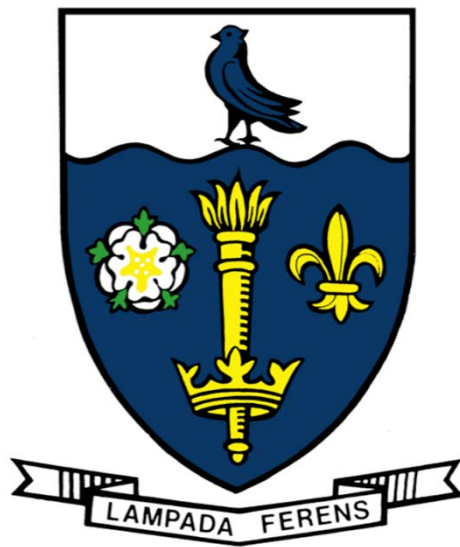


THE UNIVERSITY OF HULL



The Effect of Positive Episodic Simulation on Future Event Predictions in Non-
Depressed, Dysphoric, and Depressed Individuals

being a Dissertation submitted in partial fulfilment of
the requirements for the Degree of

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By

Jennifer Boland BSc (Hons) MSc (Hons)

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Declaration

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Abstract

Previous research demonstrates that depressed individuals have difficulties with prospection. For example, compared to non-depressed individuals, they predict negative events as more likely to happen, and positive events as less likely to happen, in their future. Recent work suggests that episodic simulation of positive events may prove a useful strategy for improving these prospective biases. The experiments within the current thesis investigated positive episodic simulation as a method of modifying predictions regarding likelihood of occurrence, perceived control, and importance for both positive and negative future events. Experiments 1 and 2 demonstrated the positive impact of a newly devised paradigm, the Future Simulation Intervention Task (F-SIT), on future event predictions in a non-depressed sample. Experiment 3 investigated the parameters under which the F-SIT modifies these predictions, by using various modifications of the paradigm. These findings suggested that both single cue words with positive instructions, and positive cue scenarios were equally effective at modifying future event predictions. Experiments 4 and 5 extended the findings to show that various versions of the F-SIT beneficially modifies predictions in both a depressed and dysphoric sample. Finally, Experiment 5 also made preliminary investigations into the mechanisms that underlie the modifications evident following the F-SIT, specifically investigating the role of affect. Findings suggested that the modification in predictions about future events that occur as a result of the F-SIT are not merely a by-product of mood improvements. Therefore, the underlying mechanisms of the prediction modification is in need of further investigation. However, overall, the findings from the current experiments suggest that training in future episodic simulation can improve future outlook and may represent a useful tool within cognitive therapeutic techniques.

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1. General Introduction

Individuals with depression experience a range of difficulties with prospective, or future-orientated, cognition. For instance, compared with non-depressed individuals, they find it difficult to envisage positive events (e.g. Anderson & Evans, 2015; Holmes, Lang, Moulds & Steele, 2008; MacLeod & Byrne, 1996; Morina, Deeprose, Pusowski, Schmid, & Holmes, 2011; Stober, 2000; Szöllősi, Pajkossy, & Racsmány, 2015) and predict that such events are less likely to occur in their own future (e.g. Beck, Wenzel, Riskind, Brown, & Steer, 2006; Pyszczynski, Holt, & Greenberg, 1987; Thimm, Holte, Brennen, & Wang, 2013). It is believed that these difficulties may serve to maintain, and potentially exacerbate, depressive symptomatology (Roepke & Seligman, 2016). Recent research has suggested that training individuals to engage in positive episodic simulation, whereby individuals repeatedly imagine positive future experiences, may be beneficial for depressed individuals. For instance, this recent work has already shown that engaging in positive episodic simulation, which is rich in mental imagery, represents a useful strategy for improving mood in individuals experiencing elevated levels of depressive symptomatology (e.g. Holmes, Lang, & Shah, 2009).

Cognitive psychological theory and research of prospection suggests that the effects of engaging in repeated positive episodic simulation may extend beyond mood enhancement; it may also impact prospection itself (e.g. Szpunar & Schacter, 2013; Szpunar, Spreng, & Schacter, 2014: 2016). Thus, it is argued that it has the potential to increase the vividness with which individuals can envisage positive future scenarios and improve the predictions individuals make about potential future experiences. However, to date, no research has specifically focused on whether directed engagement in positive episodic simulation can be used to modify prospective thinking in this way and, thus, has the potential to serve as a therapeutic method for cognitive bias modification in depressed individuals. This serves as the overarching aim of the current thesis. The remainder of this introductory chapter reviews the literature relevant to this thesis. It begins by outlining depression and the key cognitive models of depression. It then explores recent cognitive research and models of prospection, before detailing the prospection biases evident in depression and their potential implications. Finally, it discusses existing interventions that may target biased prospection in depression and the need for research that develops more focused interventions in this area.

1.1. Depression

Depression is characterized by a range of experiences, including low mood, lack of concentration, fatigue and feelings of hopelessness. Depression represents a major global health challenge that is considered to be a leading cause of disability worldwide (Collins et al., 2011; Judd LL, 1997; Lopez, Mathers, Ezzati, Jamison, & Murray, 2001; Üstün, Ayuso-Mateos, Chatterji, Mathers, & Murray, 2004; WHO, 2018). It is estimated 350 million people, of all ages, suffer from depression (World Federation for Mental Health, 2012). Most people with depression will experience recurrent episodes (Eaton et al., 2008; Mattisson, Bogren, Horstmann, Munk-Jørgensen, & Nettelblatt, 2007), with the risk of subsequent episodes increasing by 16-18% with each depressive episode (Mueller et al., 1999; Solomon et al., 2000). Depression is considered to be different from usual mood fluctuations, as it is longer lasting and more intense. It can cause difficulties in all aspects of the affected person's life, including work and family. At its worst, depression can lead to suicide, with almost one million lives lost each year to suicide (WHO, 2016).

1.1.1. DSM-5 Depressive Disorders

The term *depression* is commonly used within everyday language to refer to a range of experiences that may, or may not, meet criteria for diagnosis of a depressive disorder within diagnostic manuals of mental health conditions, such as the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; APA, 2013) or the International Classification of Diseases and Related Health Problems (ICD-10; WHO, 1992). For instance, the DSM-5 contains a range of depressive disorder diagnoses including, but not limited to, Major Depressive Disorder, Persistent Depressive Disorder (Dysthymia), Premenstrual Depressive Disorder, and Substance/Medication-induced Depressive Disorder. Each of these disorders varies in the nature of symptom presentation, such as number of symptoms present and their severity and persistence. For instance, Persistent Depressive Disorder (Dysthymia), represents a chronic, long lasting form of depression over at least two years within which the individual does not fully meet criteria for a Major Depressive Episode which is the core requirement for a diagnosis of Major Depressive Disorder.

1.1.2. Major Depressive Disorder

A key depressive disorder diagnosis within the DSM-5 (APA, 2013) is Major Depressive Disorder (MDD), with approximately one in ten people suffering from major depression at any one time, and an estimated lifetime prevalence of one in five individuals (Kessler, McGonagle, Zhao, et al, 1994). According to the World Health Organization, major depressive disorder was ranked as the third leading cause of the global burden of disease in 2004 and will move into the first place by 2030 (WHO, 2001). MDD is diagnosed when an individual experiences a major depressive episode for more than two weeks.

A major depressive episode is defined by the presence of five, or more, of the following symptoms; depressed mood, diminished interest or pleasure, significant weight loss or weight gain, insomnia or hypersomnia, psychomotor agitation or retardation, fatigue or loss of energy, feelings of worthlessness or excessive inappropriate guilt, diminished ability to think or concentrate, recurrent thoughts of death. At least one of the symptoms has to either be depressed mood or loss of interest or pleasure, and the symptoms must cause clinically significant distress or impairment in functioning, that is not attributable to any other condition. Additionally, the symptoms need to be present during the same 2 week period.

1.1.3 Dysphoria

Within the literature on depression, the term dysphoria is often used to refer to individuals experiencing elevated, yet sub-clinical threshold, levels of depressive symptomatology. One of the main criticisms of diagnostic manuals, such as the DSM-5 (APA, 2013), is their reliance on categorical assumptions regarding the nature of psychopathological symptomatology (Widiger & Clark, 2000). Many argue that depressive symptomatology occurs on a continuum, with differences between individuals experiencing sub-clinical levels of depressive symptomatology and clinical diagnoses being quantitative, rather than qualitative, in nature (Akiskal, Judd, Gillin, & Lemmi, 1997; Angst, Dobler-Mikola, & Binder, 1984; Cox, Enns, Borger, & Parker, 1999; Enns, Cox, & Borger, 2001), and that symptoms should be viewed using a dimensional, rather than a categorical, approach (Beach & Amir, 2003; Franklin, Strong, & Greene, 2002; Hankin, Fraley, Lahey, & Waldman, 2005; Haslam & Beck, 1994; Ruscio & Ruscio, 2002). It has been suggested that depression, as a continuum, is best characterised by duration and severity (Bowins, 2014), with the course and

symptom profile of depression often changing over time thereby fulfilling criteria for various subtypes (Angst & Merikangas, 1997; Angst, Sellar, & Merikangas, 2000; Kessing, 2007; Judd et al., 1998).

Within research, the sampling of individuals with dysphoria often represents an analogue for the study of those with depressive disorders. The previously discussed work that suggests dysphoria and clinical depression exist on the same continuum supports this as a legitimate method of investigation. However, the study of dysphoria is, arguably, important in its own right. For instance, subthreshold depression shares many of the symptoms of major depression (Horwath, Johnson, Klerman, & Weissman, 1992; Judd, 1997) and is associated with reduced quality of life and impairment in daily activities (Rodriguez, Nuevo, Chatterji, Ayuso-Mateos, 2012). Furthermore, it has been suggested that the presence of sub-threshold depressive symptoms may predict the development of major depression (Judd et al., 1998).

1.1.4. Measures of Depressive Symptomatology

The severity of depressive symptomatology for research purposes is typically ascertained using standardized self-report inventories such as the Beck Depression Inventory (BDI: Beck, Ward, Mendelson, Mock, & Erbaugh, 1961; Beck, Rush, Shaw, & Emery, 1979), the Center for Epidemiological Studies Depression Scale (CES-D: Eaton, Muntaner, Smith, Tien, Ybarra, 2004; Radloff, 1977), the Patient Health Questionnaire (PHQ-9) (Kroenke, Spitzer & Williams, 2001), and the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983). These inventories, and their revised versions, use specified cut off scores to indicate clinically relevant depressive symptomatology. The Hamilton Rating Scale for depression (Hamilton, 1960) is a further inventory used to indicate depressive symptomatology, although this inventory is completed by a healthcare professional, who scores the patient on a number of different dimensions using a three or five point scale depending on the item. The higher the score, the more severe the depressive symptoms.

Where researchers require separation of participants into diagnostic categories, the Structured Clinical Interview – Research Version (SCID) for DSM-5 is often used (First, Williams, Karg, & Spitzer, 2015). The SCID is broken down into separate modules corresponding to categories of diagnoses. For all diagnoses, symptoms are coded as present, subthreshold, or absent. The SCID is used to determine whether a

particular disorder is present or not. However, one limitation of the SCID within a research setting is the administration time, which can range from 30-60 minutes per participant. In order to overcome this limitation, the authors of the revised version of the CES-D (CESD-R; Eaton et al, 2004), developed an algorithmic scoring method that allows the inventory to provide both a measure of depression symptom severity and a possible depressive symptom category: no clinical significance; sub threshold depression symptoms; possible major depressive episode; probable major depressive episode; or meets criteria for major depressive episode.

1.2 Cognitive Theories of Depression

The experience of depression extends beyond both mood and motivation, incorporating a range of biases in thinking and behaviour. This has led to a number of theoretical models regarding the role of cognition-behavioural factors in the development and maintenance of depression (e.g. Abramson, Metalsky, & Alloy 1989; Abramson, Seligman, & Teasdale, 1978; Beck, 1967, 1988; 2008; Ellis 1958; Seligman, 1975).

Cognitive-behavioural models suggest that a range of factors (such as temperament/personality, early experiences, and stressful adult life events) combine to result in individuals displaying systematic and enduring cognitive-behavioural beliefs and responses that are maladaptive. Two influential models that directly feed into the key tenets of the current thesis will be discussed in depth; these are the hopelessness theory (Abramson et al., 1989) and Beck's cognitive model (Beck, 1967). Furthermore, a recent model that builds upon these theories, developed by Roepke and Seligman (2016), will also be described in detail.

1.2.1. Hopelessness Theory of Depression

The learned helplessness model, the precursor to hopelessness theory, was put forward by Seligman (1975). He observed that individuals who were exposed to uncontrollable negative events often overgeneralize from this experience and became passive in other, potentially controllable, situations. This experience of uncontrollable negative events seemed to produce expectations of helplessness. The individuals believed they could not control future negative events in their life, and believed their

attempts to escape negative situations made no difference; therefore they gave up trying to influence their environment having learned to be helpless.

Hopelessness theory was developed in response to some of the limitations of helplessness theory. For instance, helplessness theory is unable to explain why some individuals become depressed when they are confronted with an uncontrollable stressor, whilst others do not (Abramson et al., 1978). Abramson and colleagues (1978) proposed that the attributions that individuals form in response to negative life events/stressors influences the risk of becoming depressed. They suggested that individuals form attributions along three different dimensions: internal-external, stable-unstable, and global-specific. Internal attributions are where the individual blames themselves for the negative event, rather than looking for an external cause. Stable attributions are characterized by the notion that outcomes will always be the same, thus will not improve, whereas unstable attributions acknowledge that outcomes are changeable. Global attributions refer to applying the failure to all other situations and domains, rather than applying it only to the specific event. According to hopelessness theory, once people perceive that a negative life event has occurred then the causal attributions they make, and the degree of importance and potential consequences they attach to them, are crucial factors contributing to whether or not they develop hopelessness and, in turn, depressive symptoms (Alloy, Abramson, Metalsky, & Hartlage, 1988). Originally, hopelessness theory posited that depression-prone individuals make internal, stable, and global attributions to explain the causes of negative events, and external, unstable, and specific attributions about positive events. A revised version of the theory added that stable and global, rather than internal, attributions are crucial in the development of hopelessness depression (Abramson et al., 1989). This attributional style results in the individual taking personal blame for negative events in his or her life and leads to helplessness, avoidance, and hopelessness about the future, which promotes further depression.

A recent systematic review of the literature suggests strong support exists for the notion of negative attributional and inferential styles acting as a diathesis that interacts with life stress to predict depression (Liu, Kleiman, Nestor & Cheek, 2015). Furthermore, a number of authors have demonstrated that hopelessness is a key factor in serious suicide attempts and suicidal ideation (Beck, Kovacs, & Weissman, 1975;

Kazdin, French, Unis, Esveldt-Dawson, & Sherick, 1983; Klonsky, May & Saffer, 2016; Minkoff, Bergman, Beck, & Beck, 1973; Petrie & Chamberlain, 1983).

1.2.2. Beck's Cognitive Model of Depression

Arguably, the most comprehensive, and well established, cognitive theory of depression was put forward by Beck (1979; 1987; 1988; 2008). He suggests that biased thought processes are a primary cause of depressive symptoms such as loss of motivation and self-criticism. Central to Beck's theory is a triad of negativity, whereby individuals hold negative views of the self, the world and the future. The central tenet of this negative triad is that information is processed in a negative way, and that these biases pervade all aspects of an individual's world view; this includes how they think about their past, present and future. These depressive biases consist of a continuous feedback loop with the negative interpretations, attentional biases and the subjective and behavioural symptoms reinforcing each other.

Beck (1979; 1987; 1988; 2008) also applied the notion of schemas, cognitive structures that represents stable cognitive patterns of thinking, as a way of explaining depression. Schemas influence the interpretation and evaluation of experiences and Beck argues that individuals vulnerable to depression have maladaptive schemas, which remain dormant until triggered by stressful life events. Thus, information about life events is then interpreted in line with these dysfunctional schemas. Additionally, Beck argues that individuals lose control over their thought processes and become unable to activate more appropriate schemas; therefore, these dysfunctional schemas, after repeated activation, become increasingly salient over time. When dysfunctional schemas are activated, they skew the information processing system which directs attention to negative stimuli and leads the individual to interpret that experience in a negative way. These dysfunctional schemas lead to global negative perceptions of reality and to other symptoms of depression such as sadness, hopelessness, and loss of motivation. These symptoms are then subjected to negative evaluations, creating a continuous feedback loop whereby negative interpretational/attentional biases and subjective/behavioural symptoms reinforce each other. Beck believed that depressed individuals also develop a negative self-schema, whereby they possess a set of beliefs and expectations about themselves that are essentially negative and pessimistic. Support for Beck's model has been drawn from research examining maladaptive schemas, the

content of which are reflected by dysfunctional beliefs and attitudes that are often measured by the Dysfunctional Attitudes Scale (DAS) (Weissman & Beck, 1978). This scale asks participants to rate, for their extent of agreement, a series of statements representing the dysfunctional attitudes that are a hallmark of depression, such as “if a person asks for help, it is a sign of weakness”. The research using the DAS consistently shows that people with depression score higher on this scale compared with non-depressed individuals (e.g. Olinger, Kuiper & Shaw, 1987).

Both Beck’s (1979; 1987; 1988; 2008) cognitive model and hopelessness theory (Abramson et al., 1978) suggest a vulnerability-stress component in which dysfunctional cognitions interact with negative events to contribute to depressive symptoms. In Beck’s theory cognitive vulnerability is conceptualized as depressive self-schemas, containing dysfunctional attitudes, whilst in hopelessness theory cognitive vulnerability is conceptualized as a tendency to make negative inferences about the cause, meaning and consequences of a negative life event. A further factor that both theories have in common is that they suggest that cognitive biases lead individuals to the future negatively. How depressed individuals envisage their personal future has gained increasing research interest in recent years. This has led to the suggestion that these future-oriented biases may actually lie at the core of depression thinking (Roepke and Seligman, 2016).

Although cognitive theories of depression appear dominant within the literature, there are other competing theories of depression that have been proposed, for example, behaviourist theory (Lewinsohn, 1974), psychodynamic theory (Freud, 1917), and humanist theory (Maslow, 1962). Whilst it is unlikely that purely a cognitive approach is effective for the treatment of depression in every case, given the popularity of cognitive models and the vast literature that they have accumulated, the experiments in this thesis are based on such an approach.

1.2.3. Roepke and Seligman’s Prospective Framework of Depression

Roepke and Seligman (2016) extended earlier cognitive-behavioural models of depression (Beck, 1979; 1987; 1988; 2008; Abramson et al., 1989; Alloy et al., 1988) to propose a framework placing biases in *prospection* (the mental representation of possible futures) as ‘the first among equals in the triad’ (p.24). They argue that whilst biased beliefs about the self and the world are likely to leave an individual viewing

themselves and their world negatively, if they believe this could change then the outlook retains hope. However, if their prospection is biased, whereby they have difficulty in envisaging a positive future and believe that things will continue to turn out negatively, then sadness, dejection and hopelessness are understandable reactions to the belief that things will always be bad. Thus, the emotional reaction is not faulty, but rather the mental representation of the future that leads to the reaction is where the problem lies.

Roepke and Seligman (2016) argue that depressed individuals have biases in the construction, or simulation, of future events. In particular, they have difficulty constructing vivid simulations of positive future events, yet evidence no such difficulty in constructing vivid simulations of negative future events. This results in an over representation of negative events and under representation of positive events. Furthermore, they tend to evaluate possible futures more negatively, whereby they predict negative events as more likely, and positive events as less likely, to occur in their future. Finally, they exhibit a more negative predictive style whereby the negative attributions they make about the causes of future events are pervasive, permanent and personal. This model proposes that when prospection goes awry in this way, it negatively influences emotion, cognition, and behaviour. This leads to the hallmark characteristics of depression such as depressed mood, irritability, low energy and suicidal ideation.

Furthermore, Roepke and Seligman (2016) argue that prospection biases set up a vicious cycle. As well as faulty prospection causing symptoms of depression, the experience of depression, in turn, maintains biased prospection in at least three ways. First, depression often leads to social withdrawal, limiting social activities, and involving a reliance on avoidance coping. As a result, depression is associated with fewer positive experiences (Holahan, Moos, Holahan, Brennan, & Schutte, 2005; Kasch, Rottenberg, Arnow, & Gotlib, 2002). Because constructing prospective scenarios relies on information drawn from past experience (Szpunar, 2010), individuals with depression, therefore, have fewer positive past experiences that can be used as materials for constructing mental simulations of potential positive future experiences. Furthermore, evidence suggests that individuals with depression can act in ways that actually promotes the likelihood of negative experiences (Hammen, 2006; Liu & Alloy, 2010); thus, these negative experiences serve as material for vivid negative simulations

of the future. Finally, being in a sad mood can make negative aspects of the environment and negative thought processes more salient; thus individuals are more likely to remember a negative past and imagine a negative future (Buchanan, 2007; Hepburn, Barnhofer, & Williams, 2006; Jong Meyer, Kuczmera, & Tripp, 2007; Miloyan, Pachana, & Suddendorf, 2014; O'Connor & Williams, 2014).

1.3. Propection

Roepke and Seligman's (2016) model of depression places propection biases at its core. It is within the context of this model that the current thesis rests and, therefore, the growing body of literature examining propection within a cognitive psychological framework will be reviewed.

1.3.1. A Taxomonical Framework of Propection

Recent years have seen an explosion in research examining prospective cognition. This has included investigations into how individuals mentally simulate possible future events, the predictions they make about future events and their potential emotional reactions, the formation of future intentions, how they plan for future events, and the strategies and decisions involved in future-oriented problem-solving. It is only recently that these different strands of research into prospective cognition have been brought together into a single taxonomical framework by Szpunar et al., (2014; 2016).

Szpunar et al's (2014; 2016) taxonomy of prospective cognition (illustrated in Figure 1) includes four modes of future thinking: 1) simulation (the construction of a detailed mental representation); 2) prediction (the likelihood of and/or reaction to a particular outcome); 3) intention (the act of setting a goal); and 4) planning (the organization of steps/actions towards achieving the goal). Each mode of propection ranges from episodic to semantic. Episodic propection refers to thinking regarding a specific autobiographical future event whilst semantic propection refers to future thoughts about abstract states of the world. These modes support propection from the initial conceptualization of a future event through to the final attainment of a goal. The next sections will outline, in detail, each of the four modes in turn, with a particular focus on simulation and prediction, as these two modes of propection form the main focus on this thesis.

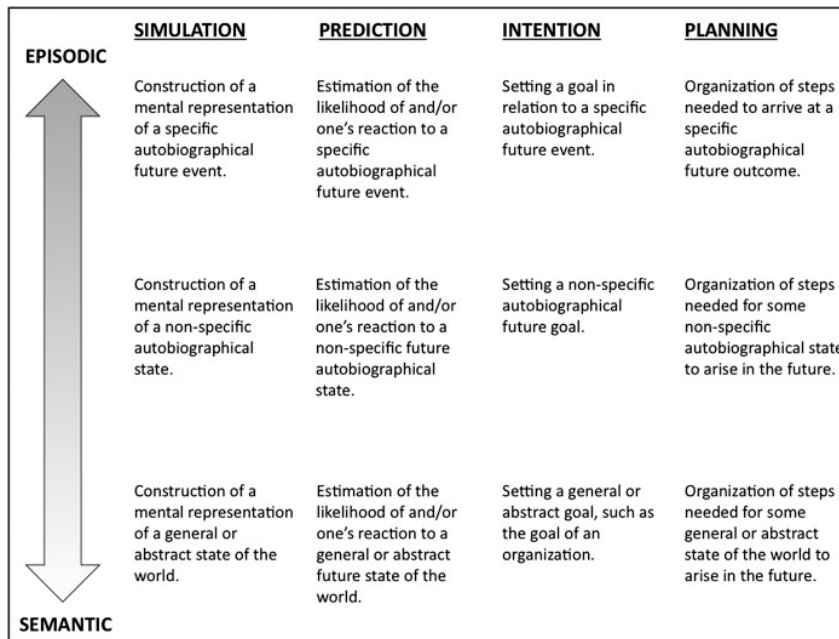


Figure 1: A taxonomy of prospective cognition. Reprinted from Szpunar et al., (2014)

1.3.2. Simulation

Simulation can be defined as the cognitive process of constructing hypothetical scenarios or reconstructing real scenarios (Taylor & Schneider, 1989). However, the term is more commonly used to refer to the former of these two. The process of simulation has been further differentiated based upon the type of knowledge used, ranging on a continuum from episodic to semantic (Szpunar et al, 2014; 2016). Episodic simulation is this construction of episodic scenarios, or the reconstruction of episodic scenarios, and semantic simulation is the construction of a mental representation of an abstract state of the world (e.g. what global warming will be like in twenty years). Furthermore, simulations of hypothetical scenarios do not have to be future focused; for instance, it is also possible to simulate alternative past experiences by considering how situations could have turned out differently (counterfactual simulation) (De Brigard, Addis, Ford, Schacter, & Giovanello, 2013; Van Hoek, Ma, Ampe, Baetens, Vandekerckhove, & Van Overwalle, 2012). However, this thesis will focus on episodic simulation.

In the context of prospection, episodic simulation refers to our ability to pre-experience the future by simulating it in our minds, containing episodic details such as associated emotions, the time and place (Atance & O'Neill, 2001; Szpunar, 2010). Being able to simulate personal events in subjective time is known as autothetic

consciousness (Tulving, 1985; Wheeler, Stuss, & Tulving, 1997), enabling mental time travel, both into personal past and future (Suddendorf & Corballis, 1997).

The construction of future event simulations is thought to rely heavily on memories. Past experience fuels expectations about what is plausible for the future (D'Argembeau & Van der Linden, 2004). More specifically, the constructive episodic simulation hypothesis suggests that memories, in particular episodic memories, provide the details required for the construction of future event simulations (Addis, Pan, Vu, Laiser, & Schacter, 2009; Schacter & Addis, 2007). As such, it is argued that episodic memory retrieval and future episodic simulations are intimately related, drawing on information that is stored within episodic memory and relying on the same cognitive construction processes. A range of literature supports this assertion (e.g. Atance & O'Neill, 2001; Gilbert & Wilson, 2007; MacLeod, Williams, & Linehan, 1992; Schacter & Addis, 2007; Seligman, Railton, Baumeister & Sripada, 2013; Williams et al., 1996). However, research shows that there are some differences, with episodic future simulation being a more cognitive demanding process than episodic memory retrieval. For instance, future episodes take longer to construct and the process is more error prone, and when they are constructed they tend to be less detailed (Addis, Hach, & Tippett, 2016; Anderson, Dewhurst, & Nash, 2012).

A core component of episodic simulation is the use of mental imagery. Mental imagery is the simulation or re-creation of perceptual experience across sensory modalities (Kosslyn, Ganis, & Thompson, 2001). Episodic memories of past events, or events that could happen in the future can be experienced as mental images, therefore it allows us to relive the past and pre-live the future, and also allows us to avoid threats, seek rewards, solve problems and complete tasks (Holmes, Blackwell, Burnett Heyes, Renner, & Raes, 2015).

Research within clinical psychology has shown that mental imagery has special links to emotion, for example, flashbacks within post-traumatic stress disorder (Brewin & Holmes, 2003). Mental imagery has also been compared to verbal processing, and appears to have a stronger effect on emotion (Holmes & Mathews, 2005). This may be because mental images are rated as more real than verbal thoughts (Mathews, Ridgeway, & Holmes, 2013). It is important to establish if emotion does in fact have a special relationship with imagery because, if imagery does impact on emotion, it could impact on well-being. Holmes and Mathews (2005) investigated the relationship

between emotion and imagery in a sample of community volunteers. In one experiment, participants either imagined unpleasant events or listened to the same descriptions while thinking about their verbal meaning. Those in the imagery condition reported more anxiety and rated new descriptions as more emotional than did those in the verbal condition. In a further experiment, groups listened to either benign or unpleasant descriptions, and again had to either imagine them or think about their verbal meaning. Anxiety again increased more after unpleasant (but not benign) imagery. In addition, Holmes, Coughtrey, and Conner (2008) extended these findings by using picture-word cues, whereby participants were asked to combine each picture/caption pair into a meaningful whole without being constrained as to what method to use (imagery or verbal). They then had to rate how emotional each combination was to them, to what extent it involved a mental image or verbal representation, and whether or not it was based on a memory of a real event. Higher ratings of emotion were significantly correlated with extent of imagery use, but not the extent of verbal representation.

1.3.3. Prediction

Predictions are the expectations of, and/or anticipated reactions to, a particular outcome. Within Szpunar et al's (2014; 2016) taxonomical framework, predictions are also subserved by knowledge across the episodic-semantic continuum. Episodic predictions are expectations about a particular future occurrence and/or one's anticipated emotional response to that occurrence, such as estimating how likely it is that you will experience a graduation ceremony and how you may feel on that day. In contrast, semantic predictions are expectations about and/or one's reaction to a general abstract future state of the world, for example, predicting who will win the general election. Predictions about the future may reflect a range of timescales, both short term (predictions about what will happen in the next hour) or more long term (what will happen in the next year) (Bar, 2007; Schultz, Dayan, & Montague, 1997). The focus of this thesis is on episodic, rather than, semantic predictions.

Research has suggested that, in general, people display an unrealistic optimism about the future, whereby they predict others to be victims of misfortune, but not themselves. Various studies have demonstrated this unrealistic optimism; for example, surveys concerning car accidents (Robertson, 1977), crime (Weinstein, 1980), and disease (Harris & Guten, 1979; Kirscht, Haefner, Kegeles, & Rosenstock, 1966) found many people predict their risk is less than average and few predict their risk is greater

than average. Research has also suggested that mood influences these predictive judgements. For example, Johnson & Tversky (1983) found negative mood, induced by a newspaper story about a tragic event, increased the frequency of predictions for future negative events.

Literature examining predicted emotional reactions to future events, termed affective forecasts, suggests that people commonly predict that upcoming future events will make them feel better or worse than they actually do, as they tend to overlook seemingly minor details that turn out to be important (Szpunar et al., 2014). Research suggests the most prevalent error in affective forecasting is the impact bias, whereby people overestimate the intensity and duration of future events on their emotional reactions (Wilson & Gilbert, 2005). For example, Kermer, Driver-Linn, Wilson, and Gilbert (2006) found that people gambling with money overestimate how unhappy they feel when they lose. Similarly, Finkenauer, Gallucci, van Dijk, and Pollmann (2007) found that people taking their driving test overestimate the disappointment they would feel if they failed. Biases in affecting forecasting have real world implications as they directly influence behaviour and decision making. People are constantly making decisions/predictions and behaving in a way that they believe will make them happy and are avoiding things they believe will make them unhappy. However, because affective forecasting is often inaccurate, such decisions may fail to create daily or long-term satisfaction (Wenze, Gunthert, & German, 2012).

1.3.4. Intention and Planning

Within Szpunar et al's taxonomy (2014; 2016), intentions are the mental acts of goal setting. People can form intentions to achieve outcomes in the context of specific future events, termed episodic intentions, for example, "I need to go to the supermarket on my way home from work to pick up a loaf of bread". Intentions can also be semantic, whereby they encompass the setting of more general/abstract goals, for example "I need to think about what I hope to achieve by the end of my PhD". Research suggest that goals are organized in a hierarchy of increasing specificity from general principles to concrete behaviours, and successful self-regulation requires people to formulate specific sub goals and plans that advance progress on more abstract goals (Dickson & Moberly, 2013). Thus specific goals are crucial for behavioural self-regulation as they provide more direct links to appropriate action (Locke & Latham, 2002).

Planning is the organization of steps/actions towards achieving the goal. Episodic plans refer to the organization of the steps needed in order to arrive at a specific episodic future outcome. Semantic plans refer to setting more general or abstract steps needed in order to for these goals to arise in the future. A plan is “a predetermination of a course of action aimed at achieving some goal” (Hayes Roth & Hayes Roth, 1979), thus it is the identification and organization of the steps toward achieving a goal state (Szpunar et al., 2014). Plans are often necessary for intended behaviours to be carried out in an effective manner, as it allows for the opportunity to decide how we will behave in future situations.

1.3.5. Interactions between Modes of Prospecction

The four modes of prospecction within Szpunar et al’s (2014; 2016) taxonomy (simulation, prediction, intention and planning) do not function independently of each other; instead, they interact and build upon each other. For instance, people may draw on simulations and predictions in order to formulate intentions and plans. It has also been argued that people base their predictions on their ability to engage in episodic simulations of the future. Thus, if episodic simulations lack detail, are inaccurate, or unrealistic, then this can result in errors in predictions.

Evidence for the relationship between simulations and predictions has emerged from the cognitive psychology literature. For instance, research using the imagination inflation paradigm has shown that individuals increase their confidence in fictitious events occurring after imagining that event, with this confidence/belief increasing the more times the event has been imagined (Thomas, Bulevich, & Loftus, 2003; Heaps & Nash, 1999). One explanation for this is effect is that the repeated mental simulation of the event means it becomes more familiar, and therefore it comes to mind more readily when later asked about it (Garry, Manning, & Loftus, 1996).

A host of studies have also shown that simulation of possible future event affects one’s predictions regarding whether the event will actually occur. For example, Carroll (1978) asked participants to imagine either Jimmy Carter or Gerald Ford winning the 1976 Presidential election; he found that the people who imagined that Jimmy Carter would win the election were then more likely to predict he would win, and vice versa. Sherman, Cialdini, Schwartzman, and Reynolds (1985) went on to demonstrate this effect in personal events. They found that people who imagined either committing a

crime, winning a prize, or contracting a disease, then predicted that they were more likely to experience these, or similar, events in the future compared to those who had not imagined those events. Similar findings have emerged from a more recent study by Szpunar and Schacter (2013). They asked participants to simulate interacting with familiar people in familiar places and evoked positive, negative or neutral emotions. Each event was simulated either four times or once, and the participants predicted how plausible it was that that event could take place in their future. The authors found that repeated simulation increased plausibility predictions; however, this effect was only evident for emotional events (positive and negative), not neutral events. Additionally, they found that the increases in plausibility for emotional events were associated with increases in the ease of simulation and event detail. This implies that the easier it is to imagine an event, and the more detail it contains, the more plausible it then seems. Again, the argument was posited that increased plausibility was a function of increased familiarity due to repeated simulation.

The impact of simulation has also been extended to predictions about actions. For instance, Anderson (1983) found that the more times people imagined performing a certain action, the more likely they were to believe that they would later carry out that action. Similarly, Libby and colleagues (2007) and Gregory and colleagues (1982), demonstrated that, through the use of imagery, imagining oneself completing a behaviour increases the likelihood of that behaviour later being accomplished. Taken together, this body of research suggests that engaging in vivid and repeated simulation plays a vital role in pre-experiencing one's potential future and impacts on the predictions we make about the future.

Prospective simulations allow one to foresee, plan and shape potential future events and are likely to also guide behaviour. As previously discussed, specific, rather than abstract, goals are crucial for behavioural self-regulation as they provide more direct links to appropriate action (Dickson & Moberly, 2013; Locke & Latham, 2002). Abstract goals seem to be associated with less vivid simulations of goal attainment and, in turn, reduced predictions of success (Holmes & Mathews, 2010). Therefore, vivid episodic simulation seems to be important for both the formation of concrete goals and the prediction of goal success. Additionally, research has also demonstrated that episodic simulation is useful in the planning of effective strategies when dealing with stressful events. Taylor, Pham, Rivkin, and Armor (1998) asked college students to

identify personal events that were currently causing them stress. Some of the participants then were asked to simulate the process of working through the stressful event and others were asked to simulate a successful outcome. One-week later, participants simulating the process of working through the problem reported more positive affect and engaged in more active coping strategies. Additionally, the authors conducted another study whereby students had to approach an upcoming exam in one of several ways. Some students had to think about how it would feel to get an A. They had to imagine walking up to the building where their scores were posted and how they would feel when they saw they had done so well. Another group had to imagine what it would take to get an A on the exam. They had to imagine what they would study and the various measures they would take to make sure they made good use of their time. Finally, a final group just monitored their study habits, without being given any instructions to simulate anything. Both the simulation groups had to do their simulations everyday for five minutes leading up to their exam. The authors found the group who simulated what they would do to get an A on the exam showed higher gain in performance than the other two groups, suggesting simulating effective strategies is more valuable for goal achievement.

In summary, evidence suggests that the four modes of prospection interact with one another, for example, simulating events affects ones predictions about these events (Szpunar & Schacter, 2013) and predictions can help with forming intentions and plans (Dickson & Moberly, 2013). Taken together, the research suggests that the ability to vividly simulate episodic events seems to underlie the other three modes of prospection. Thus, this leads to the suggestion that being able to vividly simulate positive events impacts on an individual's predictions about those events, and that this link between simulation and prediction could be crucial in the potential modification of prediction biases evident in depression. The nature of these biases are discussed in further detail within the coming sections.

1.3.6. Functions of Prospection

The four modes of prospection, and their inter-relationships, are important due to the range of adaptive functions that they are argued to serve. For example, positive episodic simulation has been shown to enhance mood and be important for psychological wellbeing. In one study, Quoidbach, Wood, and Hansenne (2009) asked participants to either imagine four positive events, four negative events, or four neutral

events that could happen to them the next day. Using the “subjective happiness scale”, results showed participants who had to imagine neutral or negative events showed no significant increase in happiness levels, whereas participants who had to imagine positive events were significantly happier two weeks later. Furthermore, being able to construct future experiences is arguably important for psychological well-being. Brown, MacLeod, Tata, and Goddard (2002) found by actively generating positive hypothetical future scenarios reduced the worry associated with an upcoming event. Additionally, focusing on positive hypothetical situations may provide individuals with a sense of relief (Szpunar, 2010).

Other research has suggested that episodic simulation may also have an effect on pro-social behaviour (Gaesser & Schacter, 2014; Gaesser, Horn, & Young, 2015). In one study (Gaesser & Schacter, 2014), participants had to either imagine a vivid scenario of helping a person in need after reading a story of need, or complete a maths problem. The stories were then read again and participants rated their willingness to help. They found participants were more inclined to help a person in need after constructing a vivid personal episode of helping that person. Gaesser et al., (2015) extended this by asking participants to either imagine themselves helping the person in need in the future, or imagine someone else helping the person. They found imagining themselves helping someone in need increased intentions to help compared to imagining someone else. These results, again, suggest episodic simulation is a useful tool for implementing future behaviours.

Predictions have also been evidenced as serving a functional purpose in guiding future behaviours. For instance, the expectation/likelihood of positive future outcomes has been linked to the successful attainment of significant personal goals, for example, successful employment and relationships (Oettingen & Mayer, 2002). Participants who predicted success at finding work as highly likely, received more job offers and had higher salaries, compared to those who passively thought about them (Oettingen & Mayer, 2002). Similarly, the authors found participants who predicted the start of a successful relationship as likely to happen, found themselves in a successful relationship.

1.4. Propection and Depression

As previously discussed, Roepke and Seligman (2016) argue that faulty propection acts as a core process underlying depression. The propection biases discussed by Roepke and Seligman can be organised using Szpunar et al's (2014; 2016) theoretical taxonomy of propection and are discussed in detail within the context of this taxonomy in the forthcoming sections.

1.4.1. Simulation Biases in Depression and Dysphoria

Simulation is the ability to mentally time travel to construct hypothetical scenarios or reconstruct real scenarios, with depressed/dysphoric individuals evidencing biases in both the reconstruction of past events and the simulation of future events. A number of studies suggest that the episodic memory biases found in depression are also evident in future thinking. Arguably, the most evidenced bias within episodic memory in depression is over-general memory, whereby individuals have difficulty recalling episodic (remembering a specific event occurring on one day, e.g., a trip to a museum) events from their past. Instead, they have a tendency to recall repeated events (e.g., going to the hairdressers every eight weeks) (Williams & Broadbent, 1986; Williams et al., 1996; Williams & Dritschel, 1988). This has also been demonstrated in episodic future thinking. Depressed individuals tend to be more over-general in their episodic future thought. When they are asked to simulate the future they are less likely than non-depressed individuals to generate events that are episodic (specific), even when the task instructions explicitly ask them to generate episodic events. Williams et al (1996) found participants who recalled over-general rather than episodic memories were less specific in detail for future events, which was also evidenced in suicidal patients. Dickson and Bates (2006) have also found over-generality in future thought in dysphoria. In response to emotional cues, participants were required to simulate and write down a specific memory and future event. The authors found dysphoric individuals were less specific in describing pleasant and unpleasant memories and future events.

MacLeod and colleagues (2005) have found that hopelessness (as measured by the Beck hopelessness scale) correlates more strongly with future positive thinking than negative thinking, suggesting a lack of positive thoughts rather than presence of negative thoughts. MacLeod et al (1998) extended these findings to clinical depression.

They asked individuals to simulate future positive and negative events for a range of future time periods. Results show parasuicide patients are less able than controls to simulate positive future events, but do not differ from controls in the number of simulation for negative future events. This suggests lack of positive anticipation but not necessarily increased negative anticipation.

Traditionally, depression has been associated with verbal, rather than imagery based processes, such as negative rumination (Fresco, Frankel, Mennin, Turk, & Heimberg, 2002). However, more recently a number of studies have looked at simulation and have found reduced positive imagery in simulations for the future in both non-clinical and clinical depression. For example, Stober (2000) provided undergraduate students with a list of twenty negative, and ten positive, future events. They were asked to simulate each event, and asked to rate how quickly the event came to mind, the vividness of the image, and the detailedness of the image. Severity of depressive symptoms, as measured by the Beck Depression Inventory (BDI-II), was correlated with reduced simulation for future positive events, but not for negative events. Similarly, Holmes et al., (2008) found people with dysphoria were associated with a deficit in generating positive simulations, despite being able to simulate negative prospective imagery. Similarly, Anderson and Evans (2014) found dysphoric participants reported reduced vividness for the simulation of self-generated future events compared to non-dysphoric participants.

Reduced vividness for the simulation of self-generated future events has also been demonstrated in depression. Morina et al., (2011) asked patients with major depressive disorder to complete a simulation task, whereby they read a series of future scenarios and imagined them happening. They were then asked to rate the vividness of the scenario and the arousal associated with the scenario. The authors found the depressed group reported a reduced ability to vividly simulate positive events, compared to the control group. Additionally, Szöllősi, Pajkossy, and Racsmány (2015) gave participants positive, negative and neutral cue words in which they had to simulate a future episode and rate the phenomenal characteristics such as vividness, time, location, feelings, visual details, accessibility, and importance. Beck's depression inventory (BDI) was used to assess depression symptom severity. The authors found higher scores on the BDI were associated with lower ratings on certain phenomenal characteristics of the imagined positive events and with higher ratings on the

phenomenal qualities of the negative events. Depressive symptom severity is related not only to reduced vividness of simulated positive episodes but also less specific event details. Positive events were imagined less positive in tone, and were less accessible.

Lack of positive simulations found in depression could compromise the ability of people with depression to act on positive goals as they may struggle to simulate anything other than negative possibilities in their future. As such, repeated practice in positive simulation may therefore be particularly helpful. In addition, depression is characterised by a bias towards a verbal, ruminative style of processing (Koster, De Lissnyder, Derakshan, & De Raedt, 2011), thus particular emphasis in the training on using vivid episodic simulations and avoiding verbal analysis maybe especially useful for positive outcomes in depression.

1.4.2. Prediction Biases in Depression and Dysphoria

Prediction biases are evident within both depression and dysphoria. Research suggests that depressed/dysphoric individuals predict negative events as more likely to happen, and positive events as less likely to happen in their future, relative to non-depressed individuals. For example, Pyszczynski et al., (1987) gave non-depressed and depressed participants twenty hypothetical scenarios, ten of which were positive and 10 were negative. For each event, participants had to rate: the likelihood of the event happening to themselves; the likelihood of the event happening to the typical undergraduate at their university; the controllability of the event; and the desirability of the event. Relative to non-depressed participants, depressed participants rated positive events as less likely for themselves, negative events as more likely for themselves, and both positive and negative events as more likely for others. Depressed participants also predicted the various events as less controllable than their non-depressed counterparts. Similarly, Thimm et al., (2013) compared probability estimates of future events of never depressed, previously depressed and clinically depressed individuals. They found clinically depressed participants estimated the probability of experiencing positive events in the future as lower than the never depressed individuals and judged the probability of experiencing negative future events as higher. Beck et al., (2006) gave participants with major depression, generalized anxiety disorder, and other psychiatric disorders the Imagined Outcome Test, in which they described a personal problem that was most distressing to them, imagined the worst and best possible outcomes, and rated the likelihood that these outcomes would actually occur. Depressed participants rated

the worst outcomes as being more likely and best outcomes as being less likely than participants in the other two groups.

Prediction biases have also been evident within research in relation to personal goals. Dickson, Moberly, & Kindermann, (2011) got participants to list approach goals (things they wanted to accomplish) and avoidance goals (things they wanted to avoid). Participants then had to rate the importance, likelihood, and perceived control of goal outcomes. Compared to never-depressed controls, depressed individuals gave lower likelihood judgments for approach goal outcomes and gave higher likelihood judgments for undesirable to-be-avoided goal outcomes. Depressed participants also gave lower ratings of control over goal outcomes. Similarly, Vincent, Boddana, & MacLeod (2004) found parasuicide patients rated their goals as less likely to be achieved and judged that they had less control over achieving them. Similarly, deliberate self-harm patients showed a lower degree of belief in the likelihood of their personal goals being achieved, and also generated fewer goals (Street, 2002).

A study by MacLeod & Cropley (1995) evidenced similar biases in dysphoria. They asked dysphoric and non-dysphoric participants to rate positive and negative events for how likely they were to happen to them in the future. Participants also had to provide a specific example of each event. They found dysphoric participants predicted future negative events as more likely to happen, but there was no difference between the dysphoric and control participants with regards to the positive events. They also found that dysphoric participants were faster at providing specific examples for future negative events relative to positive events. The same authors conducted a further study (Cropley & MacLeod, 2003) where they cued recall of 16 autobiographical memories in dysphoric and non-dysphoric participants, alongside reasons why they thought each event had occurred. Participants then had to judge the likelihood of them experiencing a similar event in the foreseeable future. The authors found that relative to controls, dysphoric individuals gave higher likelihood predictions for negative events and lower likelihood predictions for positive events. This bias was also evidenced in work by Dunning & Story (1991), who asked participants to make yes/no judgements on the occurrence of a range of future events. They found mildly depressed students predicted more negative events would happen to them but showed no difference from controls on predictions of the number of expected positive events. MacLeod and Byrne (1996) also examined the extent to which individuals experiencing non-clinical levels of depression

and anxiety predict positive and negative future events. All participants were asked to think of positive and negative future events occurring over three different time periods: the next week, the next year, and the next five to ten years. Both dysphoric and anxious individuals showed greater likelihood predictions for future negative events compared to the control group, but only the dysphoric individuals showed fewer likelihood predictions for positive events compared to both the anxious and the control group. Thus, depression, even at non-clinical levels, seems to be selectively associated with a reduction in the anticipation of positive future events.

Research within the affective forecasting literature has also suggested that individuals high in depressive symptoms expect future positive events to feel less positive even if they do occur (Marroquin & Nolen-Hoeksema, 2015), and they predict hypothetical positive events as less pleasurable than non-depressed control participants (MacLeod & Salaminiou, 2001). When predicting reactions to upcoming events, for example, valentine's day, individuals higher in depressive symptoms make more negative emotion forecasts (Hoerger, Quirk, Chapman, & Duberstein, 2012). Morina et al., (2011) found clinically depressed participants reported the positive events as less likely to happen to them in the future. With respect to the negative scenarios, there were no significant differences between the depressed group and the control group. Similarly, Bjärehed, Sarkohi, and Andersson (2010) used the future thinking task, whereby, clinically depressed and non-depressed participants were asked to name as many positive and negative events that they believe are going to happen in three time periods of the future: the next week, the next year and the next 5 to 10 years. They were then asked to rate the likelihood of each event occurring and their emotional response if that event actually happened. The authors found that the depressed group reported lower scores for emotional response for future positive events, but the two groups did not differ in terms of future negative events. This strengthens the notion that reduced anticipation of future positive events is a defining characteristic of depression.

Lack of positive future predictions in depression seems to be particularly evident within the literature. It has been suggested that reduced levels of positive predictions are more closely related to depression, whilst raised levels of negative predictions are more closely related to anxiety (eg. MacLeod & Byrne, 1996; Stober, 2000). This suggests that individuals with depression do not necessarily have elevated levels of negative future predictions; rather they struggle to develop positive future predictions. A

common characteristic of major depressive disorder is pessimism. Pessimists are people who predict the worst outcomes (Carver & Gaines, 1987), which supports the research showing lack of positive future predictions in depression (Dunning & Story, 1991).

1.4.3. Intention and Planning Biases in Depression and Dysphoria

Episodic intentions are the mental act of setting a goal in relation to a specific autobiographical future event, and planning is the organization of steps/actions towards achieving the goal. Research has demonstrated that both intention and planning biases are evidenced in depression and dysphoria.

Yufit, Benzies, Font, and Fawcett (1970) found suicidal patients have difficulty providing descriptions of events in the future and think far less into the future. They asked participants to pick a year in the future and answer questions about that year, including questions about their goals, wishes and desires. The suicidal individuals provided less detailed descriptions of the future. This could explain why depressed participants produce less specific goals compared to non-depressed participants. This is demonstrated by work from Dickson and Moberly (2013). They found that the goals produced by depressed participants were less specific in detail and that they provided less specific detailed explanations for why they would attain a goal, but not for why they would avoid a specific goal. The authors suggest that some of the motivational deficits that can be seen in depression could partly be due to the reduced vividness of goal simulation and the cognitions that support goal directed behaviour. Depressed people may plan less carefully, which in turn may make the plan more likely to fail, confirming the depressed person's original predictions that they cannot achieve their goals. Additionally, in a series of studies, MacLeod and colleagues have found that those who are suicidal (MacLeod & Conway, 2007; Vincent et al., 2004) or high in hopelessness (Hadley & MacLeod, 2010) do have personal goals for the future, but they are characterised by a lack of ability to think of plans to bring the goals to fruition.

The hypothetical problem-solving literature also provides evidence for planning deficits in depression. It has consistently been evidenced that individuals with depressive symptomology generate less effective strategies to hypothetical social problems, generate fewer alternative solutions to problems, select less effective solutions from a list of possibilities, perform worse in specifying means for achieving particular goals in hypothetical scenarios, and have lower self-perceived problem

solving competence (Dixon, Heppner, Burnett, Anderson & Wood, 1993; Goddard, Dritschel & Burton, 1996; Marx, Williams, & Claridge, 1992; Nezu & D’Zurilla, 1989). In one study, Marx et al., (1992) asked participants to report their past problem-solving behaviour, and, in retrospect, an ‘ideal’ strategy. Clinically depressed participants, compared with non-depressed controls, reported less effective actual problem-solving behaviour and generated less effective ‘ideal’ strategies. Goddard et al (1996) asked participants to retrieve a specific memory as quickly as possible in response to cue words. Participants also completed the means-end problem solving task (MEPS), in which vignettes are given that describe a problem situation and the solution. Participants have to describe the actions needed to be taken so that the conclusion is reached effectively. Consistent with Marx findings, depressed people performed more poorly on the MEPS, generating solutions that were less effective. Depressed participants also performed more poorly on the cueing task, they offered more general memories to cues.

1.5. Interventions to modify propection biases

Beck (2008) posited that by helping clients to identify and change dysfunctional beliefs, therapists could alleviate symptoms. These ideas have formed the key tenets of cognitive-behavioural therapy, which has shown to be an effective treatment for major depression, with efficacy greater than or equal to that of medication in mild, moderate, and severe episodes of major depression (Dreissen & Hollon, 2010).

The literature described in the previous sections (sections 1.4.1, 1.4.2 & 1.4.3) supports the notion that biases are evident across all modes of propection in depression. It is likely that these propection biases are more than a mere symptom of depression. Propection biases will make an individual depressed and that depression will then maintain the biases. Furthermore, the taxonomical model of propection proposed by Szpunar et al (2014: 2016), alongside supporting evidence, suggests that the different modes of propection interact with the ability to mentally simulate episodically detailed and vivid positive future events underlying positive prospective predictions, formation of clear achievable intentions and effective planning. Thus, biases in episodic future simulation, particularly regarding positive events, may be the crucial component in maintaining biased propection in depression.

The use of interventions is important because they can help to change dysfunctional beliefs (Beck, 2008). In addition, simulating positive imagery increases

self-reported optimism (Meeviseen, Peters, & Alberts, 2011) and improves mood (Burnett Heyes et al., 2016). This mood improvement is also evident in dysphoria (Pictect, Coughtrey, Mathews, & Holmes, 2011) and depression (Nelis, Vanbrabant, Holmes, & Raes, 2012). Given the potential role that prospection biases play in causation and maintenance of depression, it seems crucial that interventions target prospection biases in depression. Interventions that already target aspects of prospection, alongside experimental work examining potential new approaches, are discussed in detail in the coming sections.

1.5.1. Cognitive Behavioural Therapy

There are current methods that target prospection within cognitive behavioural therapy (CBT), one of the most widely used and recommended therapies for depression (Department of Health, 2001). For example, the use of Socratic questions can help change clients pessimistic predictions of the future by coaching them to make accurate predictions (Beck, 2011). Socratic questions aim to deal with automatic thoughts that distress the patient, by uncovering the assumptions and evidence that underpin a client's thoughts. They then aim to help the client develop reasonable alternatives, and evaluate the potential consequences. CBT can also use behavioural activation to help clients schedule pleasant experiences in the future (Jacobson, Martell, & Dimidjian, 2001). Behavioural activation explores both the events that are taking place in an individual's life and their response to these events. For instance, depressed individuals often use avoidance behaviour to try and cope with their depression. Behavioural activation targets these escape and avoidance behaviours and works towards guided activity to increase positive reinforcement.

To date, one study has explicitly investigated the effect of CBT on prospection biases. Andersson and colleagues (2013) used internet-delivered cognitive behavioural therapy (ICBT) and examined pre- to post-intervention change on a future thinking task in depressed clients. The future-thinking task asked participants to generate future positive and negative events, and rate them on likelihood of occurrence. They found no change in likelihood predictions for positive events, but a reduction in likelihood predictions for negative events. Furthermore, the changes on the future thinking task for negative events were correlated with reductions in depressive symptoms, which suggests that ICBT is a useful intervention for modifying likelihood predictions for future negative events in depression.

CBT can also train clients in goal setting and planning (GAP), which is a manualised well-being intervention focused on developing and pursuing positive goals, rather than solving problems or targeting depressive symptoms (MacLeod, Coates, & Hetherington, 2008). The focus of the sessions are; selecting and refining goals, envisaging goals, planning to achieve goals, putting goals into perspective, and obstacles to goal progress. Research has shown that GAP training can increase levels of self-reported well-being, increased ratings of life satisfaction, and predictions that goals are more likely to be attained. GAP training has been tested in group based and individual self-help formats and found to decrease depression in both (Coote & MacLeod, 2012; Ferguson, Conway, Endersby, & MacLeod, 2009; Malouff, Thorsteinsson, & Schutte, 2007).

1.5.2. Hope Therapy

Hope refers to the expectation and desire for a particular thing to happen in the future. Research has demonstrated that hopeful individuals report fewer symptoms of depression (Snyder, Irving, & Anderson, 1991) and more meaning to life (Cheavens, Feldman, Gum, Michael, & Snyder, 2006) than less hopeful individuals. In addition, people who are more hopeful generally report achieving their goals more frequently than their low-hope counterparts (Feldman, Rand, & Kahle-Wroblewski, 2009). Hope therapy is a treatment protocol designed to increase hopeful thinking and enhance goal pursuit activities (Cheavens et al., 2006). This therapy focuses on intentions and planning. The treatment was designed in a group format over eight 2-hour sessions. Each session had four segments; the first segment was dedicated to reviewing the previous week and going over homework assignments. In the second segment the participants were taught a new hope based skill each week. The third segment was spent discussing ways of applying these skills to the participant's lives. The final segment was deciding the following week's homework schedule. The treatment was designed to increase participant's level of hope, not to alleviate specific symptoms. In an initial randomized control trial, hope therapy reduced depression symptoms, increased hopeful thinking, life meaning, and self-esteem better than a waiting list control (Cheavens et al., 2006). Despite some research suggesting a short-lived reduction in depressive symptoms following hope therapy, further research on the therapy has been surprisingly scarce. No study has, to date, included a follow up to assess whether the improvements remain after a prolonged period of time. Furthermore, the initial study was conducted

using a relatively small sample size of 39, meaning that there could be concerns around the validity and generalisability of the therapy. Finally, hope therapy has not yet been compared to other established therapies such as CBT, as such it is hard to determine whether hope therapy adds anything above and beyond the traditional CBT approach.

1.5.3. Episodic Simulation and Imagery-based Approaches

The literature reviewed so far (section 1.4.1) suggests that biases in episodic future simulation, particularly regarding positive events, may be the crucial component in maintaining other aspects of biased prospection in depression. Therefore, it seems sensible to suggest that interventions that target episodic simulation biases could form a useful strategy for helping modify the other biased beliefs that depressed individuals hold about their future. Evidence for this suggestion can be found within a growing body of experimental studies and emerging therapeutic techniques that incorporate aspects of episodic simulation, in particular positive mental imagery, in the potential management of depression. For instance, studies suggest that approaches incorporating the simulation of positive imagery evidence improvements across a range of factors, including mood (Nelis et al., 2012), and self-reported optimism (Meeviseen et al., 2011). These therapeutic techniques and supporting experimental studies will now be discussed in detail.

1.5.3.1. Future Directed Therapy

Future-directed therapy is a recently developed 10-week intervention intended to decrease depression symptoms and increase well-being by teaching skills aimed at shifting the focus from dwelling on the past, to simulating more positive expectancies of the future (Vilhauer et al., 2012). The patients practice simulating positive expectancies (predictions), mindfulness, identifying and working towards values (intentions and planning), simulating outcomes and processes (simulation), and solving problems (planning). The beginning weeks of the invention focused on helping the patients understand how their thought processes produces the future, and then once they understood how the process works, they then worked on developing more positive thinking patterns about the future. During the last weeks, patients focused on practical skills for planning and achieving goals, and problem solving. The invention was compared to depressed patients who enrolled on traditional cognitive-based group

therapies. Future directed therapy improved depression, anxiety, and quality of life in patients with major depressive disorder.

In addition, future oriented group training (van Beek, Kerkhof, & Beekman, 2009) is an intervention specially targeting suicidality. Participants learn how to change their future oriented thinking and behaviour, and work towards goals that will make their life worthwhile. The training promotes goal directed and future oriented behaviour by combining cognitive therapy, problem solving therapy, and simulation. Although the results did not find that the intervention reduced suicidality (above and beyond treatment as usual), it did find an improvement in overall psychiatric symptoms, distress, and quality of life (van Beek et al., 2009).

Future directed therapy supports the theoretical cognitive model of depression which suggests that individuals with depression have lower positive expectations about the future. However, the effectiveness of the therapy was originally tested in a nonrandomised, open pilot study whereby patients chose to participate in the therapy group after being referred by their clinicians. Additionally, the majority of the participants in the therapy group were receiving pharmacological treatment and as such it is difficult to ascertain what the effect was of the experimental intervention specifically. Furthermore, there was no follow up period to determine the permanence of the effects reported.

1.5.3.2. Guided imagery and Imagery Re-scripting

Guided imagery is the use of imagination to bring about positive mind experience, by working through muscular relaxation exercises and imagining relaxing scenes such as beaches (Apostolo & Kolcaba, 2009). It is argued that when depressed individuals have access to positive thoughts and images, they have the ability to redirect their thoughts away from unpleasant, threatening stimuli, thus improving their overall mood. Both McKinney, Antoni, Kumar, Times, and McCabe (1997) and Watanabe et al (2006) have reported significant decreases in depression symptoms, and an increase in positive mood, after the use of positive mental imagery.

Imagery re-scripting has also been found to be effective in the treatment of depression, with Brewin et al., (2009) finding large treatment effects, which were

maintained at a one-year follow up. The imagery re-scripting task involved the patient giving a detailed oral description of their intrusive image or memory. The patients were then asked what they would like to change or what outcome they would have liked. They were then guided to include these changes to their intrusive image. Imagery re-scripting required only 8 sessions, on average, to show a reduction in depressive symptoms, which is considerably lower than the recommended 16–20 sessions of cognitive-behaviour therapy for the treatment of moderate or severe depression (National Institute for Health and Clinical Excellence, 2004). In addition, following imagery re-scripting, there was an average reduction of 16.60 on the BDI, suggesting that the use of mental imagery in the treatment of depression be beneficial. However, the trial did not include a control group nor did it directly compare the intervention to another established intervention such as CBT. Consequently, the results need to be treated with caution. A randomised control trial whereby participants are randomly allocated to either of two interventions (such as imagery re-scripting and CBT) would allow researchers to directly compare the effectiveness of the two interventions and determine which is more useful in reducing depressive symptoms.

1.5.3.3. Cognitive Bias Modification

Cognitive bias modification (CBM) is a general term that has been adopted to refer to experimental and therapeutic techniques developed with the intention of directly manipulating a target cognitive bias (Hallion, & Ruscio, 2011). One CBM inspired approach that has gained growing attention in recent years is the use of imagery to modify depressive biases and mood. This approach is rooted in the principle that mental imagery has an powerful effect on enhancing positive emotion (Arntz, de Groot, & Kindt, 2005; Holmes & Mathews, 2005; Holmes & Mathews, 2010; Holmes, Mathews, Dalgleish, & Mackintosh, 2006; Nelis et al., 2012).

A number of experimental studies support the role of positive imagery as a method of improving mood in non-depressed, dysphoric, and depressed individuals. For instance, Quoidbach et al. (2009) allocated non-depressed participants into 1 of 3 groups: positive future oriented thinking, neutral oriented thinking, or negative future oriented thinking. Participants had to imagine and report four events that were reasonably likely to happen the next day, for 2 weeks. They found positive oriented thinking led to significant increase in happiness ratings, whereas in the neutral and negative conditions, there was no change in happiness ratings evident. Interestingly,

Holmes et al., (2009) found vividly imagining positive events improved mood, in non-depressed participants, however verbally thinking about the same positive content made participants feel worse. Similarly, Nelis et al., (2012) found positive affect change was greater after imagining scenarios compared to listening to them, in non-depressed individuals, replicating previous research. These studies using non-depressed individuals suggest that engaging in positive imagery, compared with verbal processing of information, is more effective for mood change.

The use of positive imagery to improve mood has also been demonstrated in experimental studies using dysphoric and depressed individuals. Pictet et al., (2011) found that systematic practice of generating positive mental imagery increases positive affect in people with dysphoria. Participants were instructed to generate mental images in response to picture-word cues, which were positive, negative or mixed. The results showed the positive picture-word cues increased positive affect more than the other two conditions. Furthermore, they also found it improved performance on an unrelated behavioural task. A further study by Torkan et al., (2014) investigated the impact of daily simulation of positive scenarios for depressed individuals. They found a decrease in depressive symptoms, as measured by the BDI-II, and an increase in the vividness of the simulations, measured using the Vividness of Visual Imagery Questionnaire, which was also maintained at a 2-week follow up.

Experimental studies have also examined the impact of engaging in positive mental imagery on optimism. Optimism is the tendency to have generalized positive expectancies of the future (Carver, Scheier, & Segerstrom, 2010). Optimism is said to be important for human evolution, as it has an impact on general well-being, mental and physical health (Carver et al., 2010). Higher levels of optimism are associated with lower depression symptoms over a 15-year period, reduced risk of cardiovascular disease, and reduced rate of death (Giltay, Geleijnse, Zitman, Hoekstra, & Schouten, 2004; Giltay, Kamphuis, Kalmijn, Zitman, & Kromhout, 2006). Meevissen et al., (2011) used a “best possible self” exercise and assessed its impact on reported optimism, in a sample of students. The “best possible self” exercise involved imagining a future self where everything has turned out in the best way possible. Participants completed this task every day for five minutes, over a two-week period. Control participants were asked to complete an imagination task about their daily activities over the past twenty-four hours. Compared to the control condition, participants in the “best possible self”

condition showed significant increases in self-reported optimism. These findings suggest that engaging in positive future imagery, compared to past imagery, is more beneficial with respect to increasing optimism. An explanation for this could be that the past cannot be changed, however people can influence the future, therefore it enhances motivation. Further support for the relationship between positive imagery and optimism comes from a study by Blackwell et al., (2013). They examined the relationship between levels of dispositional optimism and ability to vividly simulate positive future events and predictions of likelihood of occurrence for those events. They found that individuals who score higher on levels of optimism generated more vivid positive future images, reported a greater sense of likelihood of the events' occurrence, and a greater sense of "pre-experiencing" the events. Therefore, enhancing the ability to vividly imagine positive future events could be a useful tool for increasing optimism.

Overall, these experimental studies suggest that simulating positive imagery appears to be beneficial for improving mood, reducing depressive symptoms, and potentially improving self-reported optimism. These ideas have also been tested within the context of developing CBM-based interventions, whereby individuals are trained to automatically imagine positive resolutions to ambiguous scenarios and pictures. For instance, Holmes et al., (2006) examined the potential usefulness of this type of positive interpretation training in non-depressed individuals. Participants listened to scenarios, and either told to imagine them or think about their verbal meaning. Each scenario was initially ambiguous, but consistently yielded positive outcomes. Those in the imagery condition reported an increase in positive affect and rated new scenarios as being more positive than those in the verbal condition, suggesting that positive interpretation training can be enhanced through the use of imagery as opposed to verbal processing.

The effectiveness of imagery-based CBM interventions has also been demonstrated in depressed participants. Blackwell and Holmes (2010) conducted a single case series using CBM style approach in clinically depressed individuals for one week. Participants listened to paragraphs that started ambiguous but ended positively, and they had to imagine the given scenario. They found improvements in mood, bias and mental health after one week, with improvements in depressive symptoms maintained at a 2-week follow up. Similarly, Lang and colleagues (2012) asked depressed participants to listen to a series of scenarios. All of the scenarios were initially ambiguous and either ended positively or negatively; in the positive training condition all the scenarios ended positively, whilst in the control condition half ended

positively and half ended negatively. The participants were told to imagine the scenarios “seeing it through your own eyes”. Their findings demonstrated that the participants in the positive condition evidenced greater improvements in depressive symptoms, as measured by the BDI-II. Finally, a positive imagery CBM intervention has been tested in a four-week randomized controlled trial by Blackwell et al., (2015). 150 depressed participants were allocated to either a four-week positive imagery CBM intervention or a four-week non-imagery control intervention. In six of the sessions participants listened to audio recordings of descriptions of everyday situations and instructed to imagine themselves in the scenarios. Each scenario was initially ambiguous, but always resolved positively. In the other six sessions, participants were presented with a photograph of everyday scenes, paired with a positive caption. For each photo, they were asked to generate a mental image combining the picture and words. The control intervention was identical, with the exception that the scenario resolutions during the first six sessions and the picture captions in the latter six sessions were split 50/50 between positive and negative. Additionally, participants in the control intervention were asked to focus on the meaning of the descriptions/pictures, rather than form mental images. Blackwell et al found that negative interpretation bias improved. This was measured using the Scrambled Sentences Test (SST; Rude, Wenzlaff, Gibbs, Vane, & Whitney, 2002) administered under cognitive load (remembering a six-digit number). Participants unscrambled a list of 20 scrambled sentences (e.g., winner born I am loser a) with a time limit of 4 minutes. A “negativity” score was generated by calculating the proportion of sentences completed correctly with a negative emotional valence (e.g., I am a born loser). Vividness of positive events, and a sense of “pre-experiencing” the event also improved for both groups. However, participants who completed the positive imagery CBM intervention experienced a greater improvement in anhedonia and a significantly greater reduction in symptoms of depression as a whole.

Imagery-based CBM techniques have also been shown to impact on self-reported behavioural activation in depression. Using the same positive imagery CBM intervention as Blackwell et al., (2015), a follow-up study by Renner, Ji, Pictet, Holmes, and Blackwell (2016) demonstrated that repeated imagining of positive events improves self-reported behavioural activation in depression. The authors argued that repeated imagining led to the participants holding higher expectations of finding similar activities rewarding in their daily life which, in turn, increased the likelihood of them engaging in this behaviour. This was measured using the behavioural activation depression scale

(BADS). This is a 25-item questionnaire comprising four subscales: Activation, representing goal-directed activation and completion of scheduled activities (seven items, e.g. “I was an active person and accomplished the goals I set out to do”); Avoidance/Rumination, representing avoidance of negative emotional states and engaging in rumination rather than active problem-solving (eight items, e.g. “I kept trying to think of ways to solve a problem but never tried any of the solutions”); Work/School Impairment, representing inactivity with regards to school or work (five items, e.g. “I took time off of work/school/chores/responsibilities simply because I was too tired or didn’t feel like going in.”); and Social Impairment, representing social isolation (five items, e.g. “I was not social, even though I had opportunities to be”). Participants rate statements according to how true they were for them during the past week, on a scale from 0 (Not at all) to 6 (Completely), with 18 items reverse-scored. Higher scores indicate higher levels of behavioural activation.

Overall, CBM-inspired techniques focusing on positive imagery have demonstrated the potential for a promising therapeutic effect in depression; studies show improvements in mood and depressive symptoms but what is most important is that these improvements in depressive symptoms are maintained at follow up. Furthermore, the overall consensus appears to be that the use of positive imagery, compared with verbal processing, leads to greater improvements. Therefore, focusing on techniques that make use of positive imagery as a way of improving depressive symptoms seems worthwhile. Future research would benefit from directly comparing the CBM approach to CBT to assess what, if any, added benefit the CBM approach brings to CBT. The CBM technique also needs conducting outside of the laboratory and trialled in clinical settings.

1.6. The Present Thesis

1.6.1. Summary of Literature & Rationale for Thesis

The reviewed literature demonstrates that a growing body of research evidences that depressed individuals have difficulties with future directed cognitions, with biases evident in all four modes of prospection outlined within Szpunar et al’s (2014; 2016) theoretical taxonomy (simulation, prediction, intention, and planning). Recently, it has been argued that these biases in prospective thinking are what maintain depressive symptoms and potentially lie at the heart of depression (Roepke & Seligman, 2016).

Therefore, developing methods of modifying these prospection biases seems like a crucial need for the effective management of depression.

Recent work within the cognitive domain suggests that the different modes of prospection are closely intertwined and that the ability to successfully simulate vivid and episodically detailed future events may underlie one's predictions regarding whether future events/intentions are likely to come to fruition and the development of effective plans (e.g. Szpunar et al, 2014). Therefore, improving an individual's ability to engage in episodic simulation may serve to modify their predictions about the future (e.g. Szpunar & Schacter, 2013). Research has already shown that engaging in positive episodic simulation, which is rich in mental imagery, represents a useful strategy for improving mood and increasing optimism (e.g. Fosnaugh et al., 2009; Holmes et al., 2009). However, to date, no research has specifically focused on whether positive episodic simulation can be used to modify biased future event predictions evidenced in depression, such as the belief that positive events are less likely, and negative events more likely, to occur. This serves as the overarching aim of the current thesis.

1.6.2. Aims of Thesis

The experiments presented within this thesis investigate the usefulness of positive future episodic simulation intervention as a method of modifying predictions regarding future events. Specifically, they investigate the impact of positive future episodic simulation intervention on predictions regarding: 1) the likely occurrence of positive and negative future events (likelihood); 2) one's perceived control over positive and negative future events (perceived control); 3) and the perceived importance of positive and negative future events (importance). In addition, given that previous literature suggests that the predictions an individual makes about future events may be closely linked to the vividness with which they can be mentally simulated, the experiments presented within this thesis also examined whether positive future episodic simulation intervention impacted on vividness ratings of positive and negative future events. Thus, the experiments presented within this thesis aim to fulfil four objectives:

- 1) to develop a positive future episodic simulation intervention paradigm and examine its impact on predictions about positive and negative future events (Chapter 2 – Experiments 1 & 2)

- 2) to use various modifications of the intervention paradigm to test the parameters under which this intervention paradigm impacts on predictions about positive and negative future events (Chapter 3 – Experiment 3);
- 3) to assess whether the intervention paradigm can be applied across non-depressed, dysphoric and depressed individuals (Chapter 4 & 5 – Experiments 4 & 5);
- 4) to investigate potential underlying mechanisms, specifically changes in optimism and affect, for the effects of positive simulation as a method of modifying event predictions (Chapters 3 & 5 – Experiments 3 & 5).

2: The Effect of Episodic Simulation versus Visualisation on Future Event Predictions

2.1. Introduction

The first overarching aim of this thesis was to develop a positive future episodic simulation intervention paradigm and examine its impact on predictions about positive and negative future events. Therefore, an initial task was to use relevant previous literature to develop an experimental paradigm to serve this purpose. A variety of research has asked individuals to make predictions, such as likelihood of occurrence, about future events (e.g. MacLeod & Byrne, 1996; MacLeod & Cropley, 1995; Dunning & Story, 1991; Pyszczynski et al., 1987; Szpunar & Schacter, 2013). Thus, previous studies provided a useful database of potential future events; both positive and negative for the purposes of developing a Future Events Predictions Task, for use within these initial investigations. However, previous literature looking at imagery- and simulation-related tasks in depression/dysphoria evidence more variation in methodology. For instance, some research has asked participants to simulate mental images in response to single cue words (e.g. Dickson & Bates, 2006), lifetime periods (e.g. Anderson & Evans, 2015), short descriptions of events (e.g. Blackwell et al., 2015; Lee et al., 2015; Morina et al., 2011) and picture-word cue combinations (e.g. Pictet et al., 2011). Therefore, a crucial decision was how to cue the simulations within the paradigm and how to ensure that the simulations generated were positive in nature.

It was decided that for these initial investigations the researcher would provide clear instructions for the need to simulate positive events in response to single word cues. This decision was primarily derived from the need to be able to easily manipulate the extent to which the simulation cues were conceptually related to the events within the Future Events Prediction Task. Previous research has suggested that predictions, such as likelihood of occurrence, are modified by repeated simulation of events that are closely related in content (Szpunar & Schacter, 2013). Therefore, the paradigm developed was based on the assumption that the simulation would be most effective if simulation cues were conceptually related to the positive events that participants were being asked to make predictions about. Therefore, each positive event within the Future Events Predictions Task was matched with a related single cue word and these cues then

formed the basis of a related version of the Future Simulation Intervention Task (F-SIT-Instructions-Related).

The use of conceptually related simulation cues was based on the work of Szpunar and Schacter (2013) from an experimental cognitive psychology perspective. However, this earlier work did not explicitly compare the simulation of conceptually related and unrelated events in modifying predictions about future events. Therefore, it was decided to explicitly explore this comparison. Thus, a second version of the Future Simulation Intervention Task was created, using single cue words that were conceptually unrelated to the events in the Future Events Prediction Task (F-SIT-Instructions-Unrelated). In order to be able to examine if either F-SIT impacted on future event predictions, a comparison control condition was also developed. This Visualisation Task required participants to vividly imagine scenes in response to neutral cue items.

Therefore, the experiments presented within this chapter use non-depressed participants to examine whether this Future Simulation Intervention Task (F-SIT), using both related and unrelated simulation cues, impacted on future event predictions when compared with a control task (visualisation task). As previously explained in Chapter 1, three predictive judgements were explored as a primary focus: the individuals' belief that each event is likely to occur (likelihood); how important the event would be to them (importance); and how much control they would have over each event's occurrence (perceived control). Participants' also provided ratings of vividness, as a secondary focus, due to research suggesting that the more vividly an individual imagines something then the more plausible it seems (Szpunar & Schacter, 2013).

2.2. Experiment 1

2.2.1. Aims & Hypotheses

The aim of experiment 1 was to examine the effect of the newly devised F-SIT on a subsequent set of predictions about potential positive and negative future events. Specifically, it compared the differential effect of two versions of the F-SIT, with a visualisation task, on a subsequent Future Event Predictions Task. One of the two F-SIT tasks used cues for simulation that were conceptually related to the events within the

predictions task (F-SIT-Instructions-Related), whilst the other used conceptually unrelated cues (F-SIT-Instructions-Unrelated).

If event predictions are reliant on the generation of conceptually related simulations, then one could expect higher predictions and ratings following the episodic simulation of future scenarios in response to related cues. Furthermore, if conceptually related simulations are crucial for impacting future event predictions, then positive simulation may have little impact on predictions regarding negative events. However, given that previous research has shown that positive prospective imagery can impact on unrelated behavioural tasks (e.g. Pictet et al., 2011), it is feasible that engaging in positive simulations about conceptually unrelated material may also impact on predictions about future events. Thus, positive future simulations in response to unrelated cues may also impact on predictions about positive future events in a similar way to simulations using related cue words. Therefore, a number of hypotheses were made about how the two versions of the F-SIT, compared with the visualisation task, would impact on predictions about positive and negative future events:

- 1) It was hypothesized that mentally engaging in positive episodic simulation would impact on predictions/ratings about positive future events as follows:
 - a. Positive events would be predicted to be more likely to occur, more controllable and more important, after completing the F-SIT compared to the visualisation task. This effect will be apparent when comparing both the F-SIT-Instructions-Related and the F-SIT-Instructions-Unrelated with the visualisation task.
 - b. Positive events would be rated as more vivid following the F-SIT-Instructions-Related and F-SIT-Instructions-Unrelated when compared with the visualisation task.

- 2) The previous literature has only explored the effects of positive episodic simulation on mood and transference to unrelated behavioural tasks that were positive in nature (e.g. Pictet et al., 2011). Thus, due to the lack of literature regarding modifying predictions regarding negative events, it was unclear what effect, if any, the F-SIT would have on predictions relating to negative future events.

2.2.2. Method

Participants

91 undergraduates from the University of Hull (11 males), with an age range of 18 to 53 years ($M = 21.20$, $SD = 6.01$), participated in exchange for course credits. Participants were sequentially assigned to one of three intervention tasks: Future Simulation Intervention Task- Related (F-SIT-Instructions-Related), Future Simulation Intervention Task-Unrelated (F-SIT-Instructions-Unrelated) or the visualisation task. The CESD-R score range and means, for each intervention task, are reported in Table 2.1. The first group (F-SIT-Instructions-Related) comprised 31 participants (3 males), with a mean age of 21.13 years ($SD=0.89$). The second group (F-SIT-Instructions-Unrelated) consisted of 29 participants (3 males), with a mean age of 21.83 ($SD=1.23$). Finally, the third group (visualisation task) consisted of 31 participants (5 males) with a mean age of 20.68 years ($SD= 1.17$). To ensure that the demographics of the participants assigned to the different intervention conditions did not differ, two one-way ANOVAs were conducted and established that neither age, $F(2,90) = .27$, $p = .76$, nor CESD-R score, $F(2,90) = .117$, $p = .89$, differed across the three intervention task conditions. A chi square test of significance found that the conditions did not differ with respect to gender ratio, $\chi^2(2) = .73$, $p = .70$. All participants provided informed consent and the procedures were approved by the University of Hull Psychology Ethics Committee.

Table 2. 1: CESD-R range and mean (and standard deviations) per intervention task.

	CESD-R Range	CESD-R Mean (SD)
F-SIT-Instructions - Related	1-45	14.90 (10.72)
F-SIT-Instructions - Unrelated	1-49	16.07 (9.79)
Visualisation Task	2-52	16.03 (11.47)

Materials

Center for Epidemiologic Studies Depression Scale - Revised (CESD-R).

The CESD-R (Eaton et al., 2004) is a 20-item inventory used to assess the presence of depressive symptoms in nine different symptom clusters as defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013). The clusters are sadness (dysphoria), loss of interest (anhedonia), appetite, sleep,

thinking/concentration, guilt (worthlessness), fatigue, movement (agitation) and suicidal ideation. Each item on the inventory is scored using a five point scale with respect to the extent the individual has experienced that symptom over the previous 1-2 week period: *0 = Not at all or less than 1 day; 1 = 1 – 2 days; 2 = 3 – 4 days, 3 = 5 – 7 days; or 4 = Nearly every day for 2 weeks.* Summation of responses provides a total score between 0 and 80, with higher values indicative of increased depressive symptomatology.

Additionally, using an algorithm provided by the scale authors, participants can be categorized according to DSM-5 criteria as follows: *symptoms of no clinical significance; subthreshold depression symptoms; possible major depressive episode; probable major depressive episode; or meets criteria for major depressive episode.* The CESD-R has demonstrated strong internal consistency across community samples (Van Dam & Earleywine, 2011).

Future Events Prediction Task. This task required participants to make predictions and ratings on 30 events, 15 positive (e.g. *people will admire you*) and 15 negative (e.g. *someone close to you will reject you*), on a number of dimensions. Firstly, how likely they were to occur in the future (likelihood), secondly, how much control they thought they would have over the event occurring (perceived control), thirdly, how important the event was to them (importance) and, finally, how vividly they could see that event happening in their mind (vividness). All four variables were assessed on a 7 point scale (e.g. *0= not at all likely* through to *6 = very likely*). 25 of the events (15 negative and 10 positive) were taken from MacLeod, Byrne, and Valentine (1996), with the experimenter devising a further 5 positive events. The full list of 30 events can be found in Appendix A. This task was presented on paper in booklet form. The front page detailed the task instructions, with the events and rating scales presented on subsequent pages.

Future Simulation Intervention Task-Related (F-SIT-Instructions-Related). The F-SIT-Instructions-Related, presented in Eprime (Schneider, Eschman, & Zuccolotto, 2002), required participants to simulate a series of positive future events as vividly as possible in response to the cue words provided. In each case a cue word appeared on the screen for 15 seconds. Each cue appeared in the middle of a black screen, in a white box. Each word was size 45 and Cambria (body) font. The cues were derived from the positive events used in the Future Events Prediction Task; with each

positive event having a corresponding cue. For example, for the event “people will admire you” the cue word was “admired”. A full list of cues and their corresponding positive events from the Future Events Prediction Task can be found in Appendix B. Participants were *instructed* that they needed to imagine a positive event that related to the cue word and that some of the cue words might appear more than once. Therefore, the requirement for positive simulations was provided through the instructions given to participants by the experimenter. Participants received a practice block, which consisted of 5 cue words prior to the experimental trials. Within the experimental trials, each cue word was presented twice hence, there were 30 experimental trials in total. The presentation of cues was randomized across participants.

Future Simulation Intervention Task- Unrelated (F-SIT-Instructions-Unrelated). The F-SIT-Instructions-Unrelated was also presented in Eprime, and was identical to the F-SIT-Instructions-Related with one key exception. The cues words used for simulation did not conceptually correspond to any of the future events in the Future Events Prediction Task. Fifteen conceptually unrelated cues were devised by the experimenter and the full list can be found in Appendix C. As in the F-SIT-Instructions-Related all cues were presented twice, hence there were 30 experimental trials in total and the presentation of cues was randomized across participants.

Visualisation Task. This control task, presented in Eprime, required participants to visualize neutral items as vividly as possible, for example, “the layout of the local shopping centre” or “two birds sitting on a tree branch”. The cues were a selection of 15 taken from a similar visualisation task employed by Nolen-Hoeksema & Morrow (1993) and a full list of cues used can be found in Appendix D. Participants were instructed that they needed to visualise the item presented and that some of the items might appear more than once. They then received a practice block, which consisted of 5 items prior to the experimental trials. Within the experimental trials, each item was presented twice hence, there were 30 experimental trials in total. The presentation of items was randomized across participants.

Design

A quasi-experimental design was used to assess the effects of the F-SIT on event predictions and ratings. Valence of prediction event (positive vs. negative) was manipulated within-subjects, whilst intervention task (F-SIT-Instructions-Related, vs. F-

SIT-Instructions-Unrelated, vs. visualisation task) was manipulated between-subjects. The dependent variables were the predictions and ratings provided by all participants with respect to the likelihood, perceived control, importance, and vividness of both positive and negative future events.

Procedure

Participants were tested in small groups (up to 4) with each participant at an individual partitioned desktop computer workstation. The researcher provided verbal instructions prior to each task and remained present throughout. After providing informed consent, participants completed the CESD-R. Participants then completed the assigned intervention task (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated, or visualisation task) on the desktop computer. All participants in each group completed the same experimental task. Finally, they completed the Future Events Prediction Task. Completion of all tasks took approximately 30 minutes.

2.2.3 Results

Event Predictions

Descriptive statistics for the three prediction variables (likelihood, perceived control, and importance) as a function of intervention task and valence of prediction event are displayed in Table 2.2.

Table 2. 2: Mean predictions (and standard deviations) as a function of intervention task and valence of prediction event.

	Event	F-SIT-Instructions-Related	F-SIT-Instructions-Unrelated	Visualisation Task
	Valence			
Likelihood	Positive	4.35 (0.72)	4.02 (0.87)	3.32 (0.88)
	Negative	3.40 (1.06)	3.64 (0.99)	3.57 (1.12)
Perceived Control	Positive	4.36 (0.83)	3.80 (1.10)	3.65 (0.86)
	Negative	2.94 (1.03)	2.90 (0.87)	2.85 (1.02)
Importance	Positive	4.84 (0.74)	4.76 (0.83)	4.46 (0.68)
	Negative	3.70 (1.12)	3.99 (1.04)	3.42 (1.27)

A series of 2 (Valence of Prediction Event: positive vs. negative) x 3 (Intervention Task: F-SIT-Instructions-Related vs. F-SIT-Instructions-Unrelated vs. visualisation task) mixed ANOVAs were conducted, with each dependent variable analysed independently, to establish whether any differences emerged in predictions following the three different intervention tasks. Bonferroni adjusted pairwise comparisons were conducted to ascertain the nature of any differences where necessary.

Likelihood. A significant main effect of valence of prediction event emerged $F(1,88) = 10.92, p = .001, np^2 = .11$, with positive events being predicted as more likely to occur compared with negative events. There was no main effect of intervention task, $F(2,88) = 1.49, p = .23, np^2 = .03$. However there was a significant Valence of Prediction Event x Intervention Task interaction, $F(2,88) = 3.55, p = .03, np^2 = .08$. Positive events were predicted to be more likely to occur following the F-SIT-Instructions-Related compared to the visualisation task ($p=.003$). There were no other significant differences in likelihood predictions (all $ps \geq .20$).

Perceived Control. There was a significant main effect of valence of prediction event, $F(1,88) = 193.83, p < .001, np^2 = .69$, with positive events being predicted as more controllable compared to negative events. There was no main effect of intervention task, $F(2,88) = 1.70, p = .19, np^2 = .04$. A significant Valence of Prediction Event x Intervention Task interaction emerged, $F(2,88) = 6.89, p = .002, np^2 = .14$. Higher levels of perceived control over positive events were predicted after the F-SIT-Instructions-Related compared to after the visualisation task ($p = .01$). A trend towards a significant difference between the F-SIT-Instructions-Related and F-SIT-Instructions-Unrelated also emerged, with higher levels of perceived control over positive events after the F-SIT-Instructions-Related ($p = .067$). There were no significant differences between intervention tasks for perceived control over negative events (all $ps = 1.00$).

Importance. A significant main effect of valence of prediction event emerged, $F(1,88) = 84.73, p < .001, np^2 = .49$, with positive events being predicted as more important than negative events. There was no main effect of intervention task, $F(2,88) = 2.36, p = .10, np^2 = .05$, nor a significant interaction, $F(2,88) = 1.06, p = .35, np^2 = .02$.

Vividness Ratings

Descriptive statistics for the vividness ratings as a function of intervention task and valence of prediction event are displayed in Table 2.3.

Table 2. 3: Mean vividness ratings (and standard deviations) as a function of intervention task and valence of prediction event.

Event Valence	F-SIT-Instructions Related	F-SIT- Instructions-Unrelated	Visualisation Task
Positive	4.25 (0.72)	4.07 (0.95)	3.62 (0.89)
Negative	3.28 (1.13)	3.55 (1.17)	3.48 (1.11)

To establish whether any differences emerged in vividness ratings following the three different intervention tasks a 2 (Valence of Prediction Event: positive vs. negative) x 3 (Intervention Task: F-SIT-Instructions-Related vs. F-SIT-Instructions-Unrelated vs. Visualisation Task) mixed ANOVA was conducted. There was a significant main effect of valence of prediction event, $F(1,88) = 18.56, p < .001, np^2 = .17$, with positive events being rated as more vivid. There was no main effect of intervention task, $F(2,88) = .90, p = .41, np^2 = .02$. There was, however, a significant Valence of Prediction Event x Intervention Task interaction, $F(2,88) = 3.63, p = .03, np^2 = .08$. Bonferroni adjusted pairwise comparisons established that vividness ratings for positive events were significantly higher after the F-SIT-Instructions-Related compared to after the visualisation task ($p = .01$). There were no other significant differences (all $ps \geq .14$).

2.2.4. Discussion

As hypothesised, predictions regarding likelihood and perceived control for positive events were significantly higher after the F-SIT-Instructions-Related task compared to the visualisation task. However, a similar pattern was not evident for importance predictions; there was no difference in importance predictions between the F-SIT and the visualisation task, which is contrary to the experimental hypothesis. Thus, the F-SIT-Instructions-Related task appears to be beneficial, when compared with the visualisation task, with respect to predictions regarding likelihood and perceived control of positive future events. However, this was not the case for importance predictions. One possible explanation for this is that the importance of events is a more stable predictive judgement. This could be because importance predictions are likely to be

closely related to an individual's goals and desires. Simulating future events may make them appear more vivid, thus more believable, and therefore more likely to occur. However, if an event does not fit within an individual's framework of personal goals then its importance is unlikely to be affected. Furthermore, events that are related to an individual's personal goals, arguably, will be viewed as important no matter whether they have been mentally simulated or not. The ability of the F-SIT to modify importance predictions could be argued to be less crucial than its ability to modify likelihood and control predictions. Previous research has demonstrated that depressed individuals produce just as many future goals, and rate them just as important, as their non-depressed counterparts, however they provide fewer reasons why these goals would be accomplished (Dickson et al., 2011). This suggests that depressed individuals do have personal goals, however they believe they are less likely to occur. Therefore, this suggests that it is modifying predictions about the likelihood of occurrence, rather than an event's importance, that is crucial.

It was also hypothesised that the F-SIT-Instructions-Unrelated task would evidence higher predictions of likelihood, importance, and perceived control for positive events when compared with the visualisation task. Contrary to this hypothesis, there were no differences between the F-SIT-Instructions-Unrelated and the visualisation task for any of these predictions. Interestingly, however, there were also no differences between the F-SIT-Instructions-Related and F-SIT-Instructions-Unrelated for predictions of likelihood and importance for positive events. A trend towards a significant difference did emerge between the F-SIT-Instructions-Related and F-SIT-Instructions-Unrelated for predictions of perceived control, with more control being perceived over the positive events after the F-SIT-Instructions-Related. The lack of a clear difference between the F-SIT-Instructions-Unrelated and the visualisation task suggests that the use of simulation as a method of improving predictions may rely on the use of conceptually related prediction and simulation events. However, the lack of a clear difference between F-SIT-Instructions-Related and the F-SIT-Instructions-Unrelated further complicates the picture. It suggests that the F-SIT-Instructions-Unrelated may be having some effect on predictions but that effect is not sufficient to evidence clear differences from the effect of the visualisation task. Further research is required to tease apart the effect of the F-SIT-Instructions-Unrelated on predictions about future events.

With regard to ratings of vividness, as hypothesized, positive events were rated as being significantly more vivid after the F-SIT-Instructions-Related compared to the visualisation task. However, contrary to the hypothesis, there were no differences in vividness ratings for positive events following the F-SIT-Instructions-Related and F-SIT-Instructions-Unrelated. These findings seem to closely mirror the findings for likelihood predictions. This suggests that the effects of simulation on likelihood predictions in the F-SIT-Instructions-Related may be a function of increasing the vividness with which an individual can mentally simulate such events and, in turn, they then seem more plausible. This proposition is in line with previous work by Szpunar and Schacter (2013).

With respect to predictions for negative events, it was unclear what effect, if any, the F-SIT would have. This is because the previous literature has only explored the effects of positive episodic simulation on mood and transference to unrelated behavioural tasks that were positive in nature (e.g. Pictet et al., 2011). Results demonstrated that there were no differences between the two versions of the F-SIT and the visualisation task with respect to all three predictions and ratings of vividness. This suggests that simulating positive events does not impact on future predictions regarding negative events. This further supports the notion that the use of simulation as a method of improving predictions relies on the use of conceptually related prediction and simulation events.

One limitation of Experiment 1 is that conclusions are drawn on the basis of post-intervention differences between conditions without any baseline, pre-intervention measures of event predictions. Therefore, it is conjecture that it is engagement in the F-SIT-Instructions-Related that is impacting on participants' predictions and ratings about potential positive future events. It is feasible that the findings could reflect baseline differences across the three interaction task conditions. Thus, in order to establish if positive episodic future simulation *modifies* predictions and ratings about future events, a pre-to post-design needs to be employed. Experiment 2, therefore, set out to fulfil this aim.

2.3. Experiment 2

2.3.1. Aims & Hypotheses

The aim of Experiment 2 was to assess whether positive episodic future simulation intervention modifies future event predictions utilising a pre-to post-intervention design. Thus, it makes use of the same two versions of the F-SIT and the same visualisation task as Experiment 1, with participants completing the Future Events Prediction Task both pre- and post- intervention. Consequently, this allowed for any *changes* in predictions and vividness ratings to be assessed. Based on previous literature and findings of Experiment 1, a number of hypotheses were made regarding pre- to post-intervention changes in event predictions and ratings as a function of the two versions of the F-SIT and the visualisation task.

- 1) With respect to predictions and ratings for *positive* future events it was hypothesised that:
 - a. Positive events would be predicted as more likely to occur and more controllable post-, compared with pre-, intervention for participants completing the F-SIT-Instructions-Related.
 - b. The previous literature suggests that it is feasible that engaging in positive simulations about conceptually unrelated material may also impact on predictions about future events, yet the findings of Experiment 1 cast doubt on this suggestion. Therefore, it is difficult to develop clear hypotheses about pre-to post-intervention changes as a function of the F-SIT-Instructions-Unrelated.
 - c. No pre- to post-intervention change in predictions of likelihood and perceived controllability are expected as a result of engaging in the visualisation task.
 - d. The findings of Experiment 1 suggest that the importance of future events potentially represent a more stable prediction. Thus, it is hypothesised that no pre- to post-intervention changes would occur in importance predictions as a result of any intervention task (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated, or visualisation task).
 - e. Positive events would be rated more vivid post-, compared with pre-, invention, for participants completing the F-SIT-Instructions-Related, whilst no pre- to post-intervention change is expected as a result of the visualisation task. For the same reasons as discussed in hypothesis 2, it is unclear what

effect the F-SIT-Instructions-Unrelated will have on vividness ratings.

- 2) Given the null findings in Experiment 1, it was hypothesized that pre- to post-intervention changes would only be evident for predictions/ratings relating to positive, but not *negative*, events.

2.3.2. Method

Participants

80 participants (12 males) were recruited, with an age range of 18 to 51 years ($M=21.45$, $SD=6.09$). Participants were sequentially assigned to one of three intervention tasks: F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated or the visualisation task. The depression score ranges and means, per intervention group, are reported in Table 2.4. The first group (F-SIT-Instructions-Related) comprised 26 participants (1 male), with a mean age of 21.65 years ($SD=7.46$). The second group (F-SIT-Instructions-Unrelated) consisted of 25 participants (3 males), with a mean age of 21.28 ($SD=5.20$). Finally, the third group (visualisation task) consisted of 29 participants (8 males) with a mean age of 21.41 years ($SD= 5.62$). To ensure that the demographics of the participants assigned to the three intervention conditions did not differ, separate one-way ANOVAs established that neither age, $F(2,79) = .02$, $p = .98$, nor CESD-R score, $F(2,79) = .46$, $p = .64$, differed across the three intervention conditions. A chi square test of significance found that the conditions did differ with respect to gender ratio, $\chi^2(2) = 6.32$, $p = .042$. The ratio of female to male participants was 25:1 in the F-SIT-Instructions-Related, 22:3 in the F-SIT-Instructions-Unrelated, and 21:8 in the visualisation task. All participants were students recruited from the University of Hull in exchange for course credits.

Table 2. 4: CESD-R range and mean (and standard deviations) per intervention task

	CESD-R Range	CESD-R Mean (SD)
F-SIT-Instructions - Related	0-24	11.12 (7.20)
F-SIT-Instructions - Unrelated	0-49	11.16 (10.06)
Visualisation Task	1-44	13.31 (11.41)

Materials

Center for Epidemiologic Studies Depression Scale - Revised (CESD-R).

The CESD-R (Eaton et al, 2004) is a 20-item inventory used to assess the presence of depressive symptoms and is described in detail in the Method of Experiment 1 (Section 2.2.2).

Future Events Prediction Task. This task was identical to the Future Events Predictions Task used in Experiment 1, except that on this occasion the task was presented using Opensesame Experiment Generator Software (Mathot, Schreij, & Theeuwes, 2012) rather than in pencil/paper format. An initial instruction screen explained that they would be presented with 30 possible future events and that for each event they needed to rate: ‘how likely you think that event will happen to you at any point in your future’; ‘how much control you feel like you would have over that event occurring’; ‘how important would that event be to your life story’, and ‘how vividly can you picture that event happening’. Participants were then presented with each event in turn; in each case, the event description was presented at the top of the screen with the four ratings scales on the lower half of the screen. Presentation order of the 30 events was randomized across participants.

Future Simulation Intervention Task-Related (F-SIT-Instructions-Related).

This task was identical to that described in Experiment 1, with the only exception being that the task was presented using Opensesame rather than Eprime.

Future Simulation Intervention Task-Unrelated (F-SIT-Instructions-Unrelated). This task was identical to that described in Experiment 1, with the only exception being that the task was presented using Opensesame rather than Eprime.

Visualisation Task. This task was identical to that described in Experiment 1, with the only exception being that the task was presented using Opensesame rather than Eprime.

Jigsaw Task. The jigsaw was part of an app for the Ipad (Sparkle Apps, 2014) and comprised 120 pieces. Participants had to move the pieces into place with their finger from the bottom of the screen, and were given 15 minutes to complete as much of the jigsaw as possible.

Design

A 3 (Intervention Task: F-SIT-Instructions-Related vs. F-SIT-Instructions-Unrelated vs. Visualisation Task) x 2 (Valence of Prediction Event: positive vs. negative) x 2 (Time: pre- vs. post-intervention) mixed design was employed, with repeated measures on the final two factors. Participants were randomly assigned to one of the three experimental intervention tasks. Dependent variables were the predictions/ratings made by participants regarding future events within the pre- and post-intervention Future Events Prediction Tasks (likelihood, perceived control, importance, and vividness).

Procedure

Participants were tested individually with the researcher present. The computerized experimental tasks were presented on a Macbook. After providing informed consent, participants completed the Future Events Predictions Task. Participants were then distracted from thinking about the events presented in this initial task for 15 minutes. During this time they completed the Jigsaw Task and the CESD-R. Participants then completed the intervention task (either the F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated or the visualisation task) and, finally, they completed the Future Events Predictions Task for a second time.

2.3.3. Results

Changes in Future Event Predictions

Mean predictions of likelihood, perceived control, and importance as a function of Intervention Task (F-SIT-Instructions-Related vs. F-SIT-Instructions-Unrelated vs. Visualisation Task), Valence of Prediction Event (Positive vs. Negative), and Time (pre-vs. Post-Intervention) are displayed in Table 2.5.

Table 2. 5: Mean predictions (and standard deviations) as a function of time, valence of prediction event and intervention task.

	Event Valence	F-SIT- Instructions-Related		F-SIT- Instructions-Unrelated		Visualisation Task	
		Pre	Post	Pre	Post	Pre	Post
Likelihood	Positive	4.10 (0.73)	4.67 (0.75)	4.12 (0.67)	4.39 (0.72)	3.83 (0.93)	3.90 (0.89)
	Negative	3.23 (0.99)	2.50 (1.05)	2.78 (0.84)	2.33 (0.97)	3.05 (1.08)	2.90(1.25)
Perceived Control	Positive	4.14 (0.77)	4.50 (0.81)	4.18 (0.61)	4.45 (0.70)	4.14 (0.87)	4.17 (0.96)
	Negative	2.86 (0.90)	3.03 (1.09)	3.22 (0.65)	2.97 (0.80)	3.06 (0.52)	2.88 (0.88)
Importance	Positive	4.61 (0.59)	4.84 (0.76)	4.75 (0.64)	4.90 (0.65)	4.64 (0.76)	4.71 (0.84)
	Negative	3.16 (1.17)	2.91 (1.29)	3.46 (1.40)	3.07 (1.54)	3.54 (0.96)	3.62 (1.33)

The change in each event prediction (likelihood, perceived control, and importance) was analysed using a 3 Intervention Task; (F-SIT-Instructions-Related vs. F-SIT-Instructions-Unrelated vs. Visualisation Task) x 2 Valence of Prediction Event; (Positive vs. Negative) x 2 Time; (pre-vs. post-intervention) mixed ANOVA, with repeated measures on the first two factors. Bonferroni adjusted pairwise comparisons were conducted, where required, to clarify the nature of significant effects.

Likelihood. Significant main effects emerged for both time, $F(1,77) = 7.31, p = .008, \eta p^2 = .09$, and valence of prediction event, $F(1,77) = 97.83, p < .001, \eta p^2 = .56$, with events being predicted as more likely pre-intervention and positive events predicted to be more likely to happen compared with negative events. However these two main effects were qualified by a significant interaction, $F(1,77) = 100.98, p < .001, \eta p^2 = .57$. Pre- to post-intervention changes showed that positive events were rated as more likely to happen ($p < .001$), whilst negative events less likely to happen ($p < .001$), post-intervention.

There was no significant main effect for intervention task, nor did intervention task interact significantly with time ($F_s \leq .90, p_s \geq .41, \eta p^2_s \leq .02$). However the intervention task did interact significantly with valence of prediction event, $F(2,77) = 3.21, p = .046, \eta p^2 = .08$. There was a significant difference in likelihood predictions for

positive events between the F-SIT-Instructions-Related and visualisation task conditions ($p = .05$), with events in the F-SIT-Instructions-Related condition being predicted to be more likely. There were no other significant differences. A significant three-way interaction also emerged, $F(2,77)=18.40$, $p<.001$, $\eta^2=.32$ (Figure 2). Both F-SIT (-Related and -Unrelated) groups showed a significant increase in likelihood predictions for positive events pre-to post-intervention ($p < .001$) and a significant decrease in likelihood predictions for negative events pre-to post-intervention ($p < .001$). However, the visualisation task led to no significant pre- to post-intervention change in likelihood predictions for positive ($p = .28$) or negative ($p = .09$) events.

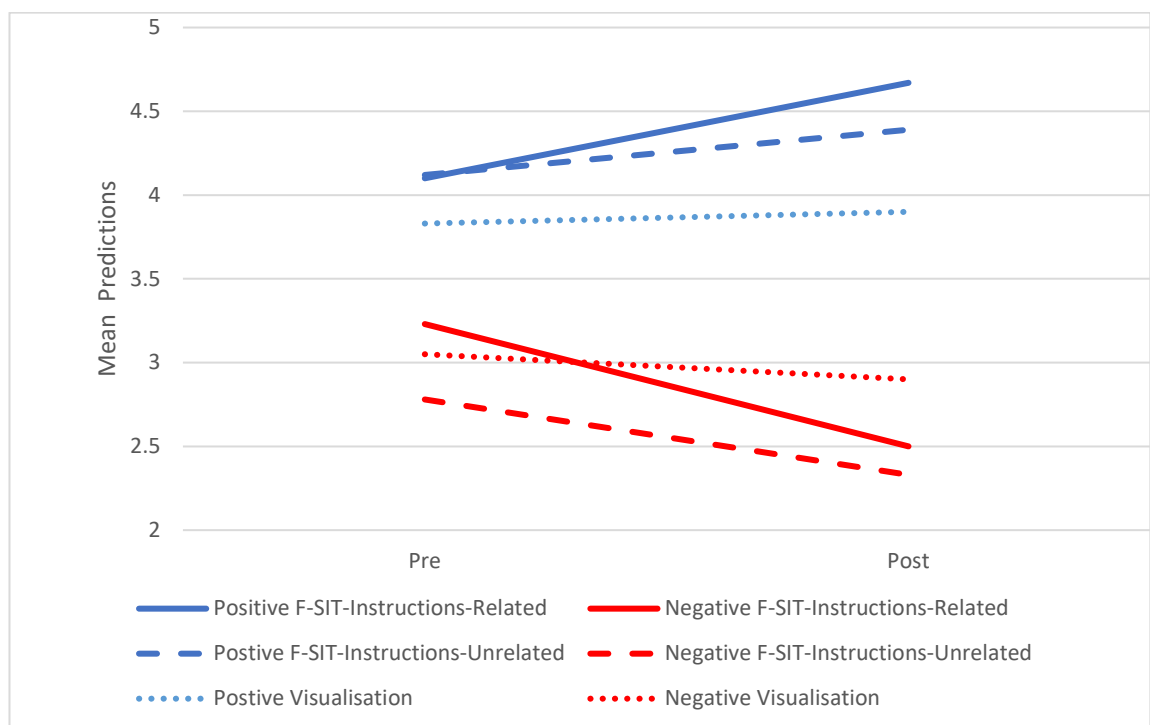


Figure 2: Changes in likelihood predictions pre-to post-intervention as a function of prediction event valence and intervention task.

Perceived Control. A significant main effect of valence of prediction event emerged, $F(1,77) = 216.77$, $p < .001$, $\eta^2 = .74$, with positive events predicted to be more controllable compared with negative events. There was no main effect of time, $F(1,77) = 1.61$, $p = .21$, $\eta^2 = .02$, however this was qualified by a significant Time x Valence of Prediction Event interaction, $F(1,77) = 16.21$, $p < .001$, $\eta^2 = .17$. There was a significant increase in perceived control over positive events pre-to post-intervention ($p < .001$), however there was no significant difference in perceived control over negative events pre-to post-intervention ($p = .29$).

There was no significant main effect of intervention task, $F(2,77) = .32, p = .73, \eta^2 = .01$ although a significant interaction emerged for Time x Intervention Task, $F(2,77) = 3.40, p = .038, \eta^2 = .08$. There was a significant increase in perceived control pre-to post-intervention for the F-SIT-Instructions-Related ($p = .007$), however there was no significant difference found for either the F-SIT-Instructions-Unrelated ($p = .46$) or the visualisation task ($p = .91$). There were no other significant interactions (all F s $\geq .45$, all p s $\geq .16$).

Importance. A main effect of valence of prediction event emerged, $F(1,77) = 101.98, p < .001, \eta^2 = .57$, with positive events being rated as more important compared with negative events. No main effect emerged for time, $F(1,77) = .18, p = .68, \eta^2 = .00$. However a significant Time x Valence of Prediction Event interaction was found, $F(1,77) = 20.55, p < .001, \eta^2 = .21$. There was a significant increase in predictions of importance for positive events pre-to post-intervention ($p < .001$) and a significant decrease in importance predictions for negative events pre-to post-intervention ($p = .011$).

There was also a significant three-way interaction, $F(2,77) = 5.79, p = .005, \eta^2 = .13$. For both the F-SIT-Instructions-Related and F-SIT-Instructions-Unrelated, there were significant increases in predictions of importance for positive events (p s = .001 & .03 respectively). There was a significant decrease in importance predictions for negative events following the F-SIT-Instructions-Unrelated ($p = .002$) and a trend towards a significant decrease in importance predictions for negative events following the F-SIT-Instructions-Related ($p = .054$). In the visualisation task, there was no significant difference in predictions of importance for either positive ($p = .27$), or negative, events ($p = .49$) pre-to post-intervention. There were no other significant main effects or interactions (F s $\leq 1.77, p$ s $\geq .18, \eta^2$ s $\leq .05$).

Changes in Vividness Ratings

Descriptive statistics for participants' vividness ratings are displayed in Table 2.6.

Table 2. 6: Mean vividness ratings (and standard deviations) as a function of time, valence of prediction event and intervention task.

Event Valence	F-SIT-Instructions-Related		F-SIT-Instructions-Unrelated		Visualisation Task	
	Pre	Post	Pre	Post	Pre	Post
Positive	3.84 (0.74)	4.41 (0.96)	4.09 (0.76)	4.48 (0.80)	3.93 (0.85)	4.09 (0.87)
Negative	3.23 (0.91)	2.52 (1.00)	3.14 (1.09)	2.82 (1.42)	3.24 (0.93)	3.19 (1.16)

Changes in vividness ratings were assessed using a 3 (Intervention Task: F-SIT-Instructions-Related vs. F-SIT-Instructions-Unrelated vs. Visualisation task) x 2 (Valence of Prediction Event: Positive vs. Negative) x 2 (Time: Pre- vs. Post-Intervention) mixed ANOVA. A significant main effect emerged for valence of prediction event, $F(1,77) = 84.04, p < .001, \eta^2 = .52$, with positive events rated as more vivid compared with negative events. No main effect of time emerged, $F(1,77) = .03, p = .87, \eta^2 = .00$. However there was a significant interaction between Time and Valence of Prediction Event, $F(1,77) = 56.39, p < .001, \eta^2 = .42$, with an increase in vividness ratings for positive events ($p < .001$) and a decrease in vividness ratings for negative events ($p < .001$) pre-to post-intervention. No significant main effect of intervention task emerged, $F(2,77) = .23, p = .80, \eta^2 = .01$, nor was there a significant interaction between valence of prediction event and intervention task, $F(2,77) = 1.82, p = .17, \eta^2 = .05$. There was, however, a significant three-way interaction, $F(2,77) = 10.23, p < .001, \eta^2 = .21$ (Figure 3). For both versions of the F-SIT (F-SIT-Instructions-Related & F-SIT-Instructions-Unrelated), there was a significant increase in vividness ratings for positive events ($ps < .001$) and a significant decrease in vividness ratings for negative events ($ps < .001$ & $.014$ respectively) pre-to post-intervention. There was no significant pre- to post-intervention change in vividness ratings for either the positive ($p = .09$), or the negative ($p = .66$), events in the visualisation task.



Figure 3: Changes in vividness ratings pre-to post-intervention as a function of prediction event valence and intervention task.

2.3.4. Discussion

Consistent with the experimental hypotheses (Hypotheses 1a and 1c), likelihood and perceived control predictions for positive events significantly increased following the F-SIT-Instructions-Related with no pre- to post-intervention change evident in the visualisation task. This suggests that the F-SIT-Instructions-Related appears to be beneficial, when compared with the visualisation task, by modifying predictions regarding likelihood and perceived control of positive future events.

As discussed in the introduction, the previous literature suggests that it is feasible that engaging in positive simulations about conceptually unrelated material may also impact on predictions about future events. However, the findings of Experiment 1 casted doubt on this suggestion because there were no differences with regards to any of the predictions, or vividness ratings, for the F-SIT-Instructions-Unrelated compared to the visualisation task. Thus, it was difficult to form a firm hypothesis regarding the impact of the F-SIT-Instructions-Unrelated within Experiment 2 (Hypothesis 1b). Interestingly, contrary to the findings of Experiment 1, Experiment 2 found that the F-SIT-Instructions-Unrelated did lead to significant increases in likelihood predictions from pre- to post-intervention, however this was not evident for predictions in perceived

control. These findings are of particular interest because they suggest that engaging in a positive simulation task not only increases the predicted likelihood of related positive future events, but also the predicted likelihood of unrelated positive future events. However, for predictions regarding perceived control, the findings of Experiment 2 add further weight to the suggestion that modification relies on the use of a conceptually related simulation task.

Interestingly, the findings of Experiment 1 had suggested that the importance of future events potentially represents a more stable prediction and it was hypothesised (Hypothesis 1d) that no pre- to post-intervention changes would occur in importance predictions as a result of any intervention task (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated, or visualisation task). However, this was not the case. Importance predictions significantly increased from pre- to post-intervention as a result of both the F-SIT-Instructions-Related and the F-SIT-Instructions-Unrelated, but not as a result of the visualisation task. As discussed previously, one possible explanation for differences between the findings of Experiments 1 and 2 could have been the lack of baseline measures between intervention task groups in Experiment 1. Arguably, the change in importance predictions following both versions of the F-SIT may reflect the fact that likelihood predictions also changed as a function of these intervention tasks. Once an event feels more likely to occur then they it may also feel more personally salient and, thus, important.

With regard to ratings of vividness, as hypothesized (Hypothesis 1e) and in line with Experiment 1, positive events were rated as being significantly more vivid after the F-SIT-Instructions-Related. Furthermore, no significant change was found for vividness ratings as a function of the visualisation task. The findings from Experiment 1 left it unclear as to the potential effect of the F-SIT-Instructions-Unrelated on vividness ratings; however, a significant change in pre- to post-intervention ratings did emerge for the F-SIT-Instructions-Unrelated within this experiment. Interestingly, again, the findings for vividness closely mirrored the pattern of findings for likelihood predictions. This provides further weight to the suggestion that likelihood predictions may be a function of the vividness with which an individual can mentally envisage such events.

With respect to predictions/ratings about negative events (hypothesis 2) it was hypothesized that pre- to post-intervention changes would not be evident. However,

contrary to this hypothesis, some changes were evidenced in predictions about negative events. The likelihood and importance predictions for negative events decreased following the F-SIT-Instructions-Related and F-SIT-Instructions-Unrelated. However, no pre- to post-intervention changes were evident as a result of the visualisation task. Furthermore, contrary to hypothesis 2, vividness ratings for negative events also decreased following both the F-SIT-Instructions-Related and F-SIT-Instructions-Unrelated. Again, no change occurred as a function of the visualisation task. The discrepancy between the findings of Experiment 1 and 2 suggest that further work is required to fully elucidate on the effect of the F-SIT on predictions/ratings regarding negative events. However, the findings of Experiment 2 provide a promising suggestion that the simulation of positive future events can not only beneficially modify predictions regarding positive events but also predictions regarding negative events. Predictions of perceived control for negative events only increased following the F-SIT-Instructions-Related, with no pre- to post-intervention change in either the F-SIT-Instructions-Unrelated or the visualisation task. This, again, suggests that it is the simulation of related events that modifies predictions of control.

Previous work by Szpunar and Schacter (2013) has suggested that an individual needs to simulate a specific, or closely related, event for that event to then seem more plausible. However, the findings of Experiment 2 suggest that positive episodic simulations using unrelated cue words can be equally effective in modifying predictions about both positive and negative future events. One explanation for this is that the process of positive episodic simulation temporarily modifies participants' optimistic orientation, an idea consistent with research showing that evoking positive imagery increases optimism (Meevissen et al., 2011). This notion is in need of further research.

2.4. General Discussion

Taken together, the findings of Experiment 1 and 2 lend support to the proposal that the newly developed positive future episodic simulation intervention paradigm, the F-SIT, can beneficially modify predictions, and ratings of vividness, about potential positive future events. The findings of Experiment 2 suggest that the F-SIT may also beneficially impact on predictions, and ratings of vividness, about potential negative future events.

Both experiments demonstrated the effectiveness of the F-SIT-Instructions-Related, whereby participants simulated events that were conceptually related to those within the Future Events Prediction Task. These findings are in line with other research showing simulating related events makes them appear more plausible (Anderson, 1983; Sherman et al., 1985; Szpunar & Schacter, 2013). Interestingly, within Experiment 2, the F-SIT-Instructions-Unrelated also impacted on predictions and ratings about positive future events. Furthermore, Experiment 2 demonstrated that both the F-SIT-Instructions-Related and F-SIT-Instructions-Unrelated impacted on predictions and ratings made about negative future events too. This was not explicitly predicted. Nevertheless, it is of great interest to note that engaging in a positive simulation task not only affects the prospect of related positive events, but may also affect how individuals view unrelated positive events and potential negative events. This is in contrast to previous literature showing changes in event appraisals only for events that were repeatedly simulated (e.g. Szpunar & Schacter, 2013).

One possible explanation for these findings is that the F-SIT actually modifies affect, which in turn leads to a general improvement in predictions about positive and negative events. Support for this notion can be found in previous work showing that imagery/simulation-based tasks do impact on state mood (e.g. Pictet et al., 2011). An alternative, albeit potentially related, explanation is that an increase in general optimism is responsible for the rating changes across both positive and negative future events – whereby their generalised expectancies about the future become more positive, rather than purely impacting predictions about events related to the simulations themselves. Previous research has suggested that optimistic orientation can be temporarily manipulated by using imagery-based techniques within an experimental setting (Fosnaugh et al., 2009; Peters, Flink, Boersma, & Linton, 2010). Furthermore, others have suggested that increasing the vividness of positive prospective mental imagery may serve as a mechanism for improving optimism, a characteristic that has strong link with psychological well-being (Blackwell et al., 2013; Ji, Holmes & Blackwell, 2017). Thus, our finding potentially lends further support to this assertion and is an avenue worthy of further investigation.

In summary, the experiments within this chapter have shown that the F-SIT can have a beneficial impact on future event predictions and ratings. The mixed nature of some of the findings from Experiments 1 and 2 do suggest that the parameters under

which the benefits of the F-SIT are optimal still require further investigation. Most importantly, however, the findings from Experiments 1 and 2 do evidence that effects of the F-SIT on predictions about, and vividness ratings for, future events were not mirrored following completion of the visualisation task. This suggests that the effects are a function of future-focused positive episodic simulation rather than merely engaging in mental imagery *per se*.

3: The Effect of Episodic Simulation on Future Event Predictions: Testing the Parameters

3.1. Introduction

The second aim of this thesis is to use various modifications of the positive future episodic simulation intervention paradigm to test the parameters under which this intervention paradigm impacts on predictions about positive and negative future events. Before the F-SIT can be tested within dysphoric and depressed individuals, it is important to establish the parameters under which this paradigm brings about change in future event predictions; thus, it is important to establish whether alternative versions of the F-SIT of those used in earlier experiments will also modify predictions and ratings about future events. Furthermore, the experimental manipulation of aspects of both the F-SIT and the Future Events Predictions Task will allow for further investigation of whether the F-SIT affects predictions about events beyond those that are conceptually related to those simulated. This should further elucidate the potential mechanisms underlying the effect of the F-SIT on prediction modification.

The F-SIT used in the two experiments presented so far used single cue words, with clear *instructions* for the need to simulate *positive* events in response to these cue words. However, it is feasible that other methods of cueing positive simulations might also prove useful. For instance, previous research has demonstrated simulating short descriptions of positive events improved mood in depressed individuals (Blackwell & Holmes, 2010) and increased the likelihood of participants engaging in the events in the future (Renner et al., 2016). The findings from Experiment 2 suggest that relatedness of the simulations is not necessarily crucial for prediction and rating modification, and that the effect of the positive simulation may generalise across different positive and negative events. Therefore, it is of interest, to investigate whether using unrelated positive cues in the form of scenarios would modify future event predictions and ratings.

It is important to establish if the use of positive scenarios as a method of cueing simulations impacts on predictions and ratings because it sets the parameters under which the use of episodic simulation could be useful within a therapeutic setting. For example, it would potentially open up the possibility for an individual to complete the

intervention alone, perhaps in the form of a computerized task. The use of computerized CBT has been found to be effective at reducing symptoms of depression (e.g. Mitchell, 2009; Proudfoot et al, 2004; Twomey, O'Reilly & Meyer, 2017). Thus, developing methods of improving prospection that would fit within such a remit could prove useful in moving forward with a therapeutic tool within depression due to the flexibility it provides.

Therefore, in order to test the usefulness of positive cues, in the form of scenarios, Experiment 3 developed a new version of the F-SIT and compared it with the F-SIT used in the previous two experiments. The new version of the F-SIT uses positive scenarios that are unrelated to the events in the Future Event Predictions Task as cues for simulation (F-SIT-Cues-Unrelated). None of the cues in this new simulation task are related to the events in the Future Events Predictions Task. This is because, in order to have positive scenario cues that are conceptually related to prediction events, one would essentially be asking participants to simulate the exact same event in the F-SIT as they rate in the prediction task. The participant would then be forming predictions and ratings about an event, simulating the identical event, then re-predicting/-rating that event. This seemed problematic from the perspective of demand characteristics. Given the use of unrelated cues in the newly developed F-SIT-Cues-Unrelated task, it was decided that the ideal comparison task from the earlier experiments was the F-SIT-Instructions-Unrelated, which uses positive instructions and unrelated single cue words for simulation.

As discussed in Chapter 2, one possible explanation for the modification in predictions and ratings seen in Experiment 2 could be that they reflect underlying changes in affect and/or general optimism, which needs investigating (aim 4 of this thesis). One methodological manipulation that could begin to test this notion is establishing whether modifications still occur when one uses different, or incongruent, prediction event lists pre- and post- intervention. Experiment 2 has already demonstrated that following the F-SIT-Instructions-Unrelated modifications occurred within some predictions and ratings for both future positive and negative events. This suggests that the relatedness of the simulation is not necessarily crucial for modifications to occur, in turn signifying that the effects of simulation may generalize beyond conceptually related events. The manipulation of prediction event list congruency across the pre- and post-intervention versions of the Future Events

Predictions Tasks will elucidate further on this issue. If modifications are still evident when the prediction event lists are incongruent then this would suggest that the F-SIT is leading to changes in a more general underlying construct, such as affect or optimism, which is then impacting on event predictions.

Therefore, Experiment 3 used non-depressed participants to examine whether the F-SIT-Cues-Unrelated led to similar modifications in the three predictive judgements (likelihood, perceived control and importance), and ratings of vividness as in the F-SIT-Instructions-Unrelated. Furthermore, Experiment 3 investigated whether the modification seen when the prediction event lists are the same, or congruent, pre- and post-intervention generalizes beyond using the same events to using prediction event lists that are different, or incongruent, pre-and post-intervention.

3.2. Experiment 3

3.2.1. Aims and Hypotheses

The aim of Experiment 3 was to assess whether positive episodic future simulation intervention modifies future event predictions using various modifications of the F-SIT and Future Events Predictions Task, specifically: 1) by using positive cues, rather than positive instructions, in the F-SIT; and 2) by using congruent and incongruent prediction event lists across the pre- and post-intervention versions of the Future Events Prediction Task. Based on the previous literature and the findings of earlier experiments, it is hypothesized that the two versions of the F-SIT will result in pre- to post-intervention changes in event predictions and ratings as follows:

- 1) Predictions/Ratings about positive future events:
 - a. Both the F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated make use of cues that are conceptually unrelated to the prediction events. In Experiment 2 the simulation of conceptually unrelated scenarios impacted on event predictions regarding likelihood of occurrence. Furthermore, previous research has suggested that using positive scenarios as simulation cues, rather than instructions, can have beneficial effects, albeit for improving mood rather than predictions per se (e.g. Renner et al., 2016). Thus, it is hypothesized that the two versions of the

F-SIT (-Instructions-Unrelated and -Cues-Unrelated) will both lead to positive events being predicted as more likely to occur post-, compared with pre-, intervention.

- b. Experiment 2 suggested that the simulation of conceptually related material seems to be important for the modification of predictions of perceived control. Both the F-SIT-Instructions-Unrelated and the F-SIT-Cues-Unrelated use simulation cues that are conceptually unrelated to the events in the Future Event Predictions Task. Therefore, it is hypothesized that neither the F-SIT-Instructions-Unrelated nor the F-SIT-Cues-Unrelated will impact on predictions of perceived control for positive events.
- c. Due to the inconsistent findings regarding importance predictions in Experiment 1 and 2, it was unclear what effect, if any, either F-SIT (F-SIT-Instructions-Unrelated or F-SIT-Cues-Unrelated) would have on predictions of importance for positive events.
- d. Given that both Experiment 1 and 2 suggest that vividness ratings seem to closely mirror predictions of likelihood, it is hypothesized that both the F-SIT-Instructions-Unrelated and the F-SIT-Cues-Unrelated will lead to pre- to post-intervention increases in vividness ratings for positive events.
- e. The findings of Experiment 2 suggest that the F-SIT may be altering affect and/or optimistic orientation which, in turn, leads to a generalized improvement in future event predictions and vividness ratings. If this is the case then one would expect a similar improvement in predictions and ratings to occur when the events used within the pre- and post-intervention versions of the Future Event Predictions Task do not match. Thus, it is hypothesized that the effects outlined in 1a-1d will occur when the events in the Future Event Predictions Task are both congruent and incongruent.

2) Predictions/Ratings about negative future events:

The findings from Experiment 1 and 2 regarding negative events were inconsistent. However, the findings from Experiment 2 did show a significant decrease in predictions and vividness ratings for negative events. This could be due to a change

in affect and/or optimistic orientation. If this is the case, then one could expect to see prediction and rating modification to generalize to negative events also. Therefore, following the same rationale as was presented for predictions/ratings about positive future events, it was tentatively hypothesized that the F-SIT will result in pre- to post-intervention changes in event predictions and ratings for negative events as follows:

- a. The F-SIT – Instructions-Unrelated and F-SIT-Cues-Unrelated will lead to negative events being predicted as less likely to occur post- compared with pre-intervention.
- b. Neither the F-SIT-Instructions-Unrelated, nor the F-SIT-Cues-Unrelated, will impact on predictions of perceived control for negative events.
- c. It is unclear what effect, if any, either F-SIT (F-SIT-Instructions-Unrelated or F-SIT-Cues-Unrelated) would have on predictions of importance for negative events.
- d. Both the F-SIT- Instructions-Unrelated and the F-SIT-Cues-Unrelated will lead to pre- to post-intervention decreases in vividness ratings for negative events.
- e. The effects outlined in 2a-2d will occur in when the events in the Future Event Predictions Task are both congruent and incongruent.

3.3. Method

3.3.1 Participants

96 participants (13 males) were recruited, with an age range of 18 to 52 years ($M=21.15$, $SD=6.05$). The between-subjects manipulation of intervention task and prediction list congruence resulted in participants being sequentially assigned to one of four experimental conditions: 1) F-SIT-Instructions-Unrelated – Congruent; 2) F-SIT-Cues-Unrelated – Congruent; 3) F-SIT-Instructions-Unrelated – Incongruent; 4) F-SIT-Cues-Unrelated - Incongruent. The CESD-R score range and means, per intervention task, can be found in Table 3.1. The first group (F-SIT-Instructions-Unrelated - Congruent) comprised 24 participants (3 males), with a mean age of 21.25 years ($SD=7.62$). The second group (F-SIT-Cues-Unrelated - Congruent) consisted of 24 participants (3 males), with a mean age of 21.46 ($SD=5.10$). The third group (F-SIT-Instructions-Unrelated - Incongruent) consisted of 24 participants (4 males) with a mean

age of 20.91 years ($SD= 4.78$). The final group (F-SIT-Cues-Unrelated - Incongruent) consisted of 24 participants (3 males) with a mean age of 20.96 years ($SD=6.05$). To ensure that the demographics of the participants assigned to the different experimental tasks did not differ, two separate 2 (Intervention Task: Positive Cues vs. Positive Instructions) x 2 (Prediction List Congruence: Congruent vs. Incongruent) between-subjects ANOVAs established that neither age (all $F_s < 1$, $ps > .74$) nor CESD-R score (all $F_s < 1$, $ps > .34$) differed. There was also no significant difference in gender ratio between the conditions, $\chi^2(3) = .27$, $p = .97$. All participants were students recruited from the University of Hull in exchange for course credits.

Table 3. 1: CESD-R range and mean (and standard deviations) per intervention task

	CESD-R Range	CESD-R Mean (SD)
F-SIT-Instructions – Unrelated – Congruent	1-52	20.17 (14.74)
F-SIT-Instructions – Unrelated -Incongruent	1-54	17.42 (14.39)
F-SIT-Cues-Unrelated-Congruent	1-62	19.83 (17.00)
F-SIT-Cues-Unrelated-Incongruent	3-50	16.79 (13.57)

3.3.2. Materials

Center for Epidemiologic Studies Depression Scale - Revised (CESD-R).

The CESD-R (Eaton et al, 2004) is a 20-item inventory used to assess the presence of depressive symptoms and is described in detail in the Chapter 2 (Section 2.2.2).

Future Events Prediction Task. This task was identical to that used in Experiments 1 and 2 (Section 2.2.2 & 2.3.2), with one exception. In order to manipulate the congruence of the prediction list (congruent vs. incongruent) a second event list was created. List A was the same list as used in Experiments 1 and 2. The experimenter devised a further 15 positive and 15 negative events to create a second list, List B. A full list of events in List B can be found in Appendix E. It was necessary to ensure the newly developed event list, List B, produced predictions/ratings that were comparable to the original event list, List A. Therefore, 26 postgraduates from the University of Hull (8 males), with an age range of 20 to 37 years ($M = 25.04$, $SD = 3.27$), rated all 60 events (30 events from each list) for likelihood, perceived control, importance and vividness. Paired samples t-test found no significant differences between the event lists on any of the predictions/ratings (all $ts \geq -.01$, all $ps \geq .12$).

F-SIT-Instructions-Unrelated. The F-SIT–Instructions-Unrelated was identical to that used in Experiments 1 and 2 (section 2.2.2 & 2.3.2). This task required participants to simulate a series of positive future events as vividly as possible in response to the cue words provided, with none of the cues relating to the events in the Future Events Prediction Task. Participants were *instructed* that they needed to imagine a positive event that related to the cue word and that some of the cue words might appear more than once. They then received a practice block, which consisted of 5 cue words prior to the experimental trials. Within the experimental trials, each cue word was presented twice hence, there were 30 experimental trials in total. The presentation of cues was randomized across participants.

F-SIT-Cues-Unrelated. The F-SIT-Cues-Unrelated formed a modified version of the F-SIT presented in previous studies. It required participants to simulate a series of positive future events as vividly as possible in response to the cues provided. However, in this task the instructions given to the participant did not emphasize the need to be positive. Instead, the cue itself presented a positive scenario. Participants were told that they needed to imagine the scenario presented in the on-screen cues and that some of the cues might appear more than once. The scenarios used as cues in the F-SIT-Cues-Unrelated were derived from the cue words used in the F-SIT-Instructions-Unrelated task. For example, the cue word “holiday” in the F-SIT-Instructions-Unrelated became “you enjoy a day at the water park whilst on holiday” in the F-SIT-Cues-Unrelated. None of the cues related to the events in the Future Events Prediction Task. A full list of the cues used in this task can be found in Appendix F. Following the instructions, participants received a practice block, which consisted of 5 cues prior to the experimental trials. Within the experimental trials, each cue was presented twice hence, there were 30 experimental trials in total. The presentation of cues was randomized across participants.

Jigsaw Task. This task was the same distraction task as used in Experiment 2 (section 2.3.2).

3.3.3. Design

A 2 (Intervention Task: Positive Cues vs. Positive Instructions) x 2 (Prediction List Congruence: Congruent vs. Incongruent) x 2 (Valence of Prediction Event: Positive vs. Negative) x 2 (Time – Pre- vs. Post-intervention) was employed, with repeated

measures on the last two factors. Participants were randomly assigned to one of the four experimental conditions that resulted from crossing the two between-subjects factors (1) F-SIT-Instructions-Unrelated – Congruent; 2) F-SIT-Cues-Unrelated – Congruent; 3) F-SIT-Instructions-Unrelated – Incongruent; 4) F-SIT-Cues-Unrelated – Incongruent). Dependent variables were the predictions/ratings made by participants regarding future events within the Future Events Prediction Tasks (likelihood, perceived control, importance, and vividness).

3.3.4. Procedure

Participants were tested individually with the researcher present. The computerized experimental tasks were presented on a Macbook. After providing informed consent, participants completed a pre-intervention Future Events Prediction Task. Participants were then distracted from thinking about the events presented in this initial task for 15 minutes. During this time they completed the Jigsaw Task and the CESD-R. Participants then completed the intervention task (either F-SIT–Instructions-Unrelated or F-SIT–Cues-Unrelated) and, finally, they completed a further Future Events Prediction Task. Participants either made predictions/ratings about the same events both pre- and post-intervention (Prediction List Congruent) or they made predictions/ratings about different events pre- and post-intervention (Prediction List Incongruent). The prediction event lists used in the Future Events Prediction Tasks were counterbalanced to minimize order effects (A-A or B-B for the congruent conditions and A-B or B-A for the incongruent conditions).

3.4. Results

3.4.1. Changes in Event Predictions

The change in each event prediction (likelihood, perceived control, and importance) was analyzed using a 2 (Intervention Task: Positive Cues vs. Positive Instructions) x 2 (Prediction List Congruence: Congruent vs. Incongruent) x 2 (Valence of Prediction Event: Positive vs. Negative) x 2 (Time – Pre- vs. Post-intervention) mixed ANOVA, with repeated measures on the last two factors. Bonferroni adjusted pairwise comparisons were conducted, where required, to clarify the nature of significant effects. Descriptive statistics for all three predictions are displayed in Table 3.2.

Likelihood. Significant main effects emerged for both time, $F(1,92) = 146.88, p < .001, \eta^2 = .16$, and valence of prediction event, $F(1,92) = 35.36, p < .001, \eta^2 = .28$. Events were predicted as more likely pre-, compared with post-intervention. Also, positive events were predicted as more likely compared to negative events. These two main effects were also qualified by a significant Time x Valence of Prediction Event interaction, $F(1,92) = 43.26, p < .001, \eta^2 = .32$. There was a significant increase in likelihood predictions for positive events pre-to post-intervention ($p < .001$) and a significant decrease in likelihood predictions for negative events pre-to post-intervention ($p < .001$).

There was no significant main effect of intervention task, nor did the intervention task significantly interact with time, valence of prediction event or prediction list congruence (all $F_s \leq 1.25$, all $p_s \geq .27$, all $\eta^2 \leq .01$). Also, there was no main effect of prediction list congruence, nor did the prediction list congruence significantly interact with time or valence of prediction event (all $F_s \leq .65$, all $p_s \geq .42$, all $\eta^2 \leq .01$). However, a Time x Valence of Prediction Event x Prediction List Congruence interaction did emerge $F(1,92) = 5.06, p = .027, \eta^2 = .05$. When the predictions lists were congruent, there was a significant increase in likelihood predictions for positive events, and a significant decrease in likelihood predictions for negative events, pre-to post-intervention (both $p_s < .001$). However, when the prediction lists were incongruent there was no significant difference in likelihood predictions for positive events pre-to post-intervention ($p = .36$), although there was a significant decrease in likelihood predictions for negative events pre-to post-intervention ($p < .001$). There was no four way interaction $F(1,92) = .06, p = .81, \eta^2 = .00$.

Perceived Control. There was a main effect of valence of prediction event, $F(1,92) = 227.56, p < .001, \eta^2 = .71$, with higher predictions of control for positive events than negative events. There was no other significant main effects or interactions (all $F_s \leq 1.2$, all $p_s \geq .10$).

Importance. There was a main effect of valence of prediction event, $F(1,92) = 62.54, p < .001, \eta^2 = .41$, with higher importance predictions for positive events. There was no main effect of time, $F(1,92) = .17, p = .67, \eta^2 = .00$, although this was qualified by a significant Time x Valence of Prediction Event interaction $F(1,92) = 4.79, p = .03, \eta^2 = .05$. Pre-intervention, there was a significant difference between importance

predictions for positive and negative events, with positive events being predicted as more important than negative events ($p < .001$). This same pattern was also evident post-intervention, however the difference between importance ratings for positive and negative events was greater post-intervention ($p < .001$). There was no main effect of intervention task, nor did the intervention task significantly interact with time, valance of prediction event or prediction list congruence (all $F_s \leq 1.25$, all $p_s \geq .27$, all $\eta^2 \leq .03$).

There was a main effect of prediction list congruence $F(1,92) = 4.36$, $p = .04$, $\eta^2 = .05$, with higher overall importance predictions when the lists were incongruent compared with congruent. However, there were no significant interactions with prediction list congruence (all $F_s \leq 1.13$, all $p_s \geq .29$, all $\eta^2 \leq .01$).

3.4.2. Changes in Vividness Ratings

A further 2 (Intervention Task: Positive Cues vs. Positive Instructions) x 2 (Prediction List Congruence: Congruent vs. Incongruent) x 2 (Valance of Prediction Event: Positive vs. Negative) x 2 (Time – Pre- vs. Post-intervention) mixed ANOVA assessed participants' vividness ratings. Descriptive statistics are displayed in Table 3..

There was a significant main effect of valance of prediction event, $F(1,92) = 46.78$, $p < .001$, $\eta^2 = .34$, with higher vividness ratings for positive, compared with negative, events. There was no significant main effect of time, $F(1,92) = .32$, $p = .57$, $\eta^2 = .00$. However, this was qualified by a significant Time x Valance of Prediction Event interaction, $F(1,92) = 30.37$, $p < .001$, $\eta^2 = .25$. There was a significant increase in vividness ratings for positive events pre-to post-intervention ($p < .001$) and a significant decrease in vividness ratings for negative events pre-to post-intervention ($p = .007$). There was no main effect of intervention task, nor did the intervention task interact significantly with time, valance of prediction event or prediction list congruence (all $F_s \leq .56$, all $p_s \geq .46$, all $\eta^2 \leq .01$).

There was no main effect of prediction list congruence $F(1,92) = .004$, $p = .95$, $\eta^2 = .00$, nor did the prediction list congruence interact with time or valance of prediction event ($F_s \leq .05$, all $p_s \geq .83$, all $\eta^2 \leq .01$). However, there was a three way interaction between time, valance of prediction event and prediction list congruence, $F(1,92) = 4.85$, $p = .03$, $\eta^2 = .05$. When the prediction lists were congruent, there was a

significant increase in vividness ratings for positive events pre-to post-intervention ($p < .001$) and a significant decrease in vividness ratings for negative events pre-to post-intervention ($p = .006$). However, when the prediction lists were incongruent, there was a significant increase for vividness ratings for positive events pre-to post-intervention ($p = .04$) but no significant difference in ratings for negative events pre-to post-intervention ($p = .28$).

Event Valence	F-SIT-Instructions-Unrelated						F-SIT-Cues-Unrelated									
	Congruent			Incongruent			Congruent			Incongruent						
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post				
Likelihood	3.93 (0.85)	4.22 (0.93)	4.26 (0.82)	4.36 (0.83)	3.82 (0.97)	4.13 (0.86)	4.34 (0.57)	4.37 (0.76)	3.48 (0.81)	2.87 (1.04)	3.65 (1.01)	3.33 (1.05)	3.74 (0.92)	3.28 (0.89)	3.56 (1.00)	3.20 (1.06)
Perceived Control	4.06 (0.67)	4.37 (0.90)	4.37 (0.60)	4.32 (0.67)	4.04 (0.90)	4.18 (0.84)	4.32 (0.53)	4.34 (0.64)	3.29 (0.80)	3.28 (0.86)	3.27 (0.68)	3.30 (0.71)	3.08 (0.94)	3.09 (0.88)	3.28 (0.71)	3.19 (0.65)
Importance	4.33 (0.65)	4.58 (0.75)	4.86 (0.61)	4.84 (0.47)	4.82 (0.61)	4.79 (0.60)	4.82 (0.66)	4.85 (0.63)	3.37 (1.41)	3.40 (1.47)	4.08 (0.87)	4.00 (0.89)	3.80 (0.97)	3.52 (1.20)	3.70 (1.27)	3.63 (1.31)

Table 3.3: Mean vividness ratings (and standard deviations) as a function of time, valence of prediction event, and intervention task

Event Valence	F-SIT-Instructions-Unrelated						F-SIT-Cues-Unrelated									
	Congruent			Incongruent			Congruent			Incongruent						
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post				
Positive	3.94 (0.79)	4.36 (0.87)	4.20 (0.89)	4.40 (0.78)	4.25 (0.79)	4.51 (0.62)	4.21 (0.77)	4.32 (0.86)	3.50 (0.96)	3.17 (1.18)	3.50 (1.11)	3.43 (1.23)	3.82 (0.92)	3.58 (0.90)	3.58 (1.05)	3.43 (1.15)
Negative	3.50 (0.96)	3.17 (1.18)	3.50 (1.11)	3.43 (1.23)	3.82 (0.92)	3.58 (0.90)	3.58 (1.05)	3.43 (1.15)								

Table 3.2: Mean predictions (and standard deviations) as a function of time, valence of prediction event, and intervention task

3.5.

Discussion

F-

The main purpose of Experiment 3 was to investigate whether the SIT-Cues-Unrelated led to similar modifications in the three predictive judgements (likelihood, perceived control and importance), and ratings of vividness as the F-SIT-Instructions-Unrelated. Furthermore, Experiment 3 investigated whether the modification seen when the pre- and post-intervention prediction event lists are the same, or congruent, is also evident when these prediction event lists are different, or incongruent.

As hypothesized, when the prediction event lists were congruent, there was a significant increase in likelihood predictions and vividness ratings for positive events following both the F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated, (hypotheses 1a and 1d). Furthermore, there was a significant decrease in likelihood predictions and vividness ratings for negative events following both interventions (hypotheses 2a and 2d). These findings are in line with the findings from Experiment 2 and suggest that by engaging in a positive simulation task one can increase both vividness ratings and likelihood predictions about unrelated positive events and decrease vividness ratings and likelihood predictions about unrelated negative events. It also suggests that likelihood predictions and vividness ratings can be modified when the simulated cues become inherently positive, rather than relying on positive instructions, which could be particularly important for moving the intervention task forward as a therapeutic intervention within depression. As was the case in Experiment 2, it could be argued that the similar pattern of findings for both vividness ratings and likelihood ratings suggests that changes in likelihood predictions could be a function of the increasing vividness of the simulated events.

Experiment 2 suggested that the simulation of conceptually related material seemed to be important for the modification of predictions of perceived control. Both the F-SIT-Instructions-Unrelated and the F-SIT-Cues-Unrelated used simulation cues that were conceptually unrelated to the events in the Future Event Predictions Task. As hypothesized, when the prediction event lists were congruent, there was no modification evident for predictions of perceived control over positive events (hypothesis 1b) or negative events (hypothesis 2b). This also adds further weight to the suggestion that modification of perceived control relies on simulating conceptually related events.

Due to the inconsistent findings regarding importance predictions in Experiment 1 and 2, it was unclear what effect, if any, either F-SIT (F-SIT-Instructions-Unrelated or F-SIT-Cues-Unrelated) would have on predictions of importance (hypotheses 1c and 2c). There was no modification evident in importance predictions for positive or negative events as a result of either the F-SIT-Instructions-Unrelated or the F-SIT-Cues-Unrelated when the prediction lists were congruent. As previously discussed, it is feasible that importance predictions may represent a more stable prediction compared with likelihood and perceived control. However, the evidence for this assertion is, so

far, rather mixed. Experiment 1 found no impact on importance predictions following both the F-SIT-Instructions-Related and the F-SIT-Instructions-Unrelated. Experiment 2, however, did find modifications in importance predictions following both the F-SIT-Instructions-Related and F-SIT-Instructions-Unrelated. The inconsistencies found within the three experiments does lend some support to the idea that importance may be related to personal goals and desires, which could be more stable than future predictions. Further investigation into understanding importance predictions is therefore needed to elucidate on these inconsistencies.

The findings of Experiment 2 suggested that the F-SIT may be altering affect and/or optimistic orientation which, in turn, leads to a generalized improvement in future event predictions and vividness ratings. If this is the case then one would expect a similar improvement in predictions and ratings to occur when the events used within the pre- and post-intervention versions of the Future Event Predictions Task are incongruent (Hypotheses 1e and 2e). However, for positive events, the only significant modification that emerged was an increase in vividness ratings from pre- to post-intervention. No change occurred from pre- to post-intervention for likelihood, perceived control, or importance predictions. In contrast, for negative events, the only significant modification was a decrease in likelihood predictions from pre- to post-intervention. No changes occurred from pre- to post-intervention for predictions of perceived control or importance, or vividness ratings. The lack of a modification in predictions of both perceived control and importance is not surprising and is in line with the findings when prediction events lists were congruent. The modification of perceived control seems to rely on simulation of conceptually related material, whilst importance predictions may represent a more stable construct that is linked to personal goals and desires. However, the findings for likelihood predictions and vividness ratings are somewhat surprising. Likelihood predictions and vividness ratings have always mirrored each other in the previous experiments. However, in the current experiment they responded very differently to the intervention. Positive events became more vivid pre- to post-intervention, yet were not predicted to be more likely to occur. In contrast, negative events were rated as less likely to occur pre- to post-intervention, but were not rated as less vivid. Therefore, this finding does call into question our previous assumption that changes in likelihood predictions are a function of increasing/decreasing the vividness with which an individual mentally simulates the events.

When the prediction event lists are incongruent the pre- to post-intervention measurements are ascertaining whether a more global change in positive and negative event predictions/ratings has occurred. Arguably, thus, it is measuring whether the intervention results in a change in optimism, which is defined as the extent to which people hold generalized favourable expectancies for their future (Carver et al., 2010). It would not rule out, however, the possibility that such changes were occurring as a function of the intervention improving affect. The findings of the present investigation, therefore, provide mixed evidence for the assumption that optimism/affect changes underlie the modifications in predictions and vividness ratings. The fact that the likelihood predictions for positive events did not increase when the events in the Future Events Prediction Task were incongruent pre-and post-intervention could suggest that affect and/or optimism is not changing, and that is why the modification is not generalizing to different event lists, i.e. when the events are not the same pre-and post-intervention. However, there was a significant decrease in likelihood predictions for negative events. This is somewhat surprising, and difficult to explain, if affect and/or optimism levels are not being altered by the intervention. However, one limitation of using incongruent prediction event lists pre- and post-intervention is that there is no baseline comparison to actually measure change. Therefore, it could be argued that each participant's predictions/ratings would vary for each list, so it is feasible that any changes are being masked by potentially different responses to the events within the two different lists. This could explain why the findings across the congruent and incongruent event lists did not match, such as the likelihood predictions for positive events increasing pre-to post-intervention when the events lists were the same (congruent) pre- and post-intervention but there was no change in likelihood predictions for positive events when the event lists were not the same (incongruent) pre-and post-intervention.

Interestingly, there was no difference between the intervention methods, that is, it did not matter whether the method used positive instructions with single cue words, or inherently positive cues in the form of scenarios. Both forms of intervention method were equally useful for modifying predictions and ratings for both positive and negative future events. This is in line with previous work demonstrating that simulating positive scenarios improves mood and likelihood predictions (e.g. Blackwell & Holmes, 2010; Renner et al., 2016). This is of interest with regard to delivering the intervention in depression as a therapeutic tool. In the long-term having an intervention that does not need a professional to deliver would be of great benefit to both patients and healthcare

providers. If simulation cues do not need to be related to the prediction events for bias modification to occur then it would be easier to create, and roll out, a training paradigm that could be accessed from home, for example, through an app, potentially making it both more accessible to patients and more cost-effective. Therefore, investigating whether simulating inherently positive cues, in the form of scenarios, can modify predictions and ratings in dysphoria and depression is in need of investigation.

In summary, the main overall findings of Experiment 3 are that both intervention tasks (F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated) appear to have a beneficial impact on positive and negative future event predictions. The findings when the events in the Future Events Prediction Task were the same (congruent), versus when they were different (incongruent), were mixed and raise a number of questions about the underlying mechanisms of the modifications observed in the experiments thus far. However, the biggest limitation to using incongruent event lists is not being able to establish the participants' predictions/ratings pre-intervention for the two different event lists used in the Future Events Prediction Task. Therefore, it is more difficult to know whether any modifications could be made over time when participants could be making completely different predictions/ratings about the two different event lists to begin with. However, although the pattern of findings were different, there were still some modifications present for negative events, suggesting that a change in affect or change in optimistic orientation may have some part to play in the modifications observed.

Thus far, the F-SIT has been tested, using various paradigms, in a non-depressed sample. It appears that the F-SIT-Instructions-Related, using congruent event lists leads to the most modifications in predictions and ratings for both positive and negative events. The overall aim of this thesis is to assess whether positive episodic simulation can be used to modify biased future event predictions evidenced in depression, therefore the F-SIT needs to be employed within a depressed sample to ascertain what effects the F-SIT has on the prospection biases seen in depression.

4: The Effect of Episodic Simulation on Future Event Predictions in Dysphoria & Depression.

4.1. Introduction

The overarching aim of this thesis is to establish whether positive episodic simulation can be used to modify biased future event predictions evidenced in depression. So far, Experiments 1-3 have developed the F-SIT paradigm and, using various versions of this paradigm, have demonstrated that future event predictions are modifiable within a non-depressed sample. However, it is now critical to ascertain

whether the F-SIT modifies the prospection biases seen in depression and dysphoria. As reviewed in Chapter 1 (section 1.4.2) it is well established that prediction biases are evident within both depression and dysphoria. For instance, a number of authors have evidenced that, in comparison to non-depressed individuals, depressed and dysphoric individuals predict negative events as more likely, and positive events as less likely, to happen in their future (Beck et al., 2006; Pyszczynski et al., 1987; Thimm et al., 2013). Therefore, the experiments presented in this chapter fulfil the third aim of this thesis; they assess whether the positive future episodic simulation intervention paradigm can be applied across non-depressed, dysphoric and depressed individuals.

The success of the F-SIT in modifying predictions in non-depressed individuals suggests that positive future episodic simulation may comprise a promising mechanism by which prospective prediction biases in depression/dysphoria can be modified. Furthermore, past research has demonstrated systematic practice of simulating positive future events using mental imagery can help to increase positive affect in people with dysphoria and depression (e.g. Pictet et al., 2011; Torkan et al., 2014). This also points to the potential of the F-SIT as a promising method of modifying prospective prediction biases in depression/dysphoria. However, it cannot be assumed from these two pieces of evidence that the F-SIT will be of benefit to depressed and dysphoric individuals. Other research has shown that positively valenced material can actually have a negative effect on cognitive-emotional processing within depressed/dysphoric individuals. For example, Joormann and colleagues (Joormann & Siemer, 2004; Joormann, Siemer & Gotlib, 2007) investigated the role of positive memory recall in mood regulation. Joorman and Siemer (2004) found that recalling positive episodic memories was only effective as a mood-regulatory strategy for non-dysphoric participants; in contrast, the dysphoric participants' mood did not improve after they recalled positive memories. With clinically depressed participants, Joormann et al., (2007) found that depressed participants' sad mood worsened after recalling positive memories. Therefore, as the current investigation includes a positive intervention task, it is crucial to ensure that the prediction modification effects seen as a function of the F-SIT in non-dysphoric participants in Experiments 1-3 also transfer to dysphoric and depressed individuals.

The experiment presented in this chapter used individuals experiencing high levels of depressive symptomatology. The algorithmic method of scoring the CESD-R (Eaton et al., 2004) was used; this method established one group of participants who

met criteria for major depressive disorder or probable major depressive disorder (depressed) and a second group who were experiencing sub-clinical levels of depression (dysphoric). A final group of non-depressed controls also participated for comparison purposes. If positive simulations are to form part of a useful toolkit for bias modification then pre- to post-intervention changes in event predictions and ratings need to be evidenced in both the dysphoric and depressed groups.

A crucial decision was which of the different versions of the F-SIT used in the previous experiments to employ within this experiment. The F-SIT-Instructions-Related (as used in Experiment 2) was chosen for use in Experiment 4. One reason for this selection is that it allowed the impact of repeated simulation on predictions regarding future events to be investigated. Earlier experimental research (e.g. Szpunar & Schacter, 2013) has placed emphasis on the process of *repeated* simulations of conceptually *related* material for the purposes of increasing plausibility of those future events. They argued that repeatedly simulating events makes them more familiar and, therefore, more plausible. However, Experiment 2 within this thesis found that both related and unrelated versions of the F-SIT functioned similarly in terms of modifying predictions about future events. However, it is possible that positive simulations of conceptually related material may prove even more beneficial when they are repeated multiple times. Thus, in order to test this assertion, Experiment 4 used a modified version of the F-SIT-Instructions-Related from Experiment 2 with some cues being presented 5 times, some presented once, and some did not appear at all. This allows one to assess whether repeated simulation of related events enhances bias modifications. Experiment 4 also used congruent event lists in the Future Events Prediction Task - that is, the event lists were the same pre- and post- intervention. This was because, in order to test whether or not repeated simulation enhances bias modifications, the cues in the F-SIT needed to relate to the positive events being predicted/rated. This allows for any changes over time to be measured, in particular the comparison of changes for the events that were simulated five times versus the events that were simulated once versus the events that were not simulated at all.

4.2. Experiment 4

4.2.1. Aims & Hypotheses

The aim of Experiment 4 was to assess whether positive episodic future simulation intervention modifies future event predictions in dysphoric and depressed individuals. It used the F-SIT-Instructions-Related, with congruent event lists pre- and post- intervention. Based on the literature and findings from the previous experiments, a number of hypotheses were made regarding pre- to post-intervention modifications in event predictions and ratings as a function of the F-SIT-Instructions-Related. It was hypothesized that these modifications will be evidenced in *all three* depression status groups (non-depressed, dysphoric and depressed).

- 1) With respect to predictions and ratings for *positive* future events, it was hypothesized that:
 - a. When the prediction event lists have been congruent in previous studies, the modification of likelihood predictions has been consistently evidenced. Thus, it is expected that, in this experiment positive events would be predicted as more likely to occur post-, compared with pre-, intervention.
 - b. Experiment 2 and 3 have suggested that the simulation of conceptually related events seems to be important for modifying predictions of perceived control. Therefore, it is hypothesized that positive events would be predicted as more controllable post-, compared with pre-, intervention.
 - c. Due to the inconsistent findings regarding importance predictions in the previous experiments, suggesting it could be a more stable prediction, it was unclear what effect the F-SIT-Instructions-Related would have on predictions of importance.
 - d. The previous experiments have evidenced a modification in vividness ratings following various versions of the F-SIT when the prediction event lists have been congruent. Thus, it is hypothesized that positive events would be rated more vivid post-, compared with pre-, intervention.

- 2) With respect to predictions and ratings for *negative* future events, using the same rationale as presented for predictions/ratings for positive events, it was hypothesized that:
 - a. Negative events would be predicted as less likely to occur post-, compared with pre-, intervention.

- b. Negative events would be predicted as more controllable post-, compared with pre-, intervention.
- c. It was unclear what effect the F-SIT-Instructions-Related would have on predictions of importance.
- d. Negative events would be rated less vivid post-, compared with pre-, intervention.

A secondary aim of Experiment 4 was to examine the impact of repeated simulation on predictions regarding future events. As the simulations in the F-SIT were only positive, these hypotheses relate to positive events only. Based on Szpunar & Schacter's (2013) findings it was hypothesized that events with a related cue word simulated multiple times (five) would lead to higher likelihood, perceived control, and vividness ratings for positive events, compared to a single simulation of a related cue word, or simulation of no related cue words. Due to the inconsistencies regarding importance predictions, it was unclear what effect, if any, repeated simulation would have on importance predictions.

4.3. Method

4.3.1. Participants

104 undergraduates and postgraduates from the University of Hull participated in exchange for course credits or participant payment, demographics can be found in Table 4.1. All participants provided informed consent and the procedures were approved by the Departmental Research Ethics Committee.

Participants' current depression status was established based on their profile on the Centre for Epidemiological Studies Depression Scale – Revised (CESD-R; Eaton et al., 2004). Participants were also asked to self-report any current, or previous, treatment for depression. 8 participants met criteria for major depressive episode and 16 for probable major depressive episode. These 24 participants formed the *depressed* group; three of these participants were currently receiving treatment for depression, whilst seven reported treatment within the past year and a further six had received treatment over a year ago. A further 35 participants met criteria for subthreshold depression symptoms and formed a second group of *dysphoric* participants. Within the dysphoric group, no participants were currently in receipt of treatment for depression, although

nine reported treatment within the past year and four had received treatment over a year ago. Finally, 45 participants reported symptoms of no clinical significance. However, seven of these participants reported receiving treatment for depression in the past. On this basis their data was excluded from further analyses and the remaining 38 participants formed the non-depressed *control* group. No participants met criteria for possible major depressive episode.

In order to ascertain that the three depression status groups differed on the CESD-R as intended, a one-way ANOVA was conducted. The three groups differed significantly with respect to CESD-R scores, $F(2,96) = 182.46, p < .001$. Bonferroni adjusted pairwise comparisons revealed that the depressed group scored significantly higher compared with both the dysphoric and control groups; additionally, the dysphoric group scored significantly higher than the control group (all $ps < .001$). To ensure that the age of the participants across the different depression status groups did not differ, a second one-way ANOVA was conducted and established they did not significantly differ, $F(2,96) = 157.80, p = .063$. There was also no significant difference in gender ratio between the three depression status groups, $\chi^2(2) = .27, p = .88$.

Characteristic	Depression Status		
	Non-Depressed	Dysphoric	Depressed
Participants	38	35	24
Age Range	18-27	18-35	18-56
Mean Age (SD)	20.03 (2.09)	20.63 (3.58)	23.21 (9.36)
Gender (%)			
Male	10 (35.7)	8 (29.6)	5 (35.7)
Female	28 (64.3)	27 (70.4)	19 (64.3)
Range of CESD-R Scores	0-15	16-38	23-74
Mean CESD-R Scores (SD)	7.79 (4.41)	22.91 (6.43)	49.00 (13.70)

Table 4. 1: Demographic characteristics for each Depression Status.

4.3.2. Materials

Center for Epidemiologic Studies Depression Scale - Revised (CESD-R).

The CESD-R (Eaton et al, 2004) is a 20-item inventory used to assess the presence of depressive symptoms and is described in detail in the Chapter 2 (Section 2.2.2). The algorithm provided by the scale authors was used so the participants could be categorized according to DSM-5 criteria as follows: *symptoms of no clinical significance; subthreshold depression symptoms; possible major depressive episode; probable major depressive episode; or meets criteria for major depressive episode.*

Future Events Prediction Task. This task is identical to that used in the previous experiments (sections 2.2.2, 2.3.2 & 3.3). Participants were required to make predictions about 30 events, 15 positive (*e.g. you will achieve things you set out to do*) and 15 negative (*e.g. you will have a serious disagreement with a close friend*). They predicted how likely they were to occur in the future, how much control they thought they would have over the event occurring, and how important the event was to them. They also had to make a rating about how vividly they could see that event happening in their mind.

F-SIT-Instructions-Related. The F-SIT-Instructions-Related was adapted from that used in Experiments 1 and 2 (section 2.2.2 & 2.3.2). Participants were required to

simulate a series of positive future events as vividly as possible in response to the cue words provided. The cues were derived from the positive events used in the Future Events Prediction Task; with each positive event having a corresponding cue. For example, for the event ‘*you will achieve things you set out to do*’ the cue word was ‘*achievement*’. Thus, there were fifteen possible cue words within the simulation task. Participants were instructed that for each cue they needed to imagine a positive event that related to the word in as much detail as possible and that some of the words might appear more than once. Each simulation lasted 15 seconds. The only difference from the task used in Experiments 1 and 2 was the repetition of simulation cues. Within the experimental trials, five of these cue words were presented five times and five cue words were presented once. The remaining five cue words were not presented. Hence, there were 30 experimental trials in total. The presentation of cues across these three conditions (five times, once and not at all) was randomized across participants. Prior to the experimental trials, participants received a practice block of five cue words that were unrelated to the events presented in the Future Events Prediction Task.

Jigsaw Task. This task was identical to the Jigsaw Task used in Experiment 2 and 3 (section 2.3.2 & 3.3).

4.3.3. Design

A quasi-experimental design was used to assess the effects of positive simulations on event predictions. The dependent variables were the predictions and ratings provided by all participants with respect to the likelihood, perceived control, importance, and vividness, for both positive and negative future events. All four dependent variables were measured pre- and post-intervention. Thus, the independent variables of time (pre-intervention vs. post-intervention) and valence of prediction event (positive vs. negative) were manipulated within-subjects. Additionally, the repetition of simulation cues was also manipulated within subjects (five presentations vs. one presentation vs. no presentation). The final independent variable, current depression status, constituted a between-subjects variable with participants assigned to one of three groups (depressed vs. dysphoric vs. non-depressed) as described in the Participants section.

4.3.4. Procedure

Participants completed the Future Events Prediction Task. They were then distracted for 15 minutes, whereby they completed the jigsaw task and the CESD-R. They then completed the F-SIT-Instructions-Related, and finally completed the Future Events Prediction Task again.

4.4. Results

4.4.1. Changes in Event Predictions.

Changes in each prediction (likelihood, perceived control, importance) were analysed using three separate 3 (Depression Status; non-depressed vs. dysphoric vs. depressed) x 2 (Valence of Prediction Event; positive vs. negative events) x 2 (Time; pre- vs. post-intervention) mixed ANOVAs. Bonferroni adjusted pairwise comparisons were then conducted where necessary to elucidate on any significant effects. Descriptive statistics can be found in Table 4.2.

Likelihood. Significant main effects emerged for time, $F(1,94) = 36.60, p < .001, \eta p^2 = .28$, and valence of prediction event, $F(1,94) = 18.18, p < .001, \eta p^2 = .16$. Likelihood predictions were higher pre-intervention compared with post-intervention and positive events were predicted as more likely to occur than negative events. These main effects were also qualified by a significant Time x Valence of Prediction Event interaction, $F(1,94) = 189.82, p < .001, \eta p^2 = .67$. A significant elevation occurred in likelihood ratings for positive events from pre- to post-intervention ($p < .001$). Conversely, likelihood ratings for negative events evidenced a significant decline from pre-to post-intervention ($p < .001$).

Neither the main effect of depression status, $F(2,94) = 1.03, p = .36, \eta p^2 = .02$, nor the Depression Status x Time interaction, $F(2,94) = 2.64, p = .08, \eta p^2 = .05$, were significant. However, the Depression Status x Valence of Prediction Event interaction was significant, $F(2,94) = 27.22, p < .001, \eta p^2 = .37$. Both the non-depressed and the dysphoric participants predicted positive events as more likely to occur than depressed participants ($p = .001$). Likelihood predictions for positive events did not differ between the dysphoric and non-depressed participants ($p = .11$). Additionally, the non-depressed participants predicted negative events as less likely than both the dysphoric ($p = .004$)

and the depressed ($p < .001$) participants, and the dysphoric group predicted negative events as significantly less likely to occur than the depressed group ($p = .04$). A significant three-way interaction also emerged, $F(2,94) = 6.11, p = .003, \eta p^2 = .12$ (Figure 4). In all three depression status groups, significant improvements in likelihood predictions were evidenced post-, compared with pre-, intervention, i.e. increased likelihood for positive events and decreased likelihood for negative events (all $ps < .001$). The nature of the interaction lies within the differential relationships between likelihood predictions for positive and negative events across depression status groups at the two time points. The non-depressed individuals predicted positive events as significantly more likely to occur than negative events; a pattern evident both pre- and post- intervention ($ps < .001$). However, depressed participants showed the reverse pattern pre-intervention, predicting negative events as significantly more likely to occur than positive events ($p < .001$). Post-intervention they evidenced no difference in likelihood predictions for positive and negative events ($p = .56$). Furthermore, the dysphoric participants evidenced no difference in the perceived likelihood of positive and negative events pre-intervention ($p = .57$), yet they reported positive events as significantly more likely to occur post-intervention ($p < .001$).

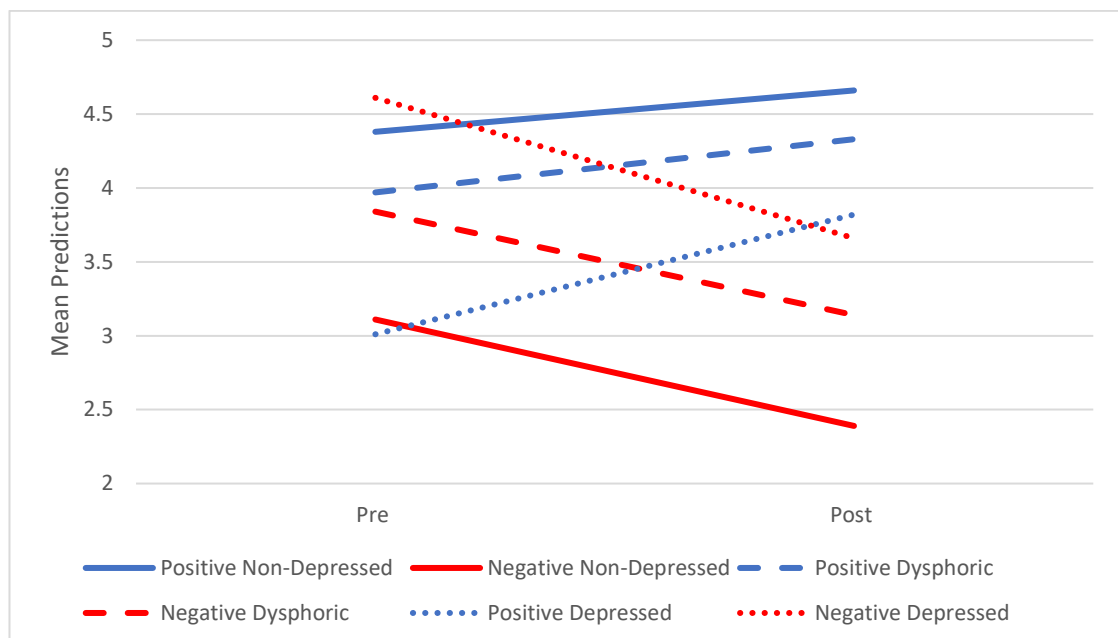


Figure 4: Changes in likelihood predictions pre-to post-intervention as a function of prediction event valence and depression status.

Perceived Control. Significant main effects emerged for time, $F(1,94) = 16.31, p < .001, \eta p^2 = .15$, valence of prediction event, $F(1,94) = 258.52, p < .001, \eta p^2 = .73$,

and depression status, $F(2,94) = 7.67, p = .001, \eta p^2 = .14$. Participants reported higher levels of control post-, compared with pre-intervention, with positive events predicted as more controllable than negative events. Both non-depressed and dysphoric participants perceived events to be more controllable compared to the depressed participants ($p = .001$ and $p = .05$ respectively). No differences emerged in perceived control between the non-depressed and dysphoric participants ($p = .37$).

A significant Time x Valence of Prediction Event interaction was evident, $F(1,94) = 4.52, p = .036, \eta p^2 = .05$. Significant increases in perceived control were evident for both positive and negative events pre- to post-intervention. However, this increase was greater for the positive ($p < .001$), compared with the negative ($p = .04$), event predictions. No other interaction effects were significant ($F_s \leq 2.76, p_s \geq .08, \eta p^2_s \leq .06$).

Importance. A significant main effect emerged for valence of prediction event $F(1,94) = 118.35, p < .001, \eta p^2 = .56$, but not for time $F(1,94) = .19, p = .66, \eta p^2 = .00$. Positive events predicted as more important compared with negative events. However, these effects were qualified by a significant Valence of Prediction Event x Time interaction $F(1,94) = 12.80, p = .001, \eta p^2 = .12$. Importance predictions for positive events increased pre-to post-intervention ($p = 0.31$) and importance predictions for negative events decreased from pre- to post-intervention ($p = .036$). The main effect of depression status was not significant, $F(2,94) = .08, p = .92, \eta p^2 = .00$, and all other interaction effects were not significant ($F_s \leq .159, p_s \geq .21, \eta p^2 \leq .03$). Thus, the effects of intervention on the importance of future event predictions did not differ as a function of depression status.

4.4.2. Changes in Vividness Ratings.

A further 3 (Depression Status; non-depressed vs. dysphoric vs. depressed) x 2 (Valence of Prediction Event; positive vs. negative events) x 2 (Time; pre- vs. post-intervention) mixed ANOVA was conducted to assess any differences in vividness ratings. Bonferroni adjusted pairwise comparisons were then conducted where necessary to elucidate on any significant effects. Descriptive statistics can be found in Table 4.3.

A significant main effect emerged for valence of prediction event $F(1,94) = 26.99, p < .001, \eta p^2 = .22$, with positive events rated more vivid compared with negative events. Whilst no significant main effect of time was found, $F(1,94) = .03, p = .86, \eta p^2 = .00$, a significant Valence of Prediction Event x Time interaction did emerge, $F(1,94) = 49.42, p < .001, \eta p^2 = .35$. There was a significant increase in vividness ratings for positive events from pre- to post-intervention ($p < .001$), and a significant decrease in vividness ratings for negative events pre-to post-intervention ($p < .001$).

Table 4. 2: Mean Predictions (and standard deviations) as a function of time, valence of prediction event and depression status.

	Event Valence	Non-Depressed		Dysphoric		Depressed	
		Pre	Post	Pre	Post	Pre	Post
Likelihood	Positive	4.38 (0.71)	4.66 (0.70)	3.97 (0.59)	4.33 (0.56)	3.01 (1.17)	3.82 (1.04)
	Negative	3.11 (1.09)	2.39 (1.15)	3.84 (0.82)	3.14 (0.84)	4.61 (0.88)	3.66 (1.22)
Control	Positive	4.35 (0.63)	4.53 (0.67)	3.97 (0.63)	4.19 (0.59)	3.28 (1.09)	3.80 (0.88)
	Negative	3.12 (0.91)	3.13 (1.09)	2.90 (0.79)	3.02 (0.86)	2.44 (0.98)	2.75 (0.93)
Importance	Positive	4.77 (0.47)	4.88 (0.52)	4.74 (0.58)	4.83 (0.98)	4.52 (0.77)	4.67 (0.97)
	Negative	3.30 (1.15)	3.23 (1.42)	3.32 (1.19)	3.09 (1.15)	3.64 (1.32)	3.45 (1.63)

Neither the main effect of depression status, $F(2,94) = 1.19, p = .31, \eta p^2 = .03$, nor the Depression Status x Time interaction, $F(2,94) = .04, p = .83, \eta p^2 < .00$, were significant. However, other significant interactions involving depression status did emerge. Firstly, there was a significant Depression Status x Valence of Prediction Event interaction, $F(2,94) = 29.62, p < .001, \eta p^2 = .39$. Non-depressed participants rated positive events significantly more vivid, and negative events as significantly less vivid, compared to the depressed participants ($ps \geq .002$). Trends towards significance suggest that a similar pattern was evident between the non-depressed and the dysphoric participants ($ps = .07$). No significant difference emerged between the depressed and dysphoric participants with respect to the vividness of positive events ($p = .48$), yet the depressed participants rated negative events as more vivid than their dysphoric counterparts ($p = .009$). No three-way interaction emerged $F(2,94) = 1.61, p = .21, \eta p^2 = .03$.

Table 4. 3: Mean vividness ratings (and standard deviations) as a function of time, valence of prediction event and depression status.

Event	Non-Depressed		Dysphoric		Depressed	
	Pre	Post	Pre	Post	Pre	Post
Positive	4.37 (0.74)	4.66 (0.79)	3.95 (0.74)	4.25 (0.67)	3.51 (1.17)	4.10 (0.99)
Negative	3.19 (0.83)	2.87 (1.05)	3.70 (0.95)	3.36 (1.10)	4.52 (0.89)	4.04 (1.27)

4.4.3. Effects of Repeated Simulation.

The secondary aim of this experiment was to examine the influence of repeated simulation of conceptually related material on prediction modification. As negative events were not simulated, these analyses focused only on predictions for positive events. Thus, four separate 3 (Depression status) x 3 (Repetition) x 2 (Time) mixed ANOVAs were conducted on the likelihood, perceived control, importance and vividness ratings for positive events. Descriptive statistics are displayed in Table 4.4. Pre- to post-intervention changes in predictions about positive events as a function of depression status have already been explored in the previous analyses, thus of particular interest here were any significant Repetition x Time or three-way interactions. For predictions of perceived control a trend towards a significant Repetition x Time interaction emerged, $F(2,93) = 2.76, p = .069, \eta p^2 = .06$. Bonferroni adjusted pairwise

comparisons revealed for events there were simulated once, there was a significant increase in predictions of perceived control ($p = .001$). There was no difference in predictions of perceived control for events that were simulated five times ($p = .14$) or for events that were not simulated at all ($p = .41$). No other such interactions emerged ($F_s \leq 1.82$, $p_s \geq .13$, $\eta p^2_s \leq .06$). Repeatedly simulating positive events did not impact on likelihood, or importance predictions, vividness ratings or any other predictions of perceived control of related events.

	Repetitions	Non-Depressed			Dysphoric			Depressed		
		Mean	SD	SE	Mean	SD	SE	Mean	SD	SE
Likelihood	0	4.46 (0.89)	4.61 (0.84)	3.92 (0.71)	4.20 (0.65)	3.10 (1.24)	3.52 (0.83)			
	1	4.48 (0.77)	4.67 (0.77)	4.09 (0.76)	4.41 (0.63)	3.53 (1.10)	3.97 (1.02)			
	5	4.44 (0.66)	4.59 (0.66)	3.99 (0.59)	4.28 (0.64)	3.07 (1.36)	3.72 (1.23)			
	0	4.57 (0.77)	4.62 (0.79)	3.98 (0.81)	4.13 (0.74)	3.69 (1.26)	3.71 (1.03)			
	1	4.24 (0.76)	4.37 (0.80)	3.97 (0.93)	4.23 (0.75)	3.44 (1.16)	3.77 (1.16)			
	5	4.29 (0.76)	4.51 (0.86)	4.00 (0.83)	5.27 (6.43)	3.20 (1.26)	3.52 (1.41)			
	0	4.86 (0.61)	4.93 (0.68)	4.65 (0.79)	4.78 (0.66)	4.63 (0.76)	4.75 (0.83)			
	1	4.79 (0.52)	4.85 (0.50)	4.75 (0.61)	4.89 (0.64)	4.68 (0.86)	4.82 (0.90)			
	5	4.68 (0.73)	4.87 (0.75)	4.73 (0.64)	4.81 (0.50)	4.31 (0.73)	4.76 (0.91)			
Vividness	0	4.42 (0.84)	4.67 (0.89)	3.93 (0.96)	4.10 (0.87)	3.53 (0.87)	3.85 (0.95)			
	1	4.42 (0.84)	4.63 (0.87)	4.03 (0.71)	4.45 (0.65)	4.06 (1.18)	4.35 (1.04)			
	5	4.36 (0.84)	4.63 (0.83)	3.86 (0.91)	4.23 (0.78)	3.66 (1.26)	4.14 (1.18)			

Table 4. 4: Mean predictions and vividness ratings (and standard deviations) for a function of time and depression status for repeated simulations. Post

4.5. Discussion

The aim of Experiment 4 was to establish whether positive episodic simulation could be used to modify biased future event predictions evidenced in dysphoria and depression. Previous research has shown that depressed, compared with non-depressed, individuals predict positive events as less likely to happen and negative events as more likely to happen (e.g. Pyszczynski et al., 1987). This bias was also evident within this study. Pre-intervention, both the non-depressed and the dysphoric participants predicted positive events as more likely to occur than the depressed participants. However, as hypothesized there were significant improvements in likelihood predictions for both positive and negative events for all three depression status groups (hypotheses 1a and 2a). In all three depression status groups, likelihood predictions for positive events significantly increased from pre- to post-intervention. Furthermore, likelihood predictions for negative events significantly decreased from pre- to post-intervention. A significant three-way interaction did emerge for likelihood predictions. However, the nature of the interaction was within the differential relationships between likelihood predictions for positive and negative events across depression status groups at the two time points. The non-depressed individuals showed a typical optimistic outlook regarding the likelihood of positive and negative future event; they predict positive events as significantly more likely to occur than negative events. However, depressed participants showed the reverse pattern pre-intervention, predicting negative events as significantly more likely to occur than positive events. This did, however, improve somewhat post-intervention with no significant difference in likelihood predictions for positive and negative events. Furthermore, the dysphoric participants evidenced no difference in the perceived likelihood of positive and negative events pre-intervention. However, again, they demonstrate improvements post-intervention. After the intervention, they demonstrate a more typical optimistic outlook, reporting positive events as significantly more likely to occur than negative events.

The previous experiments using the F-SIT-Instructions-Related (Experiments 1 and 2) both found that vividness ratings displayed a similar pattern of results to the likelihood predictions. This was hypothesized to occur in Experiment 4 (hypotheses 1d and 2d) and these hypotheses were supported by the current findings. The non-depressed participants rated positive events as significantly more vivid, compared to the dysphoric and depressed participants, pre-intervention. However, whilst some differences still existed between depression status groups post-intervention, the crucial

finding was that there was a significant improvement in vividness ratings in all three depression status groups. This was illustrated by an increase in vividness ratings for positive events and a decrease in vividness ratings for negative events. Thus, these findings add weight to the suggestion that, at least when the prediction event lists are congruent, modification to likelihood predictions may be a function of the vividness with which an individual can mentally envisage such events.

With respect to perceived control, prior to the intervention both non-depressed and dysphoric participants perceived positive events to be more controllable compared to the depressed participants. Additionally, the non-depressed participants perceived the negative events to be more controllable compared to the depressed participants. Post-intervention the non-depressed participants did still report significantly greater control compared to the depressed participants for the positive events. No differences existed between the three depression status groups with respect to control over negative events. Most importantly, however, the main effect of time suggested that improvements in perceived control were evident for all participants from pre- to post-intervention. This is in line with hypotheses 1b and 2b. Furthermore, these findings support the conclusion from Experiments 1-3 that suggest that modification of perceived control seems to depend on simulation of conceptually related material.

Due to the inconsistent findings regarding importance predictions in the previous experiments, it was unclear what effect the F-SIT-Instructions-Related would have on predictions of importance within depression and dysphoria (hypotheses 1c and 2c). There was an increase in importance predictions for positive events, and a decrease in importance predictions for negative events, across all three depression status groups. Experiment 2 also evidenced a similar pattern of findings for importance predictions following the F-SIT-Instructions-Related. Arguably, as previously discussed, the change in importance predictions may reflect the fact that likelihood predictions also increased, therefore once the events feel more likely to occur then they may also feel more personally salient and, thus, important. However, conversely, Experiments 1 and 3 suggested that importance predictions may be a more stable construct that isn't readily modified. Therefore, due to the inconsistent findings regarding importance predictions, these propositions need to be taken with caution. One interesting finding that did emerge was that there was no difference between the three depression status groups in their overall predictions of importance for positive events. This suggests that dysphoric

and depressed individuals believe positive events to be just as important to them as their non-depressed counterparts, however they just feel they are less likely to happen and that they have less control over their occurrence. This finding is in line with that of Dickson et al., (2011) who demonstrated that depressed individuals view future goals as equally important compared to their non-depressed counterparts, yet believed them to be less likely to occur and less controllable.

A secondary aim of Experiment 4 was to examine the impact of repeated simulation on predictions regarding future events. It was hypothesized that events with a related cue word simulated multiple times (five) would lead to higher likelihood, perceived control, and vividness ratings for positive events, compared to a single simulation of a related cue word, or simulation of no related cue words. Due to inconsistencies regarding importance predictions, it was unclear what effect repeated simulation would have. However, these hypotheses were not supported and there was virtually no effect of repetition. There was no greater pre- to post-intervention change in predictions/ratings for the prediction events where the F-SIT asked participants to simulate conceptually related material, either 5 times or once, compared with prediction events that were not simulated at all. This finding is not in line with previous work, such as that conducted by Szpunar & Schacter (2013) who found multiple simulations increased plausibility ratings. This provides further support for the suggestion that the pre- to post-intervention improvements evidenced within these studies may be a function of a general increase in optimism and/or change in affect. If an overall change in affect/ general increase in optimism is not occurring, then you would expect to see an effect of repeated simulation - that is, more of an increase in predictions and ratings for positive events pre-to post-intervention for those events that were simulated five times. However, not only did that effect not occur, but a decrease in predictions and ratings for negative events also occurred, suggesting that a change in affect and/or change in optimism is occurring, as the effect of modification from the F-SIT appears to be generalizing beyond the events that were simulated, and this effect is not enhanced from multiple simulations. The suggestion that a change in affect and/or change in optimism is occurring needs investigation. Another potential explanation of why no effect of repeated simulation occurred could be explained by a simple redundancy effect (Sweller, Ayres & Kalyuga, 2001). That is, when new cues were presented they were prioritised, and the cues that were presented more than once becoming redundant, due to

working memory having limited capacity, as explained by cognitive load theory (Sweller, 1988).

The difficulty that dysphoric and depressed individuals have with positive future cognitions would likely impact on their ability to foresee future success. Furthermore, it could have a demotivating influence with respect to achieving future goals. Our finding that, following a conceptually related simulation task, depressed and dysphoric individuals rate positive future events as more likely to happen and as more controllable is important, suggests that engaging in positive imagery could be used to increase motivation to achieve goals. When asked to generate important goals, depressed individuals produce similar numbers of goals to controls, but they produce goals that are less specific and have less specific explanations for why or how they would attain that goal. This suggests that some of the motivational deficits that can be seen in depression could partly be due to the reduction in the specificity of personal goal representation and the cognitions that support goal directed behaviour (Dickson & Moberly, 2013; Dickson et al., 2011). Personal goals are important as they can provide the motivation an individual needs to enacting problem solving behaviours (Oettingen & Mayer, 2002). In addition, they are important for organizing long-term behaviour and for providing meaning in life (Dickson & Moberly, 2013) . In future research it would be interesting to see if simulation techniques similar to those reported here could have an impact in making personal goals more realizable for depressed individuals.

Beck's original cognitive therapy (1967) stresses the importance of assessing patients' images, as well as their verbal thoughts. However, Roepke and Seligman (2016) argue that the majority of cognitive therapy today appears to be focused on verbal thoughts regarding the past. Thus, the focus on imagery may have been somewhat neglected. A focus on verbal thoughts could lead both patients and therapists to miss other cognitive processes that may be useful and beneficial in the treatment of depression. It has been suggested that promoting verbal thoughts in cognitive therapy may not have as much impact on positive mood as promoting positive imagery, and may even lead to a reduction in positive mood (Holmes et al., 2006). The current study suggests that, if explicitly instructed to generate positive mental imagery, dysphoric and depressed individuals can benefit with regards their future outlook. Past research has demonstrated the negative effect that positively valenced material can have on depressed individuals (e.g. Joormann et al., 2007), therefore it may be crucial to use

strict time constraints, clear instructions and closely related events in order for depressed people to engage with positive mental imagery, and not drift off into rumination. Together with previous work (eg. Holmes et al., 2006; Pictet et al., 2011), Experiment 4 has demonstrated that simulating positive events has a beneficial effect on dysphoric and depressed individuals future outlook.

In summary, the overarching aim of Experiment 4 was to establish whether positive episodic simulation can be used to modify biased future event predictions evidenced in dysphoria and depression. Most importantly, Experiment 4 demonstrated that pre-to post-intervention modifications were evident for predictions and ratings about both future positive and negative events. Most importantly, it demonstrated that these modifications are evident within individuals with both dysphoria and depression as well as non-depressed individuals. Thus, these results suggest that, through the process of simulating related positive future events, both dysphoric and depressed individuals' future-directed prediction and rating biases can be altered. Experiment 4 made use of the F-SIT-Instructions-Related where the cues in the intervention task directly related to the positive events in the Future Events Prediction Task, with the experimenter giving the participants explicit instructions on the need to simulate *positive* events in relation to the cues. All participants were able to imagine positive future events as more vivid, likely to happen, important, and controllable following a short positive episodic simulation intervention. Conversely, they rated negative events as less vivid, likely to happen and important following this intervention. They also predicted that these negative events were more controllable post-intervention.

5: The Effect of Episodic Simulation on Future Event Predictions – Investigating the Role of Affect

5.1. Introduction

The previous experiments have demonstrated that positive episodic simulation can modify predictions and ratings about positive and negative future events. The experiments so far have used variations of the F-SIT paradigm in order to try and understand which variation has the greatest impact on prediction/rating modification. To summarise, the experiments thus far have found that the F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated all, to some extent, modify future positive and negative event predictions/ratings. In each case, where modifications occurred, they constitute *improvements* in predictions/ratings post-, compared with pre-, intervention. Furthermore, the effects were much stronger when the events in the Future Events Prediction Task were congruent compared to when they were incongruent. Most importantly, Experiment 4 demonstrated that prediction/rating biases can be modified in depression and dysphoria.

The experiments reported thus far have investigated different methodological variations of the F-SIT in order to test the parameters under which prediction modification occurs. However, the majority of these variations were only tested using non-depressed individuals. These studies have shown that, in non-depressed individuals, all the variations of the F-SIT proved effective in modifying predictions about positive and negative future events when lists across the Future Event Prediction Tasks were congruent. However, the potential use of positive episodic simulation as a therapeutic tool in depression forms the key underlying tenet of this thesis. Thus, it seems appropriate to further test these methodological variations of the F-SIT in individuals experiencing high levels of depressive symptomatology. Unfortunately, it was not feasible at this stage, from both the perspective of time and the number of participants required, to test all three variations of the paradigm in both depression and dysphoria. Therefore, it was decided to use a sample of dysphoric participants to compare the usefulness of three versions of the F-SIT (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated, and F-SIT-Cues-Unrelated). These three variations were tested alongside the visualisation task (used in Experiments 1 and 2), which acted as a neutral visualisation control task. As discussed in Chapter 1 (section 1.1.3), the sampling of

individuals with dysphoria often represents an analogue for the study of those with depressive disorders, with research suggesting that dysphoria and clinically significant levels of depression exist on the same continuum (e.g. Hankin et al., 2005). Thus, it was assumed that findings from a dysphoric sample could potentially be extrapolated to provide insight into how those experiencing more severe depressive symptomatology would respond to these versions of the F-SIT. Thus, using the algorithmic method of scoring the CESD-R (Eaton et al., 2004), all participants in Experiment 5 were experiencing sub-clinical levels of depression (dysphoric).

Alongside examining the parameters under which positive episodic simulation impacts on future event predictions, it is also important to investigate what mechanisms underlie the effect. Thus, the investigation of underlying mechanisms of the effect of positive episodic simulation on future event predictions formed the final overarching aim of the thesis. One possible explanation for the modifications witnessed in the Experiments 1-4, as previously discussed, is a change in affect or change in optimistic orientation. Experiment 3, by using incongruent event lists in the Future Events Prediction Task, began to test these ideas. When the prediction event lists are incongruent the pre- to post-intervention measurements are ascertaining whether a more global change in positive and negative event predictions/ratings has occurred. Arguably, thus, it is measuring whether the intervention results in a change in optimism. However, the findings of Experiment 3 were somewhat mixed. For example, likelihood predictions for positive events did not change when the prediction events were incongruent. Therefore, the evidence for the assumption that a change in optimism underlies the modifications in predictions/ratings was limited. Having said this, there is previous research demonstrating that mental imagery improves self-reported optimism (Meevissen et al., 2011). Additionally, Experiment 3 demonstrated that the likelihood predictions for negative events decreased when the prediction lists were incongruent. Such an effect could support the possibility that subtle changes in optimism were occurring.

The potential role of affective changes as the underlying mechanism for the evidenced modifications in future event predictions has yet to be investigated within this thesis. Thus, it is feasible that the F-SIT results in mood changes, increasing positive affect and potentially decreasing negative affect. These changes then, in turn, drive the alterations in predictions/ratings about future events. Previous research

supports this proposition, with studies showing that engaging in episodic simulation improves mood (e.g. Burnett Heyes et al., 2016; Holmes & Mathews, 2005; Holmes et al., 2008; Quoitach et al., 2009). Furthermore, research has also evidenced that episodic simulation and training within episodic simulation improves mood in depression (e.g. Blackwell & Holmes, 2010; Blackwell et al., 2015; Lang et al., 2012; Renner et al., 2016). Thus, Experiment 5 set out to investigate the role of affect as a potential underlying mechanism driving the change in future event predictions. To do this it used visual analogue scales (VAS), both pre-and post-intervention, to measure any change in positive and negative affect following the various versions of the F-SIT and the neutral visualisation task.

5.2. Experiment 5

5.2.1. Aims & Hypotheses

Experiment 5 had two aims. Firstly, it aimed to test the three different versions of the F-SIT paradigm in a group of individuals experiencing high levels of depressive symptomatology. Secondly, it aimed to investigate whether changes in affect serve as the underlying mechanism by which positive episodic simulation modifies future event predictions.

Based on the previous findings in non-depressed individuals (Experiments 1, 2 & 3), it is hypothesized that the different versions of the F-SIT will result in pre- to post-intervention changes in event predictions and ratings as follows:

- 1) Predictions/ratings about *positive* future events:
 - a. Positive events would be predicted as more likely to occur post-, compared with pre-, intervention for participants completing all versions of the F-SIT (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated, and F-SIT-Cues-Unrelated).
 - b. The previous experiments have suggested that the simulation of conceptually related material seems to be important for the modification of predictions of perceived control. Therefore, it was hypothesized that predictions of perceived control would increase following the F-SIT-Instructions-Related only.

- c. Due to the inconsistent findings regarding importance predictions in the previous experiments, it was unclear what effect, if any, the different versions of the F-SIT would have on predictions of importance.
 - d. Positive events would be rated more vivid post-, compared with pre-, intervention, following all three versions of the F-SIT.
 - e. No pre-to post-intervention changes in predictions/ratings about positive future events are expected to occur following the visualisation task.
- 2) With respect to predictions and ratings for *negative* future events, using the same rationale as presented for predictions/ratings for positive events, it was hypothesized that:
- a. Negative events would be predicted as less likely to occur post-, compared with pre-, intervention for participants completing all versions of the F-SIT (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated, and F-SIT-Cues-Unrelated).
 - b. Based on the previous findings regarding predictions of perceived control for negative events (Experiments 1, 2, and 3), predictions of perceived control would increase following the F-SIT-Instructions-Related only.
 - c. For the same reasons as discussed in hypothesis 1c, it was unclear what effect, if any, the three versions of the F-SIT would have on predictions of importance.
 - d. Negative events would be rated less vivid post-, compared with pre-, intervention, following all three versions of the F-SIT.
 - e. No pre-to post-intervention changes in predictions/ratings about negative future events are expected to occur following the visualisation task.
- 3) If a change in affect is driving the impact of positive episodic simulation on future event predictions/ratings, then one would expect to see pre- to post-intervention changes in affect that are consistent with the changes in future event predictions/ratings. Evidence to rationalise the hypothesized impact of positive simulation on positive affect is abundant within the previous literature. For instance, Holmes et al., (2006; 2008) and Pictet et al., (2011) found positive imagery improved positive affect in people with dysphoria. Moreover, Torkan et al., (2012) also found simulating positive events improved positive affect in depression. Little

previous research has explored the role of positive simulation on negative affect in depression/dysphoria. However, on the basis of findings from Nelis et al., (2012), who demonstrated that simulating positive imagery decreased depressive symptoms, tentative predictions were made about the impact of positive simulation on negative affect. Therefore, the following pattern of findings were hypothesized:

- a. There will be an increase in positive affect, pre-to post-intervention, following all three versions of the F-SIT (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated).
- b. Negative affect will decrease, pre-to post-intervention, following all three versions of the F-SIT.
- c. There will be no change in either positive or negative affect as a result of the visualisation task.

5.3. Method

5.3.1. Participants

67 undergraduates from the University of Hull (13 males), with an age range of 18 to 37 years ($M = 20.72$, $SD = 4.34$), participated in exchange for course credits. All participants provided informed consent and the procedures were approved by the Departmental Research Ethics Committee.

Participants were sequentially assigned to one of four different intervention tasks (3 variations of the F-SIT and the neutral visualisation task). CESD-R score range and means, per intervention task, are displayed in Table 5.1 The first group (F-SIT-Instructions-Related) consisted of 17 participants (3 males), with a mean age of 18.82 years ($SD = 1.33$). The second group (F-SIT-Instructions-Unrelated) was made up of 17 participants (2 males), with a mean age of 20.18 years ($SD = 2.98$). The third group (F-SIT-Cues-Unrelated) consisted of 16 participants (5 males), with a mean age of 21.69 years ($SD = 4.91$). The final group (Visualisation Task) consisted of 17 participants (3 males) with a mean age of 22.24 years ($SD = 6.07$).

All participants met criteria for subthreshold depression symptoms, as established based on their profile on the Centre for Epidemiological Studies Depression Scale – Revised (CESD-R; Eaton et al., 2004). Of these 67 participants, 17 reported

receiving treatment for depression currently, 5 reported receiving treatment within the last year, 11 reported receiving treatment within the last 5 years, 3 reported receiving treatment within the last 10 years and, finally, 31 reported never receiving any treatment.

To ensure that the demographics of the participants assigned to the four intervention conditions did not differ, two separate one-way ANOVAs established that there was no significant differences in age, $F(3,66) = 2.25, p = .09$, or CESD-R scores, $F(3,66)=1.91, p=.14$, across conditions. Finally, a chi square test of significance found that the conditions did not differ with respect to gender ratio, $\chi^2(3) = 2.14, p = .54$.

Table 5. 1: CESD-R range and mean (and standard deviations) per intervention task

	CESD-R Range	CESD-R Mean (SD)
F-SIT-Instructions – Related	17-58	26.00 (10.71)
F-SIT-Instructions – Unrelated	16-43	26.00 (7.85)
F-SIT-Cues-Unrelated	17-56	33.25 (15.00)
Visualisation Task	16-44	31.24 (8.88)

5.3.2. Materials

Center for Epidemiologic Studies Depression Scale - Revised (CESD-R).

The CESD-R (Eaton et al., 2004) is a 20-item inventory used to assess the presence of depressive symptoms and is described in detail in Chapter 2 (Section 2.2.2). In the current experiment the algorithmic scoring method, provided by the scale authors, was used. This allowed the participants to be categorized according to DSM-5 criteria as follows: *symptoms of no clinical significance; subthreshold depression symptoms; possible major depressive episode; probable major depressive episode; or meets criteria for major depressive episode*. Only individuals meeting criteria for subthreshold depressive symptoms were included in this study.

Visual Analogue Scales (VAS). Positive and negative affect were measured using visual analogue scales, where participants had to mark on a 10cm line how they felt in that moment. On the first scale scores ranged from “totally not in a positive mood” (0) to “very positive mood” (100). The second scale ranged from “totally not

dejected, down, sad, depressed” (0) to “very dejected, down, sad, depressed” (100). The scales were identical to those used by Nelis and colleagues (2015).

Future Events Prediction Task. This task was identical to that used in the previous experiments (sections 2.2.2, 2.3.2, 3.3 & 4.2). Participants were required to make predictions about 30 events, 15 positive (*e.g. you will achieve things you set out to do*) and 15 negative (*e.g. you will have a serious disagreement with a close friend*). They predicted how likely they were to occur in the future, how much control they thought they would have over the event occurring, and how important the event was to them. They also had to make a rating about how vividly they could see that event happening in their mind. The event lists remained congruent pre-and post-intervention.

F-SIT-Instructions-Related. This task was identical to that used in Experiments 1, 2 and 4 (Sections 2.2.2, 2.3.2 & 4.2.). Participants were required to simulate a series of positive future events as vividly as possible in response to the cue words provided. The cues were derived from the positive events used in the Future Events Prediction Task; with each positive event having a corresponding cue. For example, for the event ‘*you will achieve things you set out to do*’ the cue word was ‘*achievement*’. Thus, there were fifteen possible cue words within the simulation task. Participants were instructed that for each cue they needed to imagine a positive event that related to the word in as much detail as possible and that some of the words might appear more than once. Each simulation lasted 15 seconds.

F-SIT-Instructions-Unrelated. This task was identical to that used in Experiments 1, 2 and 3 (Sections 2.2.2, 2.3.2 & 3.3). The F-SIT-Instructions-Unrelated was identical to the F-SIT-Instructions-Related with one key exception. The cues words used for simulation did not conceptually correspond to any of the future events in the Future Events Prediction Task. All the cues were presented twice, hence there were 30 experimental trials in total and the presentation of cues was randomized across participants.

F-SIT-Cues-Unrelated. This task was identical to that described in Experiment 3 (section 3.3). Rather than being given instructions to generate positive imagery, as in the two versions of the F-SIT-Instructions, participants were only told that they needed to imagine the scenario presented in the on-screen cues and that some of the cues might

appear more than once. The scenarios used as cues in this task were derived from the cue words used in the F-SIT-Instructions-Unrelated task. For example, the cue word “holiday” in the F-SIT-Instructions-Unrelated became “you enjoy a day at the water park whilst on holiday” in the F-SIT-Cues-Unrelated. None of the cues were conceptually related to the events in the Future Events Prediction Task.

Visualisation Task. This task was identical to that used in Experiments 1 and 2 (Sections 2.2.2 & 2.3.2). This task required participants to visualise neutral items as vividly as possible, for example, “the layout of the local shopping centre” or “two birds sitting on a tree branch”. Participants were instructed that they needed to visualise the item presented and that some of the items might appear more than once. They then received a practice block, which consisted of 5 items prior to the experimental trials. Within the experimental trials, each item was presented twice hence, there were 30 experimental trials in total. The presentation of items was randomised across participants.

Jigsaw Task. This task was the same 15 minute distraction task as used in Experiments 2, 3, and 4 (sections 2.3.2, 3.3, & 4.2).

5.3.3. Design

The effect of intervention task on predictions/ratings about positive and negative future events was assessed using a 4 (Intervention Task: F-SIT-Instructions-Related vs. F-SIT-Instructions-Unrelated vs. F-SIT-Cues-Unrelated vs. Visualisation task) x 2 (Valence of Prediction Event: positive vs. negative) x 2 (Time: pre- vs. post-intervention) mixed design, with repeated measures on the final two factors. Participants were randomly assigned to one of the four intervention tasks. Dependent variables were the predictions/ratings made by participants regarding future events within the pre- and post-intervention Future Events Prediction Tasks (likelihood, perceived control, importance, and vividness).

In order to assess change in affect as a function of the intervention tasks, a further 4 (Intervention Task: F-SIT-Instructions-Related, vs. F-SIT-Instructions-Unrelated, vs. F-SIT-Cues-Unrelated, vs. Visualisation task) x 2 (Valence of VAS: positive vs. negative) x 2 (Time: pre- vs. post-intervention) mixed design was

employed, with repeated measures on the final two factors. The dependent variables were affect scores as rated on the VAS.

5.3.4. Procedure

Participants completed all tasks individually. The researcher provided instructions prior to each task and remained present throughout. Computerised experimental tasks were presented on a Macbook. After providing informed consent, participants completed the Future Events Prediction Task. Participants were then distracted for 15 minutes; during this time, they completed the CESD-R, the positive and negative VAS, and the jigsaw task. Participants then completed their assigned intervention task (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated, F-SIT-Cues-Unrelated, Visualisation Task), and then they completed the positive and negative VAS again. Finally, they completed the Future Events Prediction Task for a second time.

5.4. Results

5.4.1. Changes in Event Predictions

The change in each event prediction (likelihood, perceived control, and importance) was analysed using a 4 (Intervention Task: F-SIT-Instructions-Related, vs. F-SIT-Instructions-Unrelated, vs. F-SIT-Cues-Unrelated, vs. Visualisation task) x 2 (Valence of Prediction Event: positive vs. negative) x 2 (Time: Pre-to Post-intervention) mixed ANOVA, with repeated measures on the first two factors. Bonferroni adjusted pairwise comparisons were conducted, where required, to clarify the nature of significant effects. Descriptive statistics are displayed in Table 5.2.

Likelihood. A significant main effect of time emerged, $F(1,63) = 5.96, p = .017, \eta^2 = .09$, with higher likelihood predictions overall pre-intervention. There was no significant main effect of valence of prediction event, $F(1,63) = .33, p = .57, \eta^2 = .01$. However, this was qualified by a significant Time x Valence of Prediction Event interaction, $F(1,63) = 34.97, p < .001, \eta^2 = .36$. Likelihood predictions for positive events increased ($p = .001$), and for negative events decreased ($p < .001$), pre-to post-intervention.

There was no main effect of intervention task, $F(3,63) = 1.79, p = .16, \eta^2 = .08$, nor did the intervention task interact with valence of prediction event, $F(3,63) = .20, p = .90, \eta^2 = .01$. There was, however, a significant Time x Intervention Task interaction $F(3,63) = 2.93, p = .04, \eta^2 = .12$. There was a significant decrease in likelihood predictions the F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated ($ps \leq .009$). There was no change in likelihood predictions following the visualisation task ($p = .46$). Most importantly, however, a significant 3-way interaction also emerged, $F(3,63) = 2.93, p = .04, \eta^2 = .12$ (Figure 5). There was a significant increase in likelihood predictions for positive events ($ps \leq .033$), and a significant decrease in likelihood predictions for negative events ($ps \leq .026$), following all three versions of the F-SIT. However, following the visualisation task, there was no change in likelihood predictions for either the positive ($p = .65$), or the negative, events ($p = .12$).

Perceived Control. A significant main effect of valence of prediction event emerged, $F(1,63) = 80.87, p < .001, \eta^2 = .56$, with higher predictions of perceived control for positive events. There was no main effect of time, intervention task, nor any two-way interactions involving time ($F_s \leq 1.84, ps \geq .15, \eta^2 \leq .08$). There was, however, a significant 3-way interaction, $F(3,63) = 8.06, p < .001, \eta^2 = .28$. This evidenced a significant pre- to post-intervention increase in predictions of perceived control for negative events for the F-SIT-Cues-Unrelated task ($p = .005$). Additionally, there was a significant pre- to post-intervention decrease in predictions of perceived control for negative events as a result of the visualisation task ($p = .034$). There was no other significant differences (all $ps \geq .072$).

Importance. There was a significant main effect of valence of prediction event, $F(1,63) = 17.80, p < .001, \eta^2 = .22$, with positive events being predicted as more important than negative events. There was also a trend towards a significant Time x Valence of Prediction Event $F(1,63) = 3.54, p = .065, \eta^2 = .05$. There was a significant increase in importance predictions for positive events pre-to post-intervention ($p = .05$), and a trend towards a significant decrease in importance predictions for negative events pre-to post-intervention ($p = .07$). There were no other significant main effects or interactions (all $F_s \geq .15$, all $ps \geq .16$).

Table 5. 2: Mean predictions (and standard deviations) as a function of time, valence of prediction event, and intervention task

Event Valence	F-SIT-Instructions-		F-SIT-Instructions-		F-SIT-Cues-		Visualisation		
	Pre	Post	Related	Unrelated	Pre	Post	Unrelated	Task	
Likelihood	Positive	4.03 (1.23)	4.25 (1.22)	3.66 (0.87)	4.00 (1.03)	3.50 (1.30)	3.74 (1.24)	3.70 (0.87)	3.66 (0.81)
	Negative	4.33 (0.53)	4.08 (0.74)	3.98 (0.85)	3.49 (0.87)	4.13 (0.76)	3.72 (0.96)	3.90 (1.12)	3.72 (1.08)
Control	Positive	4.13 (1.04)	4.18 (1.28)	3.58 (0.85)	3.77 (0.78)	3.92 (1.00)	3.84 (1.10)	3.77 (0.72)	3.69 (0.60)
	Negative	3.26 (0.88)	3.35 (0.91)	3.15 (0.72)	2.96 (0.77)	2.94 (0.84)	3.29 (0.87)	3.17 (0.66)	2.92 (0.54)
Importance	Positive	4.63 (0.54)	4.68 (0.84)	4.30 (0.71)	4.44 (0.61)	4.50 (0.78)	4.53 (0.76)	4.37 (0.74)	4.19 (0.86)
	Negative	4.38 (0.57)	4.06 (0.68)	4.09 (0.80)	4.06 (0.85)	4.15 (0.90)	4.21 (1.00)	3.96 (0.79)	3.79 (1.03)

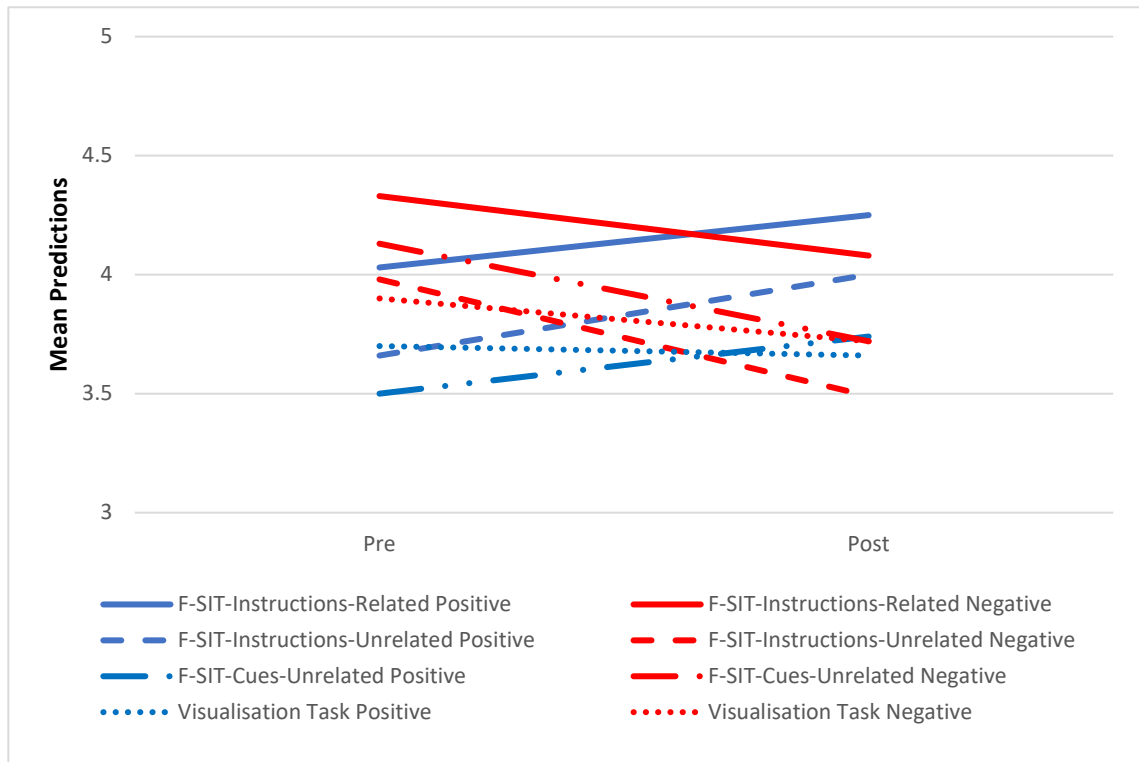


Figure 5: Changes in likelihood predictions pre-to post-intervention as a function of prediction event valence and intervention.

5.4.2. Changes in Vividness Ratings

Changes in vividness ratings were assessed using a 4 (Intervention Task: F-SIT–Instructions-Related, vs. F-SIT-Instructions-Unrelated, vs. F-SIT–Cues-Unrelated, vs. Visualisation task) x 2 (Valence of Prediction Event: positive vs. negative) x 2 (Time: pre- vs. post-intervention) mixed ANOVA. Descriptive statistics are displayed in Table 5.3.

No significant main effects emerged (all $F_s \geq .03$, all $p_s \geq .27$). There was a significant Time x Valence of Prediction Event interaction, $F(1,63) = 18.72, p < .001, \eta^2 = .23$. Overall, there was a significant pre- to post-intervention increase in vividness ratings for positive events ($p = .001$). However, there was no pre- to post-intervention change in vividness ratings for negative events ($p = .12$). There were no other significant interactions (all $F_s \geq .013$, all $p_s \geq .28$).

5.4.3. Changes in Affect

In order to establish whether changes in affect occurred as a result of the intervention tasks, a 4 (Intervention Task: F-SIT–Instructions-Related, vs. F-SIT-

Instructions-Unrelated, vs. F-SIT-Cues-Unrelated, vs. Visualisation task) x 2 (Valence of VAS: positive vs. negative) x 2 (Time: pre- vs. post-intervention) mixed ANOVA was conducted, with Bonferroni adjusted pairwise comparisons conducted where necessary. Descriptive statistics are displayed in Table 5.4.

There was a significant main effect of valence of VAS, $F(1,63) = 12.46$, $p = .001$, $\eta^2 = .17$, with positive affect being rated higher than negative affect. There was also a significant Time x Valence of VAS, $F(1,63) = 19.39$, $p < .001$, $\eta^2 = .24$. Overall, there was a significant increase in the positive affect pre-to post-intervention ($p < .001$), and a significant decrease in the negative affect pre-to post-intervention ($p = .002$). There were no other significant main effects or interactions (all $F_s \geq .21$, all $p_s \geq .12$).

Table 5. 3: Mean vividness ratings (and standard deviations) as a function of time, valence of prediction event, and intervention task

Event Valence	F-SIT-Instructions-Related		F-SIT-Instructions-Unrelated		F-SIT-Cues-Unrelated		Visualisation Task	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Positive	3.85 (1.17)	4.15 (1.28)	3.53 (0.77)	3.97 (1.04)	3.76 (0.94)	4.04 (0.81)	3.70 (0.73)	3.77 (0.96)
Negative	4.06 (0.62)	3.83 (0.71)	3.79 (0.82)	3.64 (0.67)	3.97 (1.00)	3.87 (1.05)	3.71 (0.89)	3.67 (1.17)

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Table 5. 4: Mean VAS ratings (and standard deviations) as a function of time, valence, and intervention task

Valence	F-SIT-Instructions-Related		F-SIT-Instructions-Unrelated		F-SIT-Cues-Unrelated		Visualisation Task	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
VAS Positive	50.88 (22.72)	62.12 (23.49)	49.29 (23.32)	58.94 (20.55)	51.19 (17.87)	52.50 (23.09)	53.59 (16.17)	61.53 (13.83)
Negative	39.71 (24.98)	33.53 (24.11)	42.47 (23.31)	31.71 (19.68)	44.19 (24.31)	38.81 (25.53)	39.12 (19.76)	37.06 (19.64)

5.4. Discussion

The first aim of Experiment 5 was to investigate whether the three variations of the F-SIT, compared with a neutral visualisation task, led to modifications in the predictions (likelihood, perceived control and importance) and vividness ratings that dysphoric individuals make regarding future events. In addition, Experiment 5 also measured positive and negative affect both before and after the interventions. This was to fulfill the second aim, which was to establish whether any modifications in predictions occurred as a function of corresponding changes in affect.

With regards to likelihood predictions, as hypothesized (hypothesis 1a and 2a), positive events were predicted as more likely to occur, and negative events less likely, following the F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated, and F-SIT-Cues-Unrelated. These results replicate those evident in the previous studies, suggesting that all three variations offer a potentially useful method of modifying predictions about future events. Most importantly, they suggest that these variations are all equally useful in modifying the biased predictions about the future made by individuals experiencing high levels of depressive symptomatology.

The previous experiments within this thesis have found that vividness ratings displayed a similar pattern of change to likelihood predictions; this was hypothesized to occur again in Experiment 5 (hypotheses 1d and 2d). However, these hypotheses were only partially supported by the current findings. There was a significant increase in vividness ratings for positive events following the F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated (hypothesis 1d). This provides further weight to the suggestion that predictions about the likelihood of future events may be a function of the vividness with which an individual can mentally envisage such events. However, contrary to prediction (hypothesis 2d), there was no change in vividness ratings for negative events following any version of the F-SIT (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated or F-SIT-Cues-Unrelated). Although vividness ratings for negative events have decreased in previous experiments, it could be argued that because participants are not actually simulating negative events then the vividness for these events would not be expected to change. Having said this, there is no obvious methodological difference between Experiment 5 and earlier experiments and, so this is a surprising finding. It is, therefore, a finding that requires further investigation.

In the previous experiments, increases in perceived control over positive future events emerged as a function of simulating conceptually related material (F-SIT-Instructions-Related). A similar effect was hypothesized in the current study (hypothesis 1b). However, contrary to this hypothesis, predictions of perceived control did not increase for positive events following any variations of the F-SIT (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated). This was unexpected as the previous experiments found a significant increase in predictions of perceived control following the F-SIT-Instructions-Related. Therefore, this requires further investigation as it is unclear why the findings of Experiment 5 were not in line with those from earlier experiments. Furthermore, an unexpected pattern of findings emerged for predictions of perceived control over future negative events. Contrary to the hypothesis (2b), there was no significant increase for predictions of perceived control for negative events following the F-SIT-Instructions-Related. As hypothesized, there was also no significant increase in predictions of perceived control following the F-SIT-Instructions-Unrelated. However, there was a significant increase in predictions of perceived control for negative events following the F-SIT-Cues-Unrelated. This finding is surprising and was not evidenced when the same variation of the F-SIT was used in a previous experiment (Experiment 3). The only methodological difference between Experiment 3 and Experiment 5 is the use of dysphoric participants. Experiment 3 used only non-depressed participants, whereas Experiment 5 used only dysphoric participants. Thus, the current experiment is the first time the F-SIT-Cues-Unrelated has been used in dysphoric participants. Therefore, this finding could suggest that the F-SIT-Cues-Unrelated is, for some reason, beneficial for modifying predictions of perceived control in dysphoria. However this is in need of further investigation. Firstly, it would be necessary to replicate the finding that the F-SIT-Cues-Unrelated modifies perceived control over negative future events in dysphoric, but not non-depressed, individuals. Secondly, if this is the case then potential theoretical reasons for the differential effect of this version of the F-SIT would need to be considered and experimentally tested.

The previous experiments have evidenced mixed findings with regards to predictions of importance, and therefore it was difficult to form a firm hypothesis (hypothesis 1c and 2c). There was a trend towards a significant interaction between Time and Valence of Prediction Event. Importance predictions for positive events

increased significantly pre-to post-intervention. Furthermore, there was a trend towards significance for a decrease in importance predictions for negative events. Interesting, no interaction involving intervention task emerged, thus it suggests that this pattern was evident across all three versions of the F-SIT and the visualisation task. Previous experiments have shown modification of importance predictions as a result of some version of the F-SIT. For instance, experiment 2 found a significant increase in importance predictions for positive events and a significant decrease for negative events, following both the F-SIT-Instructions-Related and the F-SIT-Instructions-Unrelated. This pattern was also evident in Experiment 4 following the F-SIT-Instructions-Related. However this was not replicated in Experiment 3 following either the F-SIT-Instructions-Unrelated or F-SIT-Cues-Unrelated. Additionally, in none of the earlier experiments did the visualisation task modify important predictions. Thus, whilst it appears that importance predictions can be modified, the parameters under which this occurs seem to be more complicated than whether one is simulating conceptually related vs. unrelated material. Therefore, further investigations are required to fully understand the parameters under which the positive simulation intervention paradigm impacts on predictions of importance.

The primary aim of Experiment 5 was to test the variations of the F-SIT in dysphoric individuals. In order to do this effectively, it was imperative that the effects of the three different versions of the positive episodic simulation task were compared against a control task. This control task took the form of the neutral visualisation task that had also been used for a similar purpose in earlier experiments. Thus, it was hypothesized that the changes evidenced as a result of the F-SIT interventions would not be seen following the visualisation task. Essentially, the visualisation task was expected to have no effect on the predictions/ratings about positive and negative future events (hypothesis 1e and 2e). However, only partial support for these hypotheses emerged. For positive future events, there were no changes in likelihood predictions, predictions of perceived control or importance predictions. This further supports the notion that the modifications evident in the three predictive judgements are not due to imagery *per se*. However, a particularly surprising finding was that there was a significant increase in vividness ratings for positive events following the visualisation task. This suggests that an increase in the vividness of mental imagery does not necessarily translate into the belief that events are more likely to occur, and raises questions for the earlier suggestion that changes in likelihood predictions are a result of

modifications in the extent to which individuals can vividly visualise those events. With regard to negative events, as hypothesized there was no change in likelihood predictions, importance predictions or vividness ratings. This, again, suggests that the modification seen following the different versions of the F-SIT could be a function of future-focused positive episodic simulation, rather than merely engaging in mental imagery *per se*. However, surprisingly, there was a significant decrease in predictions of perceived control for negative events following the visualisation task. Interestingly, however, this modification was not in a positive direction; participants did not feel more in control, in fact they actually felt they had less control over negative events occurring, as a result of the visualisation task. Thus, this further supports the notion that engaging in neutral mental imagery is not effective for modifying future event predictions.

The second aim of Experiment 5 was to examine the proposition that the prediction/rating modifications that occur as a result of the F-SIT are actually a function of changes in affect brought about by the F-SIT. Essentially, the F-SIT leads to increased positive affect and decreased negative affect which, in turn, leads to a reduction in the depressive prediction biases about future events. As hypothesized, there was a significant increase in positive affect pre-to post-intervention following the F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated (hypothesis 3a). Furthermore, the hypothesized decrease in negative affect following the F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated was also evident (hypothesis 3b). This provides further support to the previous literature that has found that positive simulation tasks increase positive affect in dysphoric individuals (e.g. Pictet et al., 2011). It also adds to the scarce literature examining the impact of positive simulation tasks on negative affect. Previous work (e.g. Torkan et al., 2014) has suggested that positive simulation tasks can reduce depressive symptoms. However, this study provides the first direct evidence that positive simulation tasks specifically reduce negative affect. This is a promising finding as it suggests that the different versions of the F-SIT not only beneficially improve positive affect but also reduce negative affect.

If changes in affect drive the prediction modifications evidenced following the F-SIT intervention then one would not expect to see changes in affect following the control task. Thus, it was hypothesized that there would be no changes in affect as a result of the neutral visualisation task (hypothesis 3c). However, contrary to this

hypothesis, the visualisation task also led to a significant pre- to post-intervention increase in positive, and decrease in negative, affect. This could potentially be explained by the fact all participants in the present experiment were experiencing high levels of depressive symptomatology. A common feature accompanying depressive symptoms are ruminative thought processes, which can generally be described as a repetitive form of thinking, in which one repeatedly ponders about oneself, and about the possible causes, meaning, and implications of one's sad and depressed feelings (Nolen-Hoeksema et al., 2008; Watkins, 2008). Previous research by Nolen-Hoeksema and Morrow (1993) used a very similar visualisation task as a distraction from ruminative thought processes in a group of dysphoric individuals. In doing so they demonstrated that mood improved following this task, whilst mood worsened following a rumination task (focusing their attention on their current feelings and personal characteristics). Therefore, the visualisation task used in this experiment is likely to have distracted the dysphoric participants from ruminative thought processes which, in turn, led to changes in positive and negative affect. Most importantly, however, this finding suggests that the modification in predictions about future events that occur as a result of the F-SIT are not merely a by-product of mood improvements. Therefore, a crucial avenue for future research will be to examine the underlying mechanisms by which imagery and simulation improve predictions about the future.

To summarise, the current experiment has demonstrated that prediction/rating modifications are evident following the different versions of the F-SIT in dysphoric individuals. The current experiment has also illustrated that following the three different versions of the F-SIT, positive affect increased, which is in line with previous research demonstrating an increase in positive affect following positive simulation (Blackwell et al., 2015; Blackwell & Holmes, 2010; Lang et al., 2012; Renner et al., 2016). The current experiment also evidenced a significant decrease in negative affect following all three versions of the F-SIT. However, the present experiment does suggest that even when affect is enhanced, this does not then impact on future event predictions. This is because within the visualisation task, there was also a change in affect, however there was no change in the three predictive judgements. This suggests that the prediction modification seen in this experiment, and the previous experiments, are not solely a function of a change in affect. Therefore, further investigation is now needed to investigate other possible underlying mechanisms of the prediction/rating modifications.

6. General Discussion

The experiments presented within this thesis have investigated the usefulness of a positive future episodic simulation intervention paradigm as a method of modifying predictions regarding future events. The experiments have used various modifications of the paradigm to test the parameters under which it impacts on predictions and ratings about positive and negative future events. Specifically, they have investigated the impact of positive future episodic simulation on predictions regarding: 1) the likelihood of future positive and negative events occurring (likelihood); 2) one's perceived control over positive and negative future events (perceived control); 3) and the importance of positive and negative future events (importance). In addition, given that previous literature has suggested that the predictions an individual makes about future events may be closely linked to the vividness with which they can be mentally simulated, the experiments presented within this thesis have also examined whether positive future episodic simulation impacts on vividness ratings of positive and negative future events. Finally, the experiments presented within this thesis have investigated potential underlying mechanisms for the effects of positive simulation as a method of modifying future event predictions; of specific interest were changes in affect and/or optimism as possible explanatory mechanisms.

6.1. Overview of Thesis

The five experiments presented within this thesis fulfilled four aims. The first aim was to develop a positive future episodic simulation intervention paradigm and examine its impact on predictions about positive and negative future events (Chapter 2 – Experiments 1 and 2). Previous research has asked individuals to make predictions, such as likelihood of occurrence, about future events (e.g. Dunning & Story, 1991; MacLeod & Byrne, 1996; MacLeod & Cropley, 1995; Pyszczynski et al., 1987; Szpunar & Schacter, 2013). Thus, these earlier studies provided a useful database of potential future events for the purposes of developing a Future Events Predictions Task that was then used throughout the investigations within this thesis.

Within Experiment 1, a newly devised Future Simulation Intervention Task (F-SIT) was developed. It was decided that within this initial investigation the researcher would clearly instruct participants to simulate positive events in response to single word cues. This allowed the manipulation of conceptual relatedness between simulation cues

and the events within the Future Events Prediction Task. Each positive event within the Future Events Predictions Task was matched with a related single cue word forming the F-SIT-Instructions-Related. This was compared with a second version of the F-SIT, the F-SIT-Instructions-Unrelated, which used single cue words that were conceptually unrelated to the events in the Future Events Prediction Task. In order to be able to examine if either F-SIT impacted on future event predictions, a visualisation task was also developed as a control for comparison purposes. This visualisation task required participants to vividly imagine scenes in response to neutral cue items and was adapted from a similar task developed by Nolen-Hoeksema and Morrow (1993).

The findings of Experiment 1 demonstrated that predictions regarding likelihood and perceived control for positive events were significantly higher after the F-SIT-Instructions-Related compared to the visualisation task. However, there was no difference in importance predictions between the F-SIT and the visualisation task. Positive events were also more vivid following the F-SIT-Instructions-Related compared to the visualisation task. Thus, the simulation of conceptually related events led to improvements in predictions about likelihood of occurrence and perceived control over positive events. It also led to positive events being more vivid. In contrast, the F-SIT-Instructions-Unrelated produced inconclusive findings. There were no significant differences between participants' predictions of likelihood or importance, or ratings of vividness, following this task compared with either the visualisation task or the F-SIT-Instructions-Related. A trend towards significance difference suggested that the F-SIT-Instructions-Related led to more perceived control over positive events compared with the F-SIT-Instructions-Unrelated. In Experiment 1, the F-SIT did not impact on predictions or vividness ratings for negative future events; there were no differences between the two versions of the F-SIT or the visualisation task.

One limitation of Experiment 1 was that conclusions were drawn solely on the basis of post-intervention differences between conditions without any baseline, pre-intervention, measures of event predictions. Therefore, it was assumed that engaging in the F-SIT-Instructions-Related impacted on participants' predictions and ratings about potential positive future events. However, it was feasible that the findings could reflect baseline differences across the three intervention task conditions. Thus, in order to establish if positive episodic future simulation *modifies* predictions and ratings about future events, Experiment 2 employed the same intervention tasks using a pre-to post-

intervention design, which allowed for any *changes* in predictions and vividness ratings to be assessed. Experiment 2 reiterated the effectiveness of the F-SIT-Instructions-Related. Participants predicted positive events as more likely to occur, controllable and important, and rated them as more vivid, after completing the intervention. Interestingly, the F-SIT-Instructions-Unrelated also led to the same improvements. Furthermore, both F-SITs improved predictions and ratings about negative future events too. Importantly, the modifications evidenced by the F-SIT were contrasted by no significant modifications in predictions and vividness ratings as a result of the visualisation task.

The second aim of the thesis was to use various modifications of the F-SIT to test the parameters under which the F-SIT impacted on predictions about positive and negative future events (Chapter 3 - Experiment 3). The F-SIT used in the first two experiments used single cue words, with clear *instructions* for the need to simulate *positive* events in response to the cue words. However, it was feasible that other methods of cueing positive simulations would also prove useful. For instance, previous research has demonstrated simulating short descriptions of positive events improved mood in depressed individuals (Blackwell & Holmes, 2010) and increased the likelihood of participants engaging in the events in the future (Renner et al., 2016). The findings from Experiment 2 suggested that relatedness of the simulations was not necessarily crucial for prediction and rating modification, and that the effect of the positive simulation may generalise across different positive and negative events. Therefore, Experiment 3 investigated whether using unrelated positive cues, in the form of scenarios, would also modify future event predictions and ratings; thus, a new version of the F-SIT was developed and compared with the F-SIT used in Experiments 1 and 2. The new version of the F-SIT used positive scenarios that were unrelated to the events in the Future Event Predictions Task as cues for simulation (F-SIT-Cues-Unrelated). As unrelated cues in the newly developed F-SIT were used, it was decided that the ideal comparison would be the F-SIT-Instructions-Unrelated, which uses positive instructions and unrelated single cue words for simulation. Experiment 3 also manipulated congruency of prediction event lists. This manipulation was included to examine whether the effect of the F-SIT on predictions/ratings could reflect underlying changes in affect and/or general optimism (the final aim of the thesis). If prediction modifications were evident when the prediction event lists were incongruent then this

would suggest that the F-SIT is leading to changes in a more general underlying construct, such as affect or optimism, which is then impacting on event predictions.

Findings from Experiment 3 demonstrated that the use of positive cues within the F-SIT is an equally effective method of modifying future event predictions. Similar patterns of findings were found for both the F-SIT-Instructions-Unrelated and the F-SIT-Cues-Unrelated throughout. For instance, when the prediction event lists were congruent, both tasks led to a significant increase in likelihood predictions and vividness ratings for positive events, and decrease for negative, events. The use of incongruent, compared with congruent, event lists led to less consistent modifications in future event predictions. For positive events, the only significant modification that emerged was an increase in vividness ratings from pre- to post-intervention. In contrast, for negative events, the only significant modification was a decrease in likelihood predictions from pre- to post-intervention. This has implications for the potential role of optimism/affect as an underlying mechanism; an issue that was elaborated upon in Experiment 5.

The third aim of the thesis was to assess whether the paradigm could be applied across non-depressed, dysphoric and depressed individuals. This was implemented across Chapters 4 and 5 (Experiments 4 & 5). Experiment 4 used the F-SIT-Instructions-Related across non-depressed, dysphoric and depressed participants. Following the F-SIT-Instructions-Related, all participants (non-depressed, dysphoric, and depressed) were able to imagine positive future events as more vivid, likely to happen, important, and controllable. Conversely, they rated negative events as less vivid, likely to happen and important following this intervention. They also predicted that these negative events were more controllable post-intervention.

Experiment 5 also assessed whether prospective biases could be modified, by using different variations of the paradigm, within dysphoric individuals. All three versions of the F-SIT (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated, F-SIT-Cues-Unrelated) were used and compared with the visualisation task from Experiments 1 and 2. Following all F-SITs the dysphoric participants predicted positive events as more likely to occur and rated them as more vivid. They also predicted negative events as less likely to occur, however they did not rate them as less vivid. Predictions of perceived control did not increase for positive events following any variations of the F-

SIT. Furthermore, an unexpected pattern of findings emerged for predictions of perceived control over future negative events. There was no significant increase for predictions of perceived control for negative events following the F-SIT-Instructions-Related or the F-SIT-Instructions-Unrelated. However, there was a significant increase in predictions of perceived control for negative events following the F-SIT-Cues-Unrelated. With regard to importance predictions, there was a trend towards a significant interaction between time and valence of prediction event. Importance predictions for positive events increased significantly pre-to post-intervention. Furthermore, there was a trend towards a significance decrease in importance predictions for negative events. This was evident across all three versions of the F-SIT and the visualisation task.

The fourth and final aim of the thesis was to investigate whether changes in optimism or affect served as the underlying mechanism by which positive episodic simulation modified future event predictions (Chapters 3 & 5 - Experiments 3 & 5). The rationale for this was that the F-SIT could be leading to optimism or mood changes which, in turn, drive the modifications in predictions/ratings about future events. Experiment 3 started to investigate whether changes in optimism was driving the modifications; therefore, Experiment 5 extended this to investigate the potential role of affect. To test this, Experiment 5 used visual analogue scales, both pre-and post-intervention, to measure any change in positive and negative affect following the various versions of the F-SIT and the neutral visualisation task. Following all interventions, including the visualisation task, there was an increase in positive affect and a decrease in negative affect. This suggests that the effects of the F-SIT are not entirely mood dependent; this is because mood was altered by the visualisation task, yet this task led to no modification in predictions about future events.

6.2. Implications of Findings

6.2.1. Simulation as a Method of Improving Prospection

The findings presented within this thesis have highlighted that simulation of positive future events has the potential to improve predictions/ratings. What is particularly important, however, is the information they provide about which simulation methods produce such modifications and the potential mechanisms underlying these modifications. Firstly, implications with respect to establishing an optimal method of

positive future event simulations will be explored. Subsequently, implications for the potential mechanisms underlying these effects will be discussed.

Optimal Method of Positive Episodic Simulation

A number of the experimental manipulations within the present thesis had the underlying aim of establishing the optimal method of positive episodic simulation for the purpose of modifying future event predictions. In particular they inform on whether different cueing techniques affect prediction modifications, whether simulations need to be conceptually related to the predictions being modified, and also whether simulations need to be repeated multiple times. These issues will be discussed in turn.

The effect of different cueing techniques

The F-SIT used two different variations of cueing positive simulations. Either positive scenarios were employed as cues for simulation (F-SIT-Cues-Unrelated) or positive instructions combined with single cue words were used (F-SIT-Instructions-Unrelated and F-SIT-Instructions-Related). Comparisons between the F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated in Experiments 3 and 5 allowed for a direct test of whether either method of cueing positive simulations was more effective. Interestingly, in both experiments, there was no difference between these two intervention methods. Thus, it did not matter whether the intervention task used positive instructions with single cue words, or inherently positive cues in the form of scenarios; both tasks were equally useful for modifying predictions and vividness ratings for positive and negative future events. This is in line with previous work demonstrating that simulating positive scenarios improves likelihood predictions (e.g. Blackwell & Holmes, 2010; Renner et al., 2016). This has potential implications for the development of a therapeutic intervention using positive episodic simulation. Firstly, it would allow more freedom with respect to how the intervention is delivered. For example, using positive cue scenarios would mean this version of the intervention could be completed alone without the physical presence of the therapist, i.e. computerised/online interventions. However, the findings also indicate that if an individual did not feel they were able to complete the task alone, then completing the task with positive instructions and single cue words is also an option.

The effect of simulating related versus unrelated material

Earlier experimental research (e.g. Szpunar & Schacter, 2013) has placed emphasis on the process of *repeated* simulations of conceptually *related* material for the purposes of increasing plausibility of those future events. They argued that repeatedly simulating events makes them more familiar and, therefore, more plausible. Thus, within the thesis, the various modifications of the F-SIT also manipulated whether the cues were conceptually related to the prediction events. Related cues were conceptually related to the positive events used in the Future Events Prediction Task, whilst the unrelated cues were not related to any of the events used in the Future Events Prediction Task. Conceptually related cues were used in Experiments 1, 2, 4 and 5, whilst unrelated cues were used in Experiments 1, 2, 3, and 5. Thus, the importance of related versus unrelated cues as a method of modifying predictions/ratings about future events was explicitly compared in Experiments 2 and 5.

In general, it was found that likelihood predictions increased for positive events and decreased for negative events irrespective of whether related or unrelated cues were employed. A similar pattern emerged for vividness ratings. Vividness ratings for positive events increased following the simulation of both related and unrelated cues. In addition, vividness ratings for negative events evidenced a decrease after simulating both positive related and unrelated cues, with one exception (neither the F-SIT-Instructions-Related nor the F-SIT-Instructions-Unrelated led to changes in vividness ratings for negative events in Experiment 5). Thus, overall, the findings within this thesis suggest that both related and unrelated simulation can lead to positive future events being more vivid and predicted as more likely to occur. Furthermore, negative events also become less vivid and less likely to occur.

The issue of conceptual relatedness of cues does, however, seem to be critical to the manipulation of predictions of perceived control. Findings indicate that the use of related cues is essential for modification to occur. To summarise, Experiments 2 and 4 included an intervention task that used related cues, with both evidencing an increase in predictions of perceived control for both positive and negative events. In contrast, Experiments 2 and 3 included an intervention task that used unrelated cues and, in both cases, there was no modification for perceived control for either the positive or negative events. Therefore, the results imply that predictions of perceived control are only modified when the use of conceptually related cues are employed. However,

surprisingly, the results from Experiment 5 did not fit with this pattern. Related simulation had no effect on perceived control, whilst simulation of unrelated cues led to a significant increase in predictions of perceived control over negative events. Therefore, further investigation of the relationship between related simulation and perceived control is necessary. Overall, however, the general pattern of findings does suggest that, in order to improve predictions of perceived control, simulation of conceptually related material is most effective.

Throughout all experiments, findings relating to the modification of predictions of importance were very mixed. This was particularly evident in the effects of related versus unrelated simulation on importance predictions. In some experiments importance predictions were modified, with an increase for positive events and a decrease for negative events, following simulation of both related (Experiments 2, 4 & 5) and unrelated cues (Experiments 2 & 5). However, other experiments did not evidence any modification (Experiment 3). One possible explanation for the mixed results is that the importance of events could be a more stable predictive judgement. This may be because importance predictions are likely to be closely related to an individual's goals and desires. Therefore, if an event does not fit within an individual's framework of personal goals then its importance is unlikely to be affected. Furthermore, events that are related to an individual's personal goals, arguably, will be viewed as important irrespective of whether they have been mentally simulated or not. The results from the five experiments within this thesis do suggest that importance predictions can be modified. However, the parameters under which this occurs seem to be more complicated than whether one is simulating conceptually related vs. unrelated material. Therefore, further investigations are required to fully understand the parameters under which importance predictions can be modified.

The effect of repeated simulation

As discussed previously, research by Szpunar and Schacter (2013) suggested that the process of *repeated* simulations of conceptually *related* material is important for the purposes of increasing the plausibility of future events. However, findings within this thesis suggest that positive episodic simulations using unrelated cues can be also be effective in modifying predictions about both positive and negative future events. However, it was possible that positive simulations of conceptually related material could prove more beneficial when it is repeated multiple times. Therefore, Experiment 4

also examined the effect of repeated simulation on predictions/ratings of future events. However, there was no effect of repeated simulation. Pre- to post-intervention change in predictions/ratings was no greater for the prediction events where participants had simulated conceptually related material multiple times compared with once or not at all.

Why did repeated simulation not emerge as an important factor in prediction modification? One possible explanation is that the F-SIT does not result in specific modifications that are a function of simulating conceptually related material. Instead, it is leading to a more global change in an underlying variable which, in turn, modifies predictions more generally. Two candidate variables that could fulfil this role are affect and/or optimistic orientation. These two variables are suggested, and were investigated, because earlier research has already shown that evoking positive imagery increases both optimism (e.g. Meevissen et al., 2011) and positive affect (e.g. Burnett Heyes et al., 2016; Nelis et al., 2012; Pictect et al., 2011).

Potential Mechanisms Underlying the Effects of Positive Episodic Simulation

The final aim of this thesis was to investigate the potential underlying mechanisms that underlie the effect of prediction modification, specifically investigating the role of optimism and affect. The investigations of optimism and affect within this thesis, and the implications of their findings, will be discussed in turn.

The Role of Optimism

One possible explanation for the modification in predictions and ratings evidenced in the experimental chapters is that they reflect underlying changes in general optimism. Support for this idea comes from the findings showing a more generalized pattern of prediction modification, whereby simulating conceptually unrelated material led to modifications in predictions, particularly likelihood of occurrence, and vividness ratings, of both positive and negative events. This thesis explicitly investigated the potential role of optimism within Experiment 3. To achieve this, Experiment 3 used a methodological manipulation to test whether modifications still occurred when incongruent prediction event lists were used pre- and post- intervention. If modifications were still evident when the prediction event lists were incongruent then this would suggest that the F-SIT is leading to changes in the individual's generalized tendency to have a positive outlook for the future, i.e. optimism.

However, findings from Experiment 3 demonstrated that the use of incongruent prediction event lists dramatically reduced the evidenced prediction modifications. For positive events the only modification evident was an increase in vividness ratings, whilst for negative events the only modification evident was a decrease in likelihood predictions. These findings, in general, do not add strong support to the argument that a change in optimistic orientation underlie the evidenced prediction modifications. The only support that could be drawn is the finding that likelihood predictions for negative events decreased. Given that all simulations are positive in nature, any changes in predictions about negative events suggests a change in a more generalized underlying cognitive/affective construct, of which optimistic orientation is one possibility.

The use of incongruent prediction event lists pre- and post-intervention provided a direct test of whether the F-SIT paradigm is leading to changes in optimism. However, one issue with this approach is that it cannot fully account for potential individual differences in responses to the events across the two lists. It is feasible that how an individual rates the pre-intervention list compared to the post-intervention list is affected by the particular events within those lists; perhaps one set contained events that were more personally relevant to the individual or more related to events they had experienced before and, therefore, easier to picture in their mind. Such differences could then mask potential pre- to post-intervention changes that actually occur as a result of the F-SITs. To try and prevent this pilot tests did establish that the events within the two lists were equivalent with respect to the predictions/ratings. However, it is still a possibility that cannot be entirely ruled out. An alternative possibility is that, rather than changes in optimism driving the more generalized modifications in predictions, the evidenced changes are coming about due to a different underlying mechanism. Previous research (e.g. Burnett Heyes et al., 2016; Holmes & Mathews, 2005; Holmes et al., 2008; Quoidbach et al., 2009) points to the possibility that changes in affect could be responsible; thus, this argument would suggest that the F-SIT is improving the mood of participants and this is, in turn, improving the predictions that they make about future events.

The Role of Affect

Previous literature has suggested that positive future-orientated simulation and imagery impacts on mood. For example, Quoidbach et al., (2009) found non-depressed participants' happiness ratings increased following imagining positive future events. In

addition, generating positive mental imagery has also been found to increase positive affect in dysphoric individuals (Pictet et al., 2011) and decrease depressive symptoms in depression (Torkan et al., 2014). Therefore, it is feasible that the F-SITs are leading to mood improvements that, in turn, lead to the evidenced prediction modifications. This proposition was explicitly investigated in Experiment 5. To test this assertion, Experiment 5 compared positive and negative affect, pre-and post-intervention, using the various versions of the F-SIT (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated) and the neutral visualisation task. If affective changes are driving the effect in prediction modifications then it was expected that improvements in affect would occur as a result of the F-SITs, but not the neutral visualisation task. Following all versions of the F-SIT a significant increase in positive affect and a significant decrease in negative affect was evident. This supports previous literature that has also found that positive simulation tasks increase positive affect (e.g. Pictet et al., 2011). It also provides the first direct evidence that positive simulation tasks specifically reduce negative affect, a promising finding that suggests the different versions of the F-SIT not only beneficially improve positive affect but also reduce negative affect.

However, as previously noted, if changes in affect drive the prediction modifications evidenced following the F-SIT interventions then one would *not* expect to see changes in affect following the neutral visualisation control task. However, the visualisation task also led to a significant pre- to post-intervention increase in positive, and decrease in negative, affect. Thus, this suggests that the modifications in future event predictions that occurred as a result of the F-SIT are not merely a by-product of affective change. One important point to note is that all participants in Experiment 5 were dysphoric. Thus, one possibility is that the neutral visualisation task distracted the dysphoric participants from their ruminative thought processes, a common feature of individuals experiencing depressive symptoms, which thus improved their mood. However, even if this was the case it does not detract from the finding that the neutral visualisation task, whilst improving mood, *did not* lead to changes in predictions or vividness ratings. Thus, it appears that the modifications in future event predictions and vividness ratings that occur as a result of the F-SIT are not merely a by-product of affective changes.

6.2.2. Improving Prospection in Depression

It is well established that simulation and prediction biases are evident within both depression and dysphoria. Roepke and Seligman (2016), within their cognitive model of depression, argue that depressed individuals have biases in the simulation of future events. In particular they have difficulty constructing vivid simulations of positive future events, yet evidence no such difficulty in constructing vivid simulations of negative future events. This results in an over representation of negative events and under representation of positive events. Experimental work supports this assertion. For example, numerous studies have demonstrated that depressed and dysphoric, when compared with non-depressed, individuals have difficulty in simulating positive, but not negative, future events (e.g. Holmes et al., 2008; MacLeod et al., 1998; Morina et al., 2011; Stober, 2000; Szöllösi et al., 2015).

Furthermore, Roepke and Seligman (2016) argue that depressed and dysphoric individuals make biased predictions about the future. Previous research has also provided evidence for this bias, with experimental studies showing that depressed/dysphoric individuals predict negative future events as more likely to happen, and positive future events as less likely to happen, relative to non-depressed individuals (e.g. Pyszczynski et al., 1987; Thimm et al., 2013). These prediction biases are also evident within research investigating personal goals. For instance, Dickson et al., (2011) demonstrated that depressed, compared with non-depressed, individuals rated approach goals as less likely to occur and to be less under their control, whilst undesirable, to-be-avoided, goal outcomes were rated as more likely to occur (Dickson et al., 2011). Similarly, Vincent et al., (2004) found parasuicide patients rated their goals as less likely to be achieved and judged that they had less control over achieving them.

Within the introduction to this thesis (Section 1.4.1.) it was posited that the difficulty that depressed/dysphoric individuals have with positive future simulation may underlie the biases they evidence in predictions about the future. If a positive future cannot be visualized then, arguably, one is unlikely to believe it will happen. Thus, in turn, one is less likely to engage in behaviours that promote achievement of positive future experiences and personal goals. Additionally, the biases in simulation mean that depressed/dysphoric individuals may struggle to simulate anything other than negative possibilities in their future. Therefore, establishing a method to try and improve depressed individuals' simulation and prediction biases seemed crucial. This formed the

overarching purpose of the current thesis. The previous section (6.2.1) discussed the usefulness of positive episodic simulation, in the form of the F-SIT, as a method of improving predictions about future events. However, the critical issue in the development of the F-SIT was its usefulness for individuals experiencing high levels of depressive symptomatology. This was tested explicitly within Experiments 4 and 5. Experiment 4 used participants from three depression status groups (depressed, dysphoric, and non-depressed). Thus, it sought to provide further evidence for the presence of prediction biases in depressed and dysphoric individuals and, most importantly, examine whether the F-SIT-Instructions-Related could modify these prediction biases. Experiment 5 tested three variations of the F-SIT, compared with the neutral visualisation task, in a purely dysphoric sample.

The baseline, pre-intervention, ratings of vividness provided within Experiment 4 suggested that depressed/dysphoric individuals have difficulty vividly simulating positive future events. The non-depressed participants rated positive events as significantly more vivid, and the negative events as significantly less vivid, compared to both the dysphoric and depressed participants, pre-intervention. This supports previous work that has demonstrated reduced vividness in the simulations of self-generated future positive events in depression (e.g. Morina et al., 2011; Szöllösi et al., 2015). Importantly, a significant improvement occurred in all three depression status groups following completion of the F-SIT-Instructions-Related. This was illustrated by an increase in vividness ratings for positive events, and a decrease in vividness ratings for negative events, pre-to post-intervention. Experiment 5 also evidenced a significant increase in the vividness of positive events following all three versions of the F-SIT in dysphoric individuals. However, this experiment did not evidence changes in vividness ratings for negative events following any version of the F-SIT. Taken together, these findings demonstrate the effectiveness of the F-SIT for improving the extent to which individuals with depression and dysphoria can vividly picture potential positive events in their future. Additionally, it also demonstrates that the method of cueing positive simulations, and the relatedness of these cues to the prediction events, isn't necessarily important. Furthermore, these experiments provide tentative support for the idea that engaging in a positive future episodic simulation task has the potential to also reduce the vividness with which individuals with depression picture negative events.

Within Experiment 4, the pre-intervention scores on the Future Event Prediction Task also provided further evidence for the presence of prediction biases in depressed and dysphoric individuals. The depressed individuals predicted positive events as less likely to occur compared with both the non-depressed and the dysphoric participants (who did not differ from each other). Additionally, the depressed group predicted negative events as significantly more likely to occur compared to the dysphoric participants who, in turn, predicted negative events as significantly more likely to occur compared with the non-depressed participants. Most importantly, in all three depression status groups, significant improvements in likelihood predictions were evidenced post-, compared with pre-, intervention, i.e. increased likelihood for positive events and decreased likelihood for negative events. In addition, Experiment 5 also evidenced an increase in likelihood predictions for positive events and decrease in likelihood predictions for negative events following all three versions of the F-SIT in dysphoric individuals. These studies, together, provide strong support for the potential role of positive episodic simulation as a method of improving the perceived likelihood of positive and negative events in individuals with high levels of depressive symptomatology. Furthermore, these findings suggest that both positive cues and positive instructions are potentially beneficial for modifying likelihood predictions in depression and dysphoria and, also, the modification does not depend on simulating conceptually related cues.

Earlier research has evidenced biases in perceived control over the attainment of future goals in depression and parasuicide (e.g. Dickson et al., 2011; Vincent et al., 2004). Experiment 4 found that depressed participants perceived future events, both positive and negative, to be less controllable compared to dysphoric and non-depressed participants. However, there were no differences in perceived control between the non-depressed and dysphoric participants. These findings suggest that biases in perceived control are more generalized than evidenced in the previous research; they suggest that biases are evident for positive and negative future events that are not necessarily related to personal goals. Furthermore, they suggest that these biases may be a function of depression severity as a significant bias was only evident for the depressed, and not the dysphoric, participants. The critical finding, however, was that improvements in perceived control were evident for all participants from pre- to post-intervention in Experiment 4. This finding was, unfortunately, not wholly replicated in Experiment 5; predictions of perceived control did not increase for positive events following any

variation of the F-SIT (F-SIT-Instructions-Related, F-SIT-Instructions-Unrelated and F-SIT-Cues-Unrelated). This was unexpected as previously a significant increase in predictions of perceived control following the F-SIT-Instructions-Related was found. Therefore, this requires further investigation as it is unclear why the findings of Experiment 5 were not in line with the findings from Experiment 4. Furthermore, there was no significant increase for predictions of perceived control for negative events following the F-SIT-Instructions-Related. Again, this was not evidenced in Experiment 4. However, there was a significant increase in predictions of perceived control for negative events following the F-SIT-Cues-Unrelated. This finding was most surprising given that previous experiments had suggested that relatedness of simulation cues was important for improving perceptions of control. However, Experiment 5 was the first time the F-SIT-Cues-Unrelated had been used in dysphoric participants. Therefore, this finding could suggest that whilst unrelated cues are not beneficial for the modification of perceived control in non-depressed participants, they may have more utility in dysphoria and/or depression. However, this is a highly tentative proposition; it would be necessary to replicate the finding that the F-SIT-Cues-Unrelated modifies perceived control over negative future events in dysphoric/depressed, but not non-depressed, individuals.

With regards to importance predictions, Experiment 4 revealed that there were no pre-intervention biases in either the depressed or the dysphoric participants. That is, there were no differences in the importance predictions between the three depression status groups in their predictions of importance for positive events. This suggests that dysphoric and depressed individuals believe positive events to be just as important to them as their non-depressed counterparts, however they just feel they are less likely to happen and that they have less control over their occurrence. This finding extends the previous work of Dickson et al., (2011) who demonstrated that depressed individuals view future goals as equally important compared to their non-depressed counterparts, yet believed them to be less likely to occur and less controllable. Thus, it is not just personal goals that depressed/dysphoric individuals hold in equal regard to their non-depressed counterparts, but positive future events in general. Despite the lack of a pre-intervention bias for the depressed/dysphoric individuals, the F-SIT-Instructions-Related still resulted in an increase in importance predictions for positive events, and a decrease in importance predictions for negative events, across all three depression status groups. This was further supported by Experiment 5, which evidenced a trend towards a

significant increase in importance predictions for positive events and a significant decrease in importance predictions for negative events following all three versions of the F-SIT. This suggests that for all individuals, including those experiencing elevated levels of depressive symptomology, the F-SIT can prove beneficial with respect to improving perceptions of importance.

Taken together, Experiments 4 and 5 have provided further evidence for prospective simulation and prediction biases in depression and dysphoria. Most importantly, however, these experiments have demonstrated that the pre- to post-intervention bias modifications evident, as a result of the F-SIT, in non-depressed individuals also extend to individuals experiencing depression and dysphoria. Thus, these results suggest that, through the process of simulating positive future events, using a variety of intervention methods, both dysphoric and depressed individuals' future-directed simulation and prediction biases can be improved.

6.2.3. Cognitive Theories of Propection

Szpunar et al's (2014; 2016) theoretical taxonomy outlines four modes of propection: 1) simulation; 2) prediction; 3) intention; and 4) planning. Szpunar and colleagues argue that the modes of propection do not function independently of each other; instead, they interact and build upon each other. For instance, it has been argued that people base their predictions on their ability to engage in episodic simulations of the future (e.g. Szpunar & Schacter, 2013). Thus, if episodic simulations lack detail, are inaccurate, or unrealistic, then this can result in errors in predictions.

Previous experimental studies have provided evidence for the relationship between simulations and predictions. For instance, research has shown that individuals increase their confidence in fictitious events occurring after imagining that event, with this confidence/belief increasing the more times the event has been imagined (Carroll, 1978; Heaps & Nash, 1999; Sherman et al., 1985; Szpunar & Schacter, 2013; Thomas et al., 2003). Importantly, the experiments presented within this thesis provide further support for the notion that one's ability to engage in episodic simulation impacts on the predictions that they make about the future. All the experiments evidenced a modification in likelihood predictions as a result of the positive episodic simulation intervention. Predictions of perceived control and importance provided a more complex picture, however, episodic simulation still impacted on these predictions also.

An explanation for the relationship between simulation and predictions can, arguably, be found within the literature on the cognitive and neural processes involved in visual imagery. The findings presented within this thesis have, in general, suggested that when changes in vividness ratings occurred, so did changes in likelihood predictions. When positive events became more vivid they were also predicted as more likely to occur. Conversely, when negative events became less vivid they were also predicted as less likely to occur. This suggests that the effects of simulation on likelihood predictions may be a function of increasing/decreasing the vividness with which an individual mentally simulates such events. A core component of episodic simulation is the use of mental imagery, which is the simulation or re-creation of perceptual experience across sensory modalities (Kosslyn et al., 2001). A mental image is created when perceptual information is accessed within memory and the constructive episodic simulation hypothesis (Schacter & Addis, 2007) argues that the process of episodic simulation draws upon such images within memory to create potential future scenarios. Neuroimaging techniques have demonstrated that mental imagery activates the same brain regions as perception (Kosslyn et al., 2001) and a recent review of experimental work in mental imagery suggests that it serves as a weak perceptual image (Pearson, Naselaris, Holmes, & Kosslyn, 2015). Thus, it is argued that simulating potential future events, using mental imagery, can be accompanied by phenomenological experiences as if one is perceiving the actual event. This proposition is supported by research demonstrating that mental images are rated as more real than verbal thoughts (Mathews et al., 2013). Thus, if an individual engages in positive prospective simulation then one is likely to experience the phenomenological qualities of real positive events, such as positive affect. Furthermore, the more vivid and real these prospective mental images seem, then the more plausible and controllable they potentially become (Szpunar & Schacter, 2013). Furthermore, the more an individual engages in the process of simulating positive events then the more familiar such events become and, in turn, they come to mind more readily (Garry et al., 1996).

Previous research has also suggested that the ability to vividly simulate episodic events may also underpin the other three modes of prospection (e.g. Szpunar & Schacter, 2013). Although the current thesis did not investigate the other two modes of prospection, intention and planning, it is certainly reasonable to suggest that positive episodic simulation could be used to modify predictions about future intentions, in the form of personal goals. Thus, it is feasible that through the use of positive episodic

simulation, predictions about future intentions (goals) could also be modified. Future research would need to investigate this and the potential role of episodic simulation in other aspects of intentions and planning, such as the formation of goals and engagement in strategy planning.

6.4. Limitations and Future Directions

The experiments presented within this thesis have demonstrated the role of positive episodic simulation as a method of modifying predictions about future events. Most importantly, this effect was evident in individuals experiencing elevated levels of depressive symptomatology. However, despite the important implications of these findings, the experiments are not without their methodological limitations. Furthermore, whilst the experiments presented in this thesis provide novel insight into this potentially exciting area of research, they also leave a number of theoretical and practical questions unanswered and, potentially, raise a host of new questions. These limitations and remaining questions, alongside suggestions for future research, will now be discussed in turn.

6.4.1. Methodological Limitations and Improvements

Some methodological limitations of the current experiments deserve comment.

First, a potential limitation of the experiments presented here is that a power analysis was not undertaken prior to data collection. Power analysis has often been used to guide researchers as to the minimum number of participants required with software such as *g power* (Faul, Erdfelder, Lang & Buchner, 2007) becoming increasingly popular. Given that such a power analysis was not conducted here, it is possible that the experiments could have been statistically underpowered. However, the sample sizes used throughout the experiments is comparable to that found in the existing literature (e.g. Holmes et al., 2006; Holmes et al., 2008; Nelis et al., 2012). Still, future research should ensure that power is taken into consideration prior to data collection.

Second, the experiments presented here is the exclusive use of student samples, which raises potential concerns around the validity and generalisability of the sample. A student sample is known not to represent the population at large; such samples are

inherently biased in terms of age, gender, intellectual experience and social class. In particular, the sample used in Experiment 4 of this thesis recruited depressed individuals from a student population therefore; future experiments should ensure that depressed individuals are recruited from the non-student population. Recruiting participants from the non-student population would ensure that the biases mentioned previously are taken into consideration and would limit the effects of any sampling bias.

Third, although the experiments within this thesis highlight the potential utility of positive episodic simulation for prediction modification, there is little control over what people are actually imagining within the simulation tasks. It is possible that whilst some participants were focused on the task, others may not have been, or even distracted by their own thoughts. Details of the simulations were not collected; therefore, there is no way of knowing what the participants were actually imagining. It is also feasible that participants completing the simulation tasks using conceptually unrelated cues (either the F-SIT-Instructions-Unrelated or the F-SIT-Cues-Unrelated) actually engaged in related simulations by employing images of events from the predictions task. Therefore, essentially engaging in a related simulation task. This could explain why little differences were detected between the effects of related versus unrelated simulation on prediction modification. Future research should aim to gain insight into the specific content of people's images to elucidate on these issues and ensure the simulations across intervention tasks do, in fact, differ as expected.

Fourth, there was also no way of establishing whether the images generated in the different versions of the F-SIT were significantly different from those in the visualisation task on measures such as vividness and emotionality. Therefore, it would be useful to obtain ratings of the phenomenological characteristics of participants' simulations during the intervention stage (e.g. vividness, sensory detail, emotionality). Obtaining phenomenological characteristic ratings would also elucidate on potential differences in simulation abilities between depression status groups. Previous research has suggested that depressed individuals have difficulty generating vivid simulations (e.g. Anderson & Evans, 2015). This information would be useful in order to establish how much training depressed individuals would need in this simulation task, before they are able to generate vivid positive simulations with more ease. The easier it is for participants to engage in positive episodic simulation the more effective the intervention could become.

Fifth, it is possible that administering the CESD-R immediately prior to the intervention task could have primed mood and/or weakened the positive simulation manipulation. Thus, future research should administer the CESD-R at a different point in the procedure and include a filler task prior to the final prediction task. The latter would help equalise mood across the different conditions and further rule out any potential explanation that the effects found are simply a reflection of differences in state mood.

Finally, the experiments within this thesis have used explicit measures of future event predictions. As a result, there is the possibility that participants were able to ascertain the purpose of the experiments and responded accordingly. However, in Experiment 5, on completing the testing session participants were probed about the potential aims of the study; very few participants had ascertained the underlying purpose. Despite this reassurance, it would be beneficial if future research could also incorporate an implicit measure of future predictions. One possible way to do this would be to use an adapted version of the implicit measure developed by Kosnes et al., (2013); their study developed a Future Thinking - Implicit Relations Assessment Procedure (FT-IRAP). This task presented participants with a range of positive and negative stimuli preceded by either 'I expect' or 'I don't expect'. They asked participants to make true/false decisions to each item, with the speed of the response providing an indication of their implicit future expectancies. Therefore, this method could be adapted to use the positive and negative future prediction events within this thesis to provide an implicit measure of the perceived likelihood of future events. It could also be adapted further to examine other predictions, such as perceived control and importance.

6.4.2. Future Directions

The experiments presented in this thesis have demonstrated the positive effect of episodic simulation on future positive and negative events, in non-depressed, dysphoric, and depressed individuals. However, a number of unanswered questions, both theoretical and practical, remain; these questions suggest a variety of directions in which future research should be focused.

Once it was established that positive episodic simulation modified both the vividness of future events and predictions about those events, it was then important to establish whether any one method was more successful than others in eliciting these modifications. A number of the issues relating to the optimal methodology were investigated. However, a number of issues remain that future research needs to resolve. First of all, the current experiments found little difference between the use of related and unrelated cues across the F-SITs. It is feasible that these findings are accurate, whereby both forms of simulation method are in fact equally as beneficial for modifying future event predictions. However, because previous research has suggested related simulation is important for increasing plausibility ratings of future events (Szpunar & Schacter, 2013), a factor that one would expect to feed into likelihood predictions, it is necessary for future research to investigate this issue further. One reason why little difference was detected between the benefit of related and unrelated simulations within the current experiments has already been discussed. Participants who were presented with unrelated cues for simulation may have actually been engaging in related simulations; it is possible that they employed images from the Future Events Prediction Task to drive their simulations, thus effectively engaging in related simulations. Future research examining the content of simulations would help establish whether this is the case.

Experiment 4 within this thesis found that *repeatedly* simulating conceptually related material was no more beneficial than simulating material once or simulating unrelated material. This finding was surprising as it was not in line with previous research (Szpunar & Schacter, 2013); it is, therefore, in need of further investigation. One potential reason why no effect of repeated simulation was found within this thesis, could be because the link between the cue word and the event in the Future Events Prediction task may not have been clear enough. Therefore, future research should aim to make the cues more obviously related to the prediction events to see if this has any effect. Another reason why no effect was found, could be because for each simulation, using same cue, the participants may have been simulating a different event each time, and therefore not engaging in repeated simulation. Therefore, future research could also explicitly tell participants that for the same cue, they must simulate the same event. At the outset of this thesis, the theoretically driven assumption was that repeated simulation of conceptually related material would be the most beneficial method of improving prediction biases. The findings of this thesis suggested otherwise. It is potentially

exciting from a therapeutic viewpoint to suggest that simulation of unrelated material, without the need for continued repetition, might be equally useful for prediction modification; this is because it opens up more avenues for the roll out of generic interventions based on the principles of the F-SIT. However, before such a conclusion can be firmly reached, and practically employed, it is essential that the current findings are replicated and extended using methodological modifications.

The current experiments found no difference in prediction modifications as a function of the cueing technique employed to elicit positive episodic simulations; both the use of single cue words with positive instructions or using inherently positive cues appeared to be equally effective. However, the use of inherently positive cues were only used within non-depressed and dysphoric individuals. Therefore, in order to confirm that this finding extends to depression, future research should use this cueing technique in a depressed sample. This is important because, as previously discussed, the use of inherently positive cues could be the most effective intervention method for use going forward as a therapeutic technique. This is because it removes the reliance on the physical presence of a therapist; thus, it provides the potential for individuals to complete the intervention alone and, potentially, via a range of electronic devices.

One important methodological factor that was not investigated within the current thesis, but could potentially impact on the effectiveness of positive episodic simulation as a method of modifying prediction biases, is the visual perspective used for simulation. Previous research has demonstrated that imagining positive scenarios from a first person perspective (seeing it through their own eyes) led to increased positive affect; in contrast, adopting a third person perspective (seeing it through someone else's eyes) led to decreased positive affect (Holmes et al., 2008). However, other experimental research has suggested that achievement motivation is enhanced by episodic simulation using the third person perspective (Vasquez & Buehler, 2007). Thus, future research needs to compare the use of first versus third person perspective within positive episodic simulation and its impact on the modification of future event predictions.

The findings presented within this thesis raise a number of questions about the potential mechanisms underlying the effects of positive episodic simulation on prediction modification. As discussed previously, findings point to the possibility that

positive episodic simulation leads to a generalized change in either affect or optimism which, in turn, leads to changes in predictions. Whilst the findings of Experiment 5 suggest that the modifications in predictions are not merely a function of affective changes, the findings relating to the role of optimism as a potential underlying mechanism were less clear. Experiment 3 used a methodological manipulation to investigate whether a change in optimism was occurring, yet the results were somewhat difficult to explain; they neither fully supported nor refuted the proposition that changes in optimism are underlying the evidenced effects. However, it is possible the method used may not have been sensitive enough to pick up on the changes in optimism. As discussed previously, using incongruent event lists with the Future Events Prediction Task cannot fully control for potential individual differences in responses to the events across the two lists. An alternative way to measure change in optimism would be to use the Life Orientation Test (Scheier & Carver, 1985), which reflects the extent to which individuals generally expect favourable outcomes. The Life Orientation Test has been used successfully to measure changes in optimism before and after a ‘best possible selves’ intervention (Meevissen et al., 2011). Therefore, incorporating the Life Orientation Test, both pre- and post-intervention, into a future study would help elucidate whether a change in optimism is the underlying mechanism by which the modifications in future event predictions are occurring.

Cognitive theories of prospection propose that one’s ability to engage in vivid episodic simulation may underlie successful engagement in the other modes of prospection (predictions, intentions, and planning) (Szpunar et al., 2014; 2016). The findings presented within this thesis supported the idea that the effects of simulation, particularly with respect to likelihood predictions, were a function of increasing/decreasing the vividness of the mental imagery associated with the future events. As discussed in section 6.2.3, a number of theoretical arguments support the critical role that mental imagery is likely to play in this function of episodic simulation (e.g. Pearson et al., 2015; Schacter & Addis, 2007). However, the experiments within this thesis demonstrated that positive episodic simulation led to modifications in predictions that were not evident in a neutral visualisation task. This suggests that the prediction modifications evidenced are not merely a function of engaging in imagery per se. Thus, the *positive future-oriented* nature of the intervention appears to be important. However, it is not clear whether it is the positive or the future-orientated nature of the simulations, or the combination of the two, that is critical. For instance, it

could be that engaging in any positive task would have the same effect as engaging in the positive episodic simulation task. To answer this question future research would need to compare a non-imagery based positive intervention task (e.g. listening to positive music or a positive verbal task) to compare against the positive episodic simulation tasks to see whether such a task also modifies future event predictions. Additionally, further research should elucidate the importance of the future-oriented nature of the simulations. For instance, could directed recall of relevant positive episodes from the past lead to similar improvements in predictions about future events? It is possible that memory recall may not provide the same benefits as future-oriented thought; whilst research has consistently demonstrated the mood benefits of positive prospective thinking for depressed/dysphoric individuals (e.g. Blackwell & Holmes, 2010; Pictet et al., 2011; Torkan et al., 2014), evidence suggests that the same may not be true for positive memory recall. For instance, never depressed individuals can repair a sad mood by retrieving positive memories, yet this strategy was unsuccessful in formerly and currently depressed/dysphoric individuals (Joorman et al., 2004; 2007). Therefore, comparing positive episodic recall and positive episodic simulation would be an interesting avenue for future work to explore.

Previous research has also suggested that the ability to vividly simulate episodic events may also underpin the other three modes of prospection (e.g. Szpunar & Schacter, 2013). As discussed in Section 6.2.3, it is reasonable to propose that positive episodic simulation could be used to modify predictions about future intentions, in the form of personal goals. This proposition, however, requires explicit empirical investigation. Furthermore, it would, of course, be of interest to establish whether positive episodic simulation impacts on other cognitive-behavioural processes related to intentions and planning, such as the process of goal setting itself, planning goal-oriented strategies or problem-solving strategies, and motivation to engage in achievement-oriented behaviours.

The overarching aim of this thesis was to investigate the potential role of positive episodic simulation as a method of improving the biased predictions about future events that are evident in depression. Thus, the long-term purpose of such a line of research would be to develop the methods into a therapeutic tool. In order for this to occur there are a number of practical issues and questions that would require further investigation. Firstly, it would be important to investigate the longevity of the effects of

positive episodic simulation in future event predictions. None of the experiments within this thesis included any additional follow-up assessment to examine the longevity of the changes. It would be of interest to see whether after a single intervention the effects of modification maintain, or whether, in order to maintain the modifications seen, continued practice in positive episodic simulation is necessary. This may be paramount to the success of using positive episodic simulation techniques within therapy; determining the lasting effects of the simulation task on depressed individuals will ultimately show the long-term effectiveness. Furthermore, this information would also allow professionals to establish how frequently such an intervention should be carried out to ensure lasting results.

A longer-term goal would be to create a positive episodic simulation training task, possibly quite similar to the F-SIT used within the current thesis, that could be turned into an online therapeutic tool. Currently, the F-SIT is a computerized task that participants could complete by themselves if necessary. Therefore, it could be adapted into an online therapeutic tool or even, perhaps, a smart phone app. The potential utility of internet-based interventions has already been evidenced with internet-delivered cognitive-behavioural therapy (iCBT). iCBT follows the principles of traditional CBT, but is delivered via the internet rather than a CBT therapist. Studies have revealed that individuals with depression experience improvement with their depressive symptoms following online CBT-based methods (e.g. Andrews, Cuijpers, Craske, McEvoy, & Titov, 2010). In addition, it has been argued that iCBT improves access to evidence-based therapies and overcomes the prohibitive costs and lack of availability that can be associated with retaining a human therapist (Marks, Mataix-Cols, Kenwright, Cameron, Hirsch, & Gega, 2003; Musiat & Tarrier, 2014).

Finally, the experiments presented within the current thesis have focused on modifying prospection biases evident in depression and dysphoria. However, biases within prospection have also been associated with other mental health issues, such as excessive worry and anxiety. For instance, research suggests that higher levels of vividness and likelihood ratings for negative events are generally more strongly associated with symptoms of anxiety, rather than depression (e.g. Morina et al., 2011). The findings of the present thesis suggest that positive episodic simulation has the potential to impact on predictions about negative events. Therefore, it is feasible that the principles adopted in this thesis could be extended beyond the scope of

depression/dysphoria and that repeated engagement in positive episodic simulation could also modify the future prediction biases evident within anxiety.

6.5. Conclusion

The experiments presented within this thesis have shown that by simulating positive future events, modifications are evident in the vividness with which individuals envisage, and the predictions they make about, positive and negative future events. The most beneficial version of the F-SIT within this thesis, where the most modifications occurred, appeared to be the F-SIT-Instructions-Related. Following this, participants predicted positive events as more likely to occur, more controllable, more important, and rated them as more vivid. They also predicted negative events as less likely to occur, less important and rated them as less vivid, whilst predicting more control over them. Most importantly, this was also demonstrated within individuals experiencing dysphoria and depression. The current experiments are not without their limitations and further investigation is still needed to ascertain the outstanding issues relating to the optimal methodology and underlying mechanisms. However, the current findings provide novel insight into the effect of positive episodic simulation as a method of modifying predictions about future events in non-depressed, dysphoric, and depressed individuals. Most importantly, they suggest a fruitful avenue through which prospection biases within depression could be modified and, therefore, provide further evidence for the beneficial use of simulation/imagery in the treatment of depression.

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Appendix A

Positive Events	Negative Events
People will admire you	You will have a serious disagreement with a good friend
You will have lots of energy	You will feel misunderstood
You will do well on your course	You will get the blame for things going wrong
You will achieve things you set out to do	Someone close to you will reject you
You will be very fit and healthy	Things won't work out as you hoped
You will have lots of good times with friends	People will dislike you
You will be able to cope easily with pressure	People will find you dull and boring
People you meet will like you	People will think you're a failure
You'll make good and lasting friendships	You'll be excluded by friends
Your mind will be alert and "on the ball"	You'll make lots of mistakes
You will receive some good news	You will be unable to confide in anyone
You'll make a good decision	You will become tired and lethargic
You will receive praise from someone	People will make fun of you
Things will work out as you hoped	You will let someone close to you down
You will be able to solve a problem	You will be unable to cope with your responsibilities

Appendix B

Prediction Event	Related Cue
People will admire you	Admired
You will have lots of energy	Energy
You will do well on your course	Success
You will achieve things you set out to do	Achievement
You will be very fit and healthy	Healthy
You will have lots of good times with friends	Good Times
You will be able to cope easily with pressure	Cope
People you meet will like you	Liked
You'll make good and lasting friendships	Friendships
Your mind will be alert and "on the ball"	Alert
You will receive some good news	Good News
You'll make a good decision	Good Decision
You will receive praise from someone	Praised
Things will work out as you hoped	Hoped
You will be able to solve a problem	Problem Solve

Appendix C

Acknowledgement

Celebration

Develop

Fulfilment

Independence

Opportunities

Relaxed

Wealth

Career

Confident

Family

Holiday

Marriage

Proud

Stability

Appendix D

A band playing outside
Two birds sitting on a tree branch
A boat slowly crossing the Atlantic
The structure of a long bridge
A double decker bus driving down a street
They layout of a typical classroom
Clouds forming in the sky
A freshly painted door
A full moon on a clear night
A plane flying overhead
The layout of the local post office
Raindrops sliding down a window
The layout of the local shopping centre
A train stopped at a station
The shape of a large black umbrella

Appendix E

Positive Events	Negative events
You will act charitable	You will have health problems
You will receive a compliment	You will make a decision you'll regret
You will be invited out	You will be a victim of crime
You will be pleased with yourself	You will be involved in an accident
You will get your dream job	You will fall badly behind in your work
You will graduate from university with a good degree	People will get annoyed with you
You will feel happy and content	People will act hostile towards you
People will find you the "life and soul of the party"	You will feel inferior
You will win a competition	You will make an important mistake
You will be promoted	You will be ignored
You will be in a loving relationship	You will have a bitter Quarrel
You will overcome a bad habit	You will experience an academic disappointment
You will buy your dream home	An important relationship will break down
You will feel confident	You will be unable to kick a bad habit
You will have a good relationship with your children	You will lose your job

Appendix F

Unrelated Cues	Cue Scenarios
Acknowledgement	You receive acknowledgement of your hard work when you get a good grade on your coursework
Career	Your career takes a step forward when you receive the phone call offering you a job
Celebration	You will have a birthday celebration with close friends
Confident	You receive a compliment that will make you feel confident
Develop	You go on a course and develop new valuable skills
Family	You have an enjoyable day out with your family
Fulfilment	You do some voluntary work which gives you a feeling of fulfilment
Holiday	You enjoy a day at a water park whilst on holiday
Independence	You feel like you have gained independence when you start your new job
Marriage	You celebrate the golden anniversary of your marriage
Opportunities	You join a new social club that gives you opportunities to meet new people
Proud	You receive some good feedback from work that makes you feel proud of yourself
Relaxed	You spend a day at the beach, which makes you feel relaxed
Stability	You find out your temporary job becomes permanent which gives you stability
Wealth	You receive some money increasing your wealth considerably