in my life)	○	○	○	○	○	○	○

	1	2	3	4	5	6	7
The future event is central to my personal identity	○	○	○	○	○	○	○
I have previously thought about this future event (1=Never, 7 = Very often)	○	○	○	○	○	○	○

The future event left my mood

- ○ Better
- ○ Worse
- ○ Unaffected

At what point in the future did you imagine the event happening:

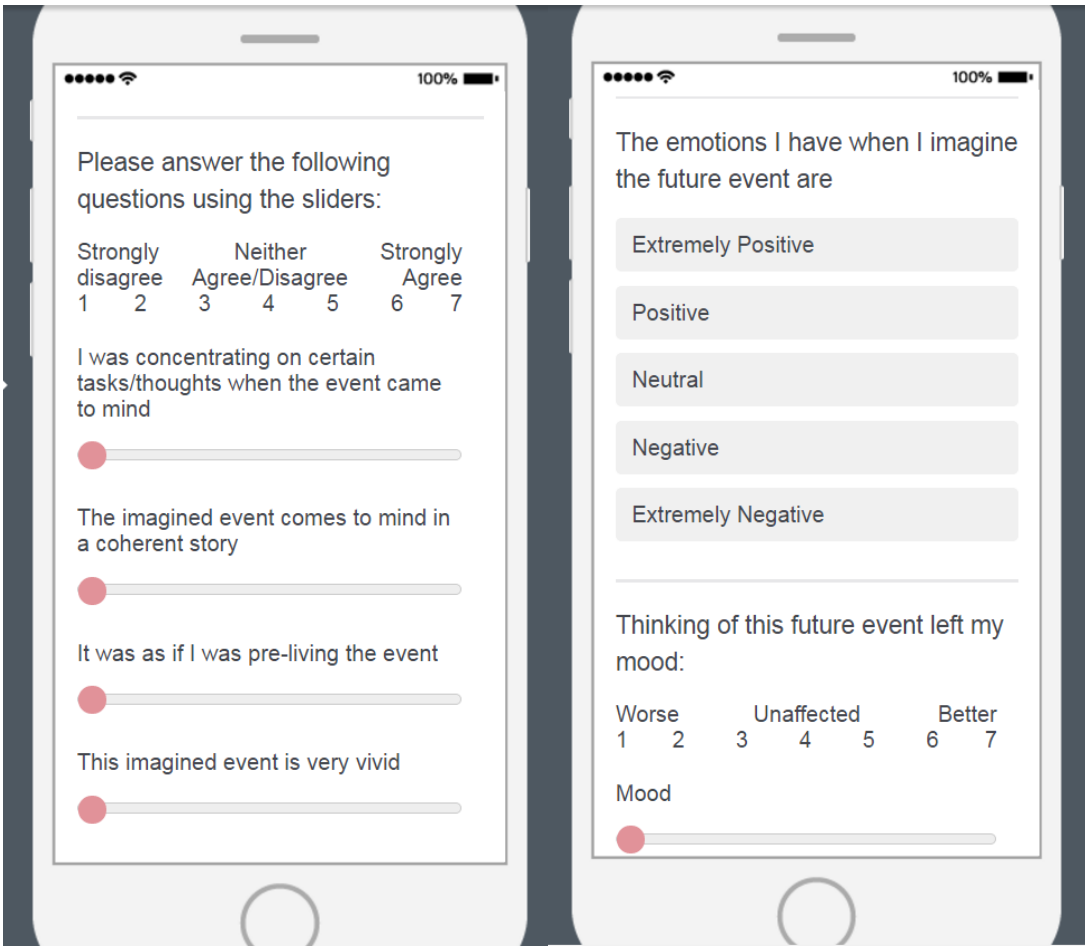
- ○ Less than one month from now
- ○ Within the next year, but greater than one month
- ○ Greater than one year from now, but less than 3 years
- ○ Greater than 3 years from now

APPENDIX E

Involuntary Questionnaire For Future Events

Questionnaire accessed through participants mobile phones. These questions were for events in a future direction. Past events had the same questions but were oriented for events that had already occurred i.e. “It was as if I re-lived the event.” Please note the Likert scales were sliders that participants could slide on their touch-screen phones.

Example of how survey appeared on participants phones



Survey in order of questions

Q1. Please enter your PARTICIPANT NUMBER

Enter which imagined FUTURE event this is:

- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8

Does this imagined future event refer to a specific situation in your future?

- ○ Yes
- ○ No
- ○ Unsure

Describe in your own words the imagined FUTURE event

Where were you when the imagined FUTURE event came to mind?

Were there commonalities present in your physical surroundings, present in your private thoughts/feelings, or present in both surroundings and feelings to the event?

- ○ Physical Surroundings
- ○ Thoughts/Feelings
- ○ Mixed
- ○ No commonalities

What were you doing at the time you imagined the FUTURE event?

How is your current mood?

	Very Poor						Very Good
	1	2	3	4	5	6	7
Mood							

Please answer the following questions using the sliders (refer to image above for slider view)

	Strongly disagree			Neither Agree/Disagree			Strongly Agree
	1	2	3	4	5	6	7
I was concentrating on certain tasks/thoughts when the event came to mind							
The imagined event comes to mind in a coherent story							
It was as if I was pre-living the event							
This imagined event is very vivid							

	Strongly disagree 1	2	3	4 Neither Agree/Disagree	5	6	7 Strongly Agree
When I think of the event I can see the location clearly							
When the event came to mind, I could see and hear in my mind what happened							
I had a physical body reaction to the imagined future event (laughed, cried, sweated, heart raced etc.)							
When the event came to mind I could smell and							

	Strongly disagree 1	2	3	4 Neither Agree/Disagree	5	6	7 Strongly Agree
taste in my mind the things around me							
When I imagine the event I primarily see what will happen through my own eyes							
When I imagine the event I primarily see what will happen as if I was "a fly on the wall"							
The imagined futre event is emotionally intense							

	Strongly disagree 1	2	3	4 Neither Agree/Disagree	5	6	7 Strongly Agree
The imagined future event is important to me (important to my life story)							
The imagined future event is central to my personal identity							

The emotions I have when I imagine the future event are

- Extremely Positive
- Positive
- Neutral
- Negative
- Extremely Negative

Thinking of this future event left my mood:

	Worse			Unaffected			Better
	1	2	3	4	5	6	7
Mood							

At what point in the future did you imagine the event happening:

- Less than one month from now
- Within the next year, but greater than one month
- Greater than one year from now, but less than 3 years
- Greater than 3 years from now