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The effect of future thinking and emotion on false memory formation

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The effect of future thinking and emotion on false memory formation

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Abstract

Research has found that future thinking increases the number of false memories formed when compared to thinking about the past (Dewhurst et al., 2016; Dewhurst et al., 2019). Previous research, however, has not controlled for emotional valence. Therefore, the present research aimed to investigate the effect of future thinking on false memories whilst controlling for the valence of the stimuli in order to use a more ecologically valid procedure than those previously used. In Experiment 1, participants imagined past, future, or typical scenarios that were positive, negative, and neutral. Participants then rated object nouns for how likely they were to encounter those objects in the events they had imagined. Then, participants completed a recognition test for those items as well as items that were not presented, but were related to the scenarios (critical lures). Experiment 2 followed the same method, but action phrases were used as stimuli instead of object nouns. Overall, results showed no difference in the incidence of false memories after thinking about past, future, or typical events. However, results showed that there was an overall reduction in false memories after thinking about neutral events compared to positive or negative events. The null effects of future thinking on false memory may have been a result of conducting the experiments online, so future research should conduct these experiments in the laboratory to rule out this potential methodological problem. Potential explanations for the findings are discussed with relevance to adaptive theories of false memories and suggestions for future research are given.

The effect of future thinking and emotion on false memory formation

Memories of one's life events often include inaccuracies and distortions. Therefore, some life events may be remembered differently to how they actually occurred. Additionally, individuals may have memories of an event that never occurred. These are called false memories (Roediger & McDermott, 1995). False memories can be simple, 'every-day' inaccuracies (e.g. having a memory of locking the door when you did not lock it) or they could even be of bizarre events that are likely impossible (e.g. having vivid memories of alien abductions) (Clancy et al., 2002; Newman & Baumeister, 1996). An early theory suggested that false memories may develop over time due to the reconstructive nature of memory (Bartlett, 1932). The idea that memory is reconstructive suggests that true memories are generated based on one's knowledge and past experiences, rather than simply being spontaneously reproduced. Therefore, it has been suggested that some false memories may occur partially due to errors in the reconstruction of memories (Loftus, 1995).

Research has suggested that the more often a false event is thought about, the more vivid it becomes, and the more likely one is to believe that the event is true. Ceci and Huffman et al. (1994) noted this when asking children to recall true events and events that never happened over a period of 10 weeks. At the end of the 10 weeks, the children recalled these events to interviewers who did not know whether the event was true or false. It was found that the children's vividness and sincerity in telling the false stories were indistinguishable from how they told the true stores. In a replication study, the children were told after each session that the false events were actually real (Ceci & Loftus et al., 1994). They were then asked which events were real and which events were not real. It was found that as time went on, the children were more likely to believe that the false events actually occurred. Hence, this suggests that false memories may be reconstructed over time and that they become more vivid the more one thinks about them.

In addition to false memories being very vividly remembered, Ceci and Loftus et al. found that some children still believed the memory to be true, even after being told that it was false in the debrief. This phenomenon has also been found in various false memory studies with adult participants (e.g. Loftus & Pickrell, 1995). Therefore, this suggests that participants often believe that their false memories are real memories.

Spontaneous False Memories

False memories can be tested in various ways and the type of method that is used can affect the type of false memory that is produced. One prominent method is the Deese/Roediger-McDermott (DRM) paradigm (Deese, 1959; Roediger & McDermott, 1995). The DRM paradigm produces 'spontaneous' false memories. This means they occur due to normal memory processes rather than false memories being implanted by researchers (Mazzoni, 2002). In the DRM paradigm, participants

study word lists where all the words are associates of another word (referred to as the critical lure) that is not presented in the study phase. For example, a word list may contain the words ‘glass’, ‘pane’, and ‘ledge’, which all relate to the critical lure ‘window’. After studying the word lists, participants may be given free recall or recognition tests. If given a recall test, participants may incorrectly recall the critical lure (i.e. recall the word ‘window’). This would be an example of a false memory as the word ‘window’ did not appear in the study list, but the participant falsely remembered it appearing. In a recognition test, participants are presented with the old words from the studied lists as well as non-studied, critical lures. If a participant falsely recognises a critical lure as having been previously studied, this is also an example of a false memory.

In their initial study, Roediger and McDermott (1995) employed the DRM procedure and conducted both recall and recognition tests in Experiment 2. In the recall tests, participants were instructed to only recall an item if they were sure that the word had appeared previously in the studied lists. In the recognition tests, participants were asked to identify if an item previously appeared in the study lists. However, the remember-know procedure was also employed for recognition of old words that were previously presented in the study phase (Tulving, 1985). This requires participants to respond with either ‘remember’ or ‘know’ responses in the recognition test. A ‘remember’ response indicates that the participant is able to consciously recall previously seeing the item in the list and hence, are certain that the items appeared previously. A ‘know’ response indicates that participants believed that the item appeared previously, but could not consciously recall any details of seeing it appear with certainty (i.e. a feeling of familiarity of the item). It was found that both recall and recognition tests led to high levels of false memories. Additionally, it was found that participants often selected the ‘remember’ response for the critical lures. Hence, this indicates that participants had false episodic recollections of the critical lures.

Following up their initial research, McDermott and Roediger (1998) employed the DRM procedure again, but specifically warned participants of the DRM effect prior to starting the experiment. Despite this, it was found that the critical lures were still falsely recognised to a high level. Therefore, the DRM procedure has been suggested to be a valid and robust measure for investigating false memories. This view has been further supported as the DRM procedure was found to have good test-retest reliability (see Blair et al., 2002).

There are two influential theories of the DRM effect. One of these is fuzzy trace theory (FTT, Brainerd & Reyna, 2002; Reyna 1998). FTT emphasises the importance of verbatim memories (true memories representing items in the studied DRM lists) against gist memories (memories of the general theme of the DRM lists) (Reyna, 1998). FTT suggests that false memories occur when participants remember the gist of the DRM lists. Hence, they will incorrectly recall or recognise the critical lures relating to the general theme (i.e. gist) of the lists. Additionally, FTT explains how

participants may correctly reject the critical lures (i.e. respond that they have not seen the critical lure previously) (Brainerd et al., 2003). It was suggested that verbatim memories of the items in the studied lists may allow participants to make correct rejections of the critical lures. This is because participants may have true memories of items they have previously studied. These verbatim memories help participants to remember that the new, critical lure was not presented to them in the studied lists. It was suggested that participants often trust this judgement as verbatim memories tend to be more vivid than gist memories. However, it was noted that participants may vividly remember gist traces if the DRM lists are repeatedly presented to them.

An alternative explanation of the DRM effect is activation monitoring theory (AMT; Roediger & Balota et al., 2001; Roediger & Watson et al., 2001). AMT suggests that whilst studying the DRM lists, participants spontaneously generate the associated, related words (i.e. critical lures), either consciously or unconsciously. This has been suggested to occur upon first seeing the items in the DRM lists (i.e. at encoding) and potentially also when retrieving the items. The magnitude of the DRM effect is driven by backward associative strength (BAS), which is a measure of how likely the critical lure is to be generated in response to each studied item. The higher the BAS, the more likely a critical lure will be generated when the list is presented. This is because, if the critical lures are very strongly related to the themes of the DRM lists, then it is more likely that the participant will become aware of them than if the critical lures are less strongly related to the themes of the DRM lists. Hence, if the critical lures are strongly related, it is more likely that participants will falsely recall or recognise the critical lures in the testing phase of the experiment because it may lead to errors in source monitoring (Johnson et al., 1993). Errors in source monitoring may lead participants to erroneously identify or recall a critical lure as a word that was previously presented to them in the study phase. This is because the activation of the critical lures in the study phase (i.e. becoming aware of the critical lures in study) may prevent participants from remembering whether that word was actually presented to them or not (Roediger & Watson et al.). Hence, participants may misremember the source of the critical lure which may lead them to believe they saw the item during the study phase of the experiment. Therefore, it was suggested that false memories could be a result of source monitoring errors.

False Suggestion

Another widely used method of measuring false memories is through false suggestion and memory implantation studies. These experiments are more ecologically valid than the DRM procedure as they require participants to use their own imagination to generate false (and true) memories of personal life events (Miller & Gazzaniga, 1998). Therefore, the false memories formed in these experiments are different from the spontaneous type that are formed in the DRM procedure

as they occur due to researchers suggesting to participants that an event occurred in their life when in fact, it did not (Mazzoni, 2002). For example, Loftus and Pickrell (1995) gave participants four paragraphs describing events that occurred specifically in their childhood. Three of the events were true and one event was fabricated by the researchers. The false event suggested to participants was that they had become lost in a shopping mall as a child. After reading the paragraphs, participants discussed them with interviewers and provided clarity ratings for how clearly they could remember the events. Two weeks later, participants had another interview discussing the events. It was found that some participants formed false memories of getting lost in a mall as a child. As well as claiming to remember the event, participants' clarity ratings increased and participants added extra details, such as how they became lost and the features of the individual who helped them, to their descriptions of the event. Additionally, it was found that some participants still believed the event had occurred even after being debriefed. These findings indicated that false memories can be implanted by researchers and that they are often believed to be true memories by the participants.

Similar findings have been observed in studies using fake photographs of events that never happened instead of telling participants fabricated stories in order to form false memories. For example, Wade et al. (2002) photoshopped real images of participants as children into a hot air balloon and showed them the image. Then, participants were asked to recall what happened in the scenario captured by the photograph. Additionally, family members of the participants confirmed to them that the event did occur and that the photograph was genuine. After two weeks, half of the participants recalled some new information about the event, adding many details to their story from the first time they recalled what happened, suggesting that false memories had been formed. Wade et al. suggested that this could have been due to an error in source monitoring (Johnson et al., 1993) as they confused their imagination of this event for a true memory.

Following on from this, Garry and Wade (2005) wanted to compare the difference between the false memories formed as a result of false photographs used in Wade et al. (2002) to the false memories formed as a result of false narratives, as used in Loftus and Pickrell (1995). To do this, participants were either given false photographs of the hot air balloon ride or were given false narratives describing a hot air balloon ride they went on as children. It was found that those who were given narratives about the hot air balloon ride recalled more false details about the event than those who saw the photograph. So, it was suggested that both methods elicit false memories. However, being told a false narrative may lead to more false memories and more detailed false memories.

Generally, it has been suggested that in order for participants to form these types of false memories, the event the researcher would like to suggest/implant must be believable. Then, in order to form the false memory, some error in source monitoring must occur whereby the participant mistakes the false memory for a true memory (Hyman & Kleinknecht, 1999; Hyman & Loftus, 1998).

This suggests that the more believable a false event is, the more likely the participant is to mistake it for a true memory and, hence the more likely they are to form a false memory.

An additional method, similar to false suggestion, is to use 'false feedback'. In one study, Bernstein et al. (2005a) gave participants a questionnaire about their food preferences and the presented participants with 'false feedback' regarding their childhood food preferences. For example, participants were told they disliked certain foods as children (boiled eggs and pickles) as they became ill upon trying them. Then, participants were told to imagine they had been invited to a party and to rate how likely they were to select certain foods at the party. It was found that those who were given false feedback were less likely to choose the foods they were told made them ill as a child than those who were not given false feedback. This suggests that false feedback can lead to the creation of false memories which could influence future behaviour.

In a follow up study using a similar method, Bernstein et al. (2005b) investigated whether this information could be used to influence healthier eating. Participants were given false feedback indicating that they felt ill when eating strawberry ice cream for the first time. Results showed that participants were less likely to choose the ice cream in the rating task if they were told they had a negative experience with it in the past than if they were not given false feedback. Hence, it was suggested that false memories may have positive consequences as they may be used to influence healthier food choices.

This idea has been supported by various studies. For example, positive feedback indicating that individuals enjoyed healthier foods (e.g. asparagus) as children led to those individuals selecting that food over less healthy foods (Laney et al., 2008). Additionally, it has been found that negative false feedback regarding certain types of alcohol consumption can lead to a reduction in preferences towards that type of alcohol (Clifasefi et al., 2013), supporting the idea that false memories can have positive consequences for health.

In spite of findings such as this, false memories are typically associated with negative consequences. For example, in regard to the legal system and eyewitness testimonies (EWT), eyewitnesses of crimes may falsely remember some important details of the crime they have witnessed. When that false information has been reported in the past, it has led to serious, negative consequences, such as false convictions (e.g. Wells et al., 2006). It has been suggested that eyewitnesses may be susceptible to false memories partially based on the complex emotional state they are likely to experience when viewing such events (see Laney & Loftus, 2018). Therefore, factors that affect susceptibly to false memories have been widely investigated in order to understand which factors may increase susceptibly to false memories, often with the aim of applying the findings to EWT. As a result of this, a number of researchers have investigated the effect of emotion on false memories.

Emotion and Memory

There are many different emotions and it has been argued that some may be universal (Ekman, 1992; Ekman & Friesen, 1971). These emotions have been labelled 'basic emotions' (comprising of: anger, sadness, fear, disgust, enjoyment, surprise) and it has been suggested that any emotion experienced may fall into one of these categories (Ekman, 1992). Emotions last for brief moments which differentiates them from moods, which last for long periods of time (Ekman, 1984). Emotion has been studied in regard to false memories to investigate the role it plays in false memory susceptibility. Additionally, it is also added as a variable in order to increase the ecological validity of the studies. This is because individuals experience emotions when witnessing events in real life, especially in the case of traumatic events or witnessing a crime.

Generally, research has suggested that memories for events witnessed when experiencing strong emotions may be better remembered than when the events are not highly emotional (see Levine & Pizarro, 2004). Additionally, it has been argued that memory for highly emotional events tend to be particularly vivid (Conway, 1995; Thompson et al., 1996). In spite of this, these memories do not always provide accurate depictions of the events witnessed and may not be any more accurate than less emotional events (Talarico & Rubin, 2003). For example, Talarico and Rubin recorded participants' memories of the September 11 terrorist attacks one day after the attacks and then again at either one, six, or 32 weeks after the attacks. These memories were compared to participants who recalled a non-emotional event. It was found that memories for the attacks were no better remembered than for the non-emotional event. However, participants were more confident that their memories were accurate, even when providing incorrect information, than participants who recalled the non-emotional event. Additionally, the memories were rated to be more vivid for the emotional event than the non-emotional event. Therefore, it was suggested that emotional events may not enhance memory in comparison to non-emotional events, but emotion may increase confidence in one's memories, whether or not they are true.

Memories for witnessing highly emotional events have also been investigated over longer intervals. For example, Hirst et al. (2015) analysed the accuracy of memories for the September 11 attacks over a period of 10 years and it was found that these memories included inaccuracies that remained over time. However, memories of the events were found to be consistent over time and were perceived as very vivid by participants, even if the memories included inaccuracies. Although, it was found that some of the inaccuracies could be corrected upon watching true documentaries or listening to true media accounts of the event. Despite this, the true memories were found to be vividly remembered over time, suggesting that highly emotional events may lead to very vivid memories. However, this experiment did not compare the findings to memory for a non-emotional event. So, it

would be difficult to conclude whether or not emotion enhanced memory over time in comparison to regular, neutral events.

Similar memory enhancements for emotional words, rather than life events, have also been investigated. For example, Kensinger and Corkin (2003) investigated the memory and vividness for negative, compared to neutral, words. In Experiment 1, participants studied word lists containing negative and neutral words and then rated the words for their imaginability (i.e. whether the words were concrete or abstract). Then, participants completed a recognition test for the items using the 'remember-know' procedure (Tulving, 1985). It was found that more negative words were correctly recognised than neutral words and that participants correctly made more 'remember' responses to negative items compared to neutral items. So, it was suggested that the increase in correct 'remember' responses for negative stimuli compared to neutral stimuli indicated that participants remembered the negative stimuli more vividly than the neutral stimuli. Experiment 2 investigated whether this increased vividness of negative items compared to neutral items specifically leads to a memory enhancement. To do this, the same method to their first experiment was used, but the source memory (i.e. the context in which the participants saw the words) for the items was investigated by presenting the items in either blue or red font colour. Therefore, participant also had to indicate the colour of the word in the recognition test. Again, more negative items were correctly recognised than neutral items. Although, participants better remembered the colour of the negative items compared to the neutral items, suggesting that there was also a memory enhancement for the details (i.e. source) of the stimuli. The findings of the two experiments suggested that emotional stimuli may not simply increase the perceived vividness of the stimuli, but may also enhance memory for more specific details of the stimuli in comparison to neutral stimuli. Additional research has since supported these findings as a memory enhancement for negative over neutral stimuli has been consistently reported in true memory research (Kensinger, 2007). Therefore, it has been suggested that this negativity effect for true memory may be robust within true memory research.

Emotion and False Memories

Due to the powerful effects of emotion on true memories, a body of researchers have investigated the effects of emotion on false memories. One way this has been investigated is through the use of emotional DRM lists (e.g. Budson et al., 2006; Kensinger & Corkin, 2004; Pesta et al., 2001). For example, El Sharkawy et al. (2008) gave participants negatively valanced or neutral DRM lists to study. Then, participants completed free recall or recognition tests for the previously studied DRM lists. The recognition tests included old and new (critical lures) items. It was found that participants falsely recognised or recalled more critical lures for the negative DRM lists than for the neutral DRM lists. Therefore, it was suggested that emotionally valanced stimuli may increase

susceptibly to false memories. This was suggested to be consistent with activation monitoring theory (Roediger & Balota et al., 2001; Roediger & Watson et al., 2001). This is because one may make stronger associations between the words in the emotional DRM lists than in the neutral DRM lists because they are associated emotionally as well as semantically. This increases the likelihood of false memories as a result of source monitoring errors. Additional research has also found an overall increase in false memories as a result of emotionally valanced DRM lists (e.g. Brainerd et al., 2008, Chang et al., 2020).

However, research that has investigated emotion and false memory has often utilised different procedures to the DRM procedure in order to increase the ecological validity of the experiments. This is because the DRM procedure produces false memory of emotional words and objects, but individuals often think about emotional events that have occurred in their life rather than emotional words associated with those events. Therefore, research investigating emotion and false memories has often used paradigms that involve memory for emotional events rather than lists. This is partially because there have been many instances reported of false eyewitness testimonies (Laney & Loftus, 2018), which typically involve memories of emotional events. So, research investigating false memory and emotion has largely focused on using more ecologically valid procedures than the DRM procedure in order to apply the findings to the legal system. However, when investigating memory for emotional events, such as witnessing crimes, it has been shown that false memories may only be increased for certain aspects of the events, rather than an overall increase in false memories for emotional events (Christianson & Loftus, 1987). Easterbrook (1959) suggested that 'attentional narrowing' may occur when witnessing emotional events, such as crimes. This means that attention focuses on the main focal point of the event (referred to as 'central details') and as a result, does not focus on the smaller details (referred to as 'peripheral details') as they seem less important. Therefore, false memories for emotional events may be more likely to occur for peripheral details, rather than central details of the events, as they may be more prone to false suggestion (e.g. Deffenbacher et al., 2004).

Research has provided evidence for the Easterbrook hypothesis using laboratory studies and real-life case studies investigating memory for emotional events. For example, Yuille and Cutshall (1986) investigated the memory of real eyewitnesses to a shooting which caused serious injury and death. Witnesses were interviewed four months after the event and their accounts were compared to police reports taken at the time of the event. It was found that witnesses had excellent memory for the central details of the crime (such as the types of wounds the individuals acquired), but had poor memory for the peripheral details of the crime (such as the type of clothes the individuals involved were wearing). This supports the hypothesis that emotional events can impair memory for peripheral details of an event, but can enhance memories for the central details of the event. However, this study

investigated the memory of real eyewitnesses, so there was no comparison made to non-emotional events. Therefore, it could not be concluded from this study that emotional events may enhance or impair memory more than for a neutral event.

In order to address this, Christianson and Loftus (1987) compared memory for central and peripheral details for both emotional and neutral events. Participants were presented with a set of slides showing either a negative event (where a boy was hit by a car) or a neutral event (where the boy was simply walking alongside the car). Results showed that those who saw the negative event recalled more accurate central details of the slides than peripheral details. This was found to be the same when given a recognition test instead of a recall test. So, it was suggested that memory may be enhanced by emotion for the central details of an event, but it may be impaired by emotion for the peripheral details of the event. However, it was suggested that memory may only appear better for the emotional event because it was more unusual than the neutral event. So, it could not be suggested that memory was enhanced or impaired in the emotional condition more than the neutral condition purely based on emotion because the distinctiveness of the events was not controlled for.

As a result of this, Christianson and Loftus (1991) ran a series of experiments to build upon their previous research, but controlled for the distinctiveness of the events. Participants were split into three groups, with all groups being shown a set of slides of a regular walk down a street, with one critical slide that changed depending on the group the participants were in. In the neutral group, the critical slide showed a woman on a bicycle with a car in the background. Those in the negative group were instead shown a slide depicting a woman bleeding from her head next to a bicycle, again with a car in the background. Finally, the 'unusual' group were shown a critical slide showing a woman carrying the bicycle on her shoulder, again with a car in the background. Participants were given a recall test where they were shown the critical slides with the woman and car edited out of them and had to add in the missing details.

Across the experiments, it was found that participants in the emotional condition recalled more central details than those in the unusual and neutral conditions. Hence, suggesting that memory for central details may be enhanced by emotion, rather than the enhancement being simply due to distinctiveness. Additionally, it was suggested that those in the emotional condition may be better at recalling the central details of the event because they may have felt concerned for the injured woman. So, it was suggested that participants may have paid more attention to her than in the neutral and unusual condition, supporting Easterbrook's (1959) hypothesis of attentional narrowing for emotional events. However, it was found that participants in the emotional and unusual conditions were equally as poor at recalling the peripheral details of the event, whereas those in the neutral condition recalled the peripheral details better than those in the emotional and unusual conditions. From this, it was

suggested that memory may be enhanced by emotion for the central details of an event, but emotion and the distinctiveness of the event may both impair memory for the peripheral details of the event.

More specifically investigating false memories, Porter et al. (2003) conducted a similar study to Christianson and Loftus (1991), but investigated the effect of emotion on the misinformation effect. The misinformation effect is whereby incorrect or misleading information given to an individual after witnessing an event often leads to an impairment in memory for certain aspects of the event that was originally witnessed (Loftus, 1979; Pickrell et al., 2016). In order to investigate the effect of emotion on the misinformation effect, Porter et al., gave participants either positive, negative, or neutral photographs depicting different scenes, in which the negative emotional condition showed a photograph of a fatal accident. Participants were then given misinformation suggesting that an object (e.g. a car or animal) was present in the background of the photographs. Participants were also given inaccurate information regarding items that were present in the photographs. Overall, it was found that those given misinformation were more likely than those who were not given misinformation to recall false information. Amongst the participants who were given the misinformation, those in the negative emotional condition were twice as likely to falsely recall objects that were not present in the scene than those in the positive and neutral conditions. Therefore, it was suggested that those in the negative emotional condition focused more on the central details of the photographs and did not attend as much to the details in the background of the photographs, making them more susceptible to the misinformation effect regarding peripheral information. In contrast, those in the positive and neutral conditions may have looked at both the central and background information in the photographs, making those participants less susceptible to the misinformation effect regarding peripheral information.

In a follow up study, Porter et al. (2010) investigated whether this effect remained one week or one month after receiving misinformation about positive or negatively valanced photographs. Again, it was found that there was an overall effect for those who received misinformation for both positive and negative valence. In addition, it was found that those in the negative emotional condition were the most susceptible to the misinformation effect. It was also found that this effect lasted one month after receiving the misinformation, indicating that negative emotion can increase susceptibility to false memories over longer retention intervals. However, negative emotion did not lead to an enhancement in true memory for participants who did not receive any misinformation, which is at odds with prior studies suggesting a memory enhancement for emotional stimuli (e.g. Christianson & Loftus, 1991; Yuille & Cutshall, 1986). However, Porter et al. suggested that this may be because all photographs were similar in emotional arousal, suggesting that any form of emotional arousal can enhance correct recall of emotional information rather than negative emotion alone.

More recent studies have investigated the effect of emotional arousal compared to emotional valence of stimuli in regard to false memories. For example, Van Damme and Smets (2014) investigated the effects of emotional arousal and emotional valence in the misinformation effect in order to understand which factors affect susceptibility to false memories. Participants were given photographs depicting positive, negative, or neutral events and the emotional arousal levels were controlled for (either high or low arousal). Half of the participants were then given misinformation regarding the images. Supporting prior research, it was found that those in the negative valence condition (as well as those who viewed emotionally ambiguous photographs) had more impairments in memory for the peripheral details of the photographs. Additionally, there was a greater amount of false memories for the peripheral details for those in the negative condition compared to those in the positive or neutral conditions. This occurred regardless of whether participants were given misinformation. Furthermore, it was found that participants in the negative valence and high arousal conditions were the least likely to falsely recall central details of the photographs. This supports prior research showing a memory enhancement for central details and an impairment of peripheral details. However, when participants were given misinformation, the memory-enhancing effect of negative valence and high arousal was no longer present as it was found that memory for the central details was impaired and participants in those conditions were the most susceptible to false memories. Hence, it was suggested that being given misinformation may overcome the memory-enhancing effect of negative emotion and arousal for central details of the photographs.

Bookbinder and Brainerd (2016) reviewed the literature on emotional valence and emotional arousal for research using a range of methods (e.g. the DRM paradigm, false photographs, memory implantation studies, and the misinformation effect). It was found that across these studies, the findings suggested a general increase in false memories in response to negative stimuli. Additionally, it was found that positive emotion may increase false memory production over neutral stimuli, but this effect was less consistently seen in the literature. For true memory, a general impairment in memory was found, but a few studies did find a memory enhancement for negative stimuli over neutral and positive stimuli. However, Bookbinder and Brainerd noted that it is difficult to assume that the effects seen, particularly the effects on true memory, are purely a result of emotional valence. This is because they suggested that previous literature has not consistently controlled for emotional arousal in their experiments. So, it was unclear whether the trends seen were the results of emotional valence, emotional arousal, or both.

Addressing this, Bookbinder and Brainerd (2017) investigated the effect of emotion on false memory, whilst controlling for both emotional arousal and valence. Participants were shown positive, negative, or neutral photographs and were then given recognition tests regarding those photographs. It was found that negative photographs elicited more false memories than positive or neutral

photographs. However, it was found that high emotional arousal may not contribute to this effect as the same findings were shown even with moderate arousal levels. Hence, it was suggested that negative valence alone may increase susceptibly to false memories. For true memory, it was found that memory was enhanced for negative stimuli more than for positive or neutral stimuli, which was seen regardless of the level of emotional arousal. Therefore, it was suggested that emotional valence may be more important than arousal in determining susceptibility to false memories and potentially also for the enhancement of true memory. This provides additional evidence for the general trend that negative emotional valence may increase false memory susceptibility, but it also provides evidence that negative emotion may enhance true memory rather than impairing it.

Adaptive False Memories

Another variable that has been investigated in regard to false memory susceptibility is that of individual traits. It has been suggested that individuals who have certain traits, such as expertise and creativity, may be at a heightened risk for false memories compared to individuals who do not show those traits. For example, Castel et al. (2007) investigated false memories in individuals who were experts in the topic of American football compared to individuals who were not experts in that area. To do this, participants studied lists of animals, whereby the animals in the lists were also the names of popular American football clubs. Participants also studied control lists of comprising of names of body parts. Participants then completed a recall test for both word lists. The experts at American football recalled more items from the animal study list than the non-experts. However, it was found that those who had expert knowledge of American football incorrectly recalled a greater number of animals than those who were not experts. However, there was no difference in the amount of falsely recalled items in the control lists comprising of the names of body parts. Therefore, it was suggested that experts may be at increased risk of false memories in comparison to non-experts in regard to their area of expertise.

Furthermore, research has also investigated the trait of creativity in regard to false memory susceptibly (Dewhurst et al., 2011). For examples, participants completed two tasks that required problem solving. One task was to complete a remote associate task (RAT), whereby individuals read three words that are all related to one other word (e.g. ‘petrol’, ‘bus’, and ‘train’ are all related to the word ‘station’) (Mednick, 1962). The second task was an alternative use task (AUT), whereby participants noted down as many possible different uses for an object (in this case, the object was a brick) (Guilford, 1967). Participants studied DRM lists and completed a recognition test for the items in the lists. It was found that those who performed the best in the RAT falsely recognised the most critical lures. However, the performance on the AUT did not affect the false recognition rate. Dewhurst et al., concluded that false recognition was predicted by the RAT, but not by the AUT

because both the DRM procedure and the RAT rely on the generation of semantic associates. Therefore, it was suggested that the creativity of an individual may affect the amount of falsely recognised critical lures as those who were most creative (via the best performance on the RAT) falsely recognised the most critical lures. This further suggests that positive factors (i.e. creativity) could lead to a potentially negative increase in false memories.

However, there has been emerging evidence suggesting that false memories may not solely have negative consequences as it has been suggested that false memories may have adaptive purposes. For example, Howe and Derbish (2010) asked participants to imagine events relating to survival and rate a list of items for their relevance to survival. A second group of participants were asked to rate a list of items for pleasantness. The word lists used were similar to those used in the DRM procedure. Then participants were given a recognition test comprised of words they had previously rated, as well as critical lures. It was found that those who rated items for survival falsely recognised more critical lures than those who rated items for pleasantness. Additionally, participants who rated items for survival showed enhanced true memory in comparison to those who rated items for pleasantness, supporting prior research showing a memory enhancement as a result of survival ratings (Nairne et al., 2007). Therefore, it was suggested that survival may increase both true and false memory. Furthermore, Howe and Derbish used activation theories of false memories (such as AMT) to argue that false memories (or the processes that are thought to cause false memories) may be adaptive. For example, it was suggested that rating items for survival may lead to the activation of other, relevant information (that is already known by the individual) that could be useful in a survival scenario. As a result of this, it was suggested that false memories themselves could be adaptive. To illustrate this, Howe and Derbish gave the example that one may mistakenly attribute a predator's markings (e.g. footprints) at a watering hole for actually seeing the predator there. So, a false memory of seeing a predator at that watering hole may be beneficial for survival as one may be more careful if they were to go to the same watering hole in the future. Therefore, it is possible that false memories may have an adaptive purpose.

Further research has investigated specific advantages as a result of false memories and it has been suggested that false memories may aid in problem solving (e.g. Howe et al., 2011; Howe et al., 2010). For example, Howe et al. (2011) investigated whether false memories could provide advantages when completing problem solving tasks. For example, both children and adults studied DRM lists, followed by a recall test for the items in the lists. Then, participants completed remote associate tasks (Mednick, 1962). However, the critical lures of the DRM lists presented in the study phase were the answers to the tasks. It was found that those who reported the critical lures in the recall test were quicker at solving the tasks and produced more correct answers than those who did not have false memories of the critical lures from the DRM lists. As a result of this, it was suggested that false

memories may be adaptive as the findings showed that they aided in problem solving and this was evidenced in both children and adults. Since, additional studies have replicated this effect, suggesting that this finding may be robust (e.g. Howe & Garner, 2018; Howe et al., 2013; Otgaar et al., 2015). Therefore, these findings contribute to the idea that false memories can have some advantages and that these advantages may be adaptive

As a result of the developing view that false memories may be adaptive, additional research has investigated other factors, such as future thinking, that may influence susceptibility to true and false memories. Tulving (1983) named the ability to think about one's past 'mental time travel' as individuals feel as if they are re-experiencing the remembered event. Therefore, mental time travel allows one to retrieve memories experienced in the past. According to Tulving, mental time travel can also occur when thinking about potential future events. Thinking about the future involves the planning and anticipation of events that may unfold in the future. Therefore, it has been suggested that future thinking may provide an adaptive advantage as anticipating future events may be useful in survival scenarios as it would allow one time to prepare for the anticipated event (Suddendorf & Corballis, 2007).

This adaptive advantage of future thinking has been investigated in various studies. For example, in Nairne et al. (2007) study, participants either imagined a survival scenario (being stranded in the grasslands of a foreign country) or imagined a simple future event (moving house). Participants then rated items in a word list for their relevance to the event they had imagined and were then given a recall test for those items. It was found that those who imagined the survival scenario recalled more words than those who imagined moving house. So, it was suggested that survival ratings may lead to a memory enhancement, which could provide an adaptive advantage.

Contrastingly, additional studies have suggested that planning for the future could be more important than survival for a potential memory enhancement. For example, Klein et al. (2010) asked participants to remember a past, future or typical camping trip, or imagine a camping trip that includes an element of survival. Participants then rated word lists for their relevance to the events they had just imagined and completed a recall test for the items in those word lists. It was found that those who imagined a survival scenario recalled more items than those who simply remembered a camping trip they previously went on. In contrast, those who planned for a future camping trip recalled more items than those who imagined a survival scenario and those who imagined past or typical camping trip. Hence, this finding was at odds with prior research (e.g. Nairne et al.) as it suggested that planning for the future may be more important than simply imagining survival scenarios.

To address this more specifically, Klein et al. (2011) used a similar method to Klein et al. (2010) and compared a purely planning scenario (a dinner party), to a purely survival scenario (stranded in the grasslands), and a survival scenario that also included elements of planning (stranded

in the grasslands with the requirement to find food). It was found that those in the planning and survival-plus-planning conditions recalled more words than those in the survival condition. Therefore, it was suggested that planning for future events may be more important than survival alone for the memory enhancement effects seen in previous research. Additionally, Klein et al. suggested that the results provide evidence that memory may be 'future orientated' in nature and that it may have evolved this way to allow individuals to plan for survival-related future events.

As this memory enhancement for true memory was found as a result of future thinking and future planning, research has investigated the effect of future thinking on false memory, rather than true memory. For example, Dewhurst et al. (2016) asked participants to imagine a past or future event, that either included, or did not include, elements of planning. Then, participants were presented with DRM lists and rated how relevant the items in the list were to the event they had previously imagined. A third group simply rated items in the lists for pleasantness, without first imagining a past or future event. Participants were then given a recall test. It was found that those who imagined future events falsely recalled more critical lures than those who imagined past events (for both planning and no planning conditions) and those who rated items for pleasantness. In the second experiment, participants completed a recognition test for the items in the DRM lists and the findings were replicated. However, neither experiment found any effect of future thinking on true memory. It was suggested that this may have been a result of using the DRM procedure. For example, the item lists in used in the DRM procedure ensure that the items are greatly associated with each other as the intention is to create false memories of the critical lures in the recognition/recall test. So, Dewhurst et al. speculated that the high relatedness of the items in the DRM lists may have overshadowed any effects of future thinking on correct recognition that has been seen in previous research investigating solely true memory and future thinking (e.g. Klein et al., 2010). Therefore, additional research has been conducted in order to understand if the effects of future thinking on false and true memory extend to more ecologically valid methods than the DRM procedure.

One study used the imagination inflation procedure (Garry et al., 1996) to investigate whether thinking about the future could lead to false memories (Calvillo et al., 2019). Participants were given a list of various life events to rate whether or not they had experienced them on a certainty scale of one to six. In a second session, participants imagined four events (half positive, half negative) that they had previously noted that they had not experienced before. There was also a control group who did not imagine any events. Participants then rated the initial list of events again and noted whether or not they had experienced the events using the same certainty scale. Calvillo et al., included both positive and negative events, but found no effects of emotional valence, therefore valence was excluded from their analyses. It was found that imagining events as occurring in the past or future led to increased ratings of certainty that participants had actually experienced the events compared to

those who did not imagine any events. Therefore, it was suggested that imagining an event as occurring in the future led to false memories of having previously experienced an event. This is consistent with Dewhurst et al., who found an increase in false memories after thinking about the future compared to those who did not think about past or future events. However, inconsistent with the results of Dewhurst et al., there was no difference between the number of false memories between those who imagined past events and those who imagined future events. Despite the null effect of temporal direction, Calvillo et al. did show that future thinking can lead to false memories when using a more ecologically valid procedure than the DRM procedure.

In a more direct follow up study to their prior research, Dewhurst et al. (2019) used a schema-based experimental procedure to investigate the effect of future thinking on false memories in order to use a more ecologically valid method than the DRM procedure. In Experiment 1, participants imagined future scenarios, typical scenarios, or remembered past scenarios and then studied lists of items that were related or unrelated those scenarios. Participants rated the items for their relevance to the scenarios they had just imagined and then completed a recognition test comprising of old items from the studied lists and new items that were consistent with the scenarios (i.e. critical lures). It was found that participants in the future condition falsely recognised more new items than those in the past and typical conditions. This suggests that future thinking can increase false memories when using more ecologically valid methods than the DRM procedure. Furthermore, no effect on true memory was found, consistent with the findings of Dewhurst et al. (2016). However, Dewhurst et al. noted that it could be possible that the increase in false memories for the future condition may have been a result of simulation, rather than thinking about the future. For example, it could have been possible that the differences seen may have been a result of those in the future condition having to simulate the event, whereas those in the past condition did not as they simply remember it occurring. Therefore, the simulation of an event could have been the reason for the increase in false memories in the future condition, rather than thinking about the future itself.

To address this, Dewhurst et al. second experiment investigated the effect of future thinking on false memories for events that all needed to be simulated. To do this, the same method as Experiment 1 was used, but the scenarios the participants imagined were all unfamiliar events that would not have been experienced before (e.g. robbing a bank). As with Experiment 1, it was found that more critical lures were falsely recognised in the future condition compared to the past condition. Additionally, there were also no effects of the temporal group on correct recognition of the old items. Therefore, it was suggested that the increase in false memories as a result of future thinking is not simply due to those in the future conditions having to simulate an event compared to remembering an event. Dewhurst et al. suggested that this increase in false memories after thinking about the future could be adaptive and gave a suggestion that was in line with an activation monitoring account of

false memory. For example, thinking about the future could lead one's attention to objects that could be useful in a future scenario. Dewhurst et al. noted that when planning for events, such as holidays, individuals often think about objects that they may require on the holiday. So, it was suggested that it could be adaptive to falsely remember related items to the items in one's list because they may be of use in the future.

To investigate this more specifically, Dewhurst et al. third experiment required participants to think about past, future, or typical holidays and rate the items for the likelihood that they would see those objects on the holiday. Then, participants wrote down as many objects as they could that they would take on a holiday. It was found that those who thought about a future event listed more objects that did not appear in the study list compared to those who thought about past and typical events. Therefore, the results were consistent with the suggestion that future thinking may help one to think of items that one may have initially forgotten about, but may need in a future scenario. So, it was suggested that the seen increase in false memories for those in the future condition may be an adaptive advantage. Overall, it was suggested that the findings of the three experiments support the adaptive theory of false memories as it may be adaptive to falsely remember items that may be of use in a future scenario.

The Present Research

The aim of the current research was to extend the findings of Dewhurst et al. (2019) and further explore the relationship between future thinking and false memories. Two experiments will explore this relationship from two different directions. Experiment 1 aims to follow on from Dewhurst et al. (2019) using a more ecologically valid paradigm. To do this, the emotional valence of the events will be controlled for. This is important in order to increase the ecological validity of the research as emotions are usually experienced when thinking about life events. Additionally, previous research has not fully considered the effects of emotional valence on future thinking and false memories. So, it is important to investigate how emotional valence affects false memories as a in regard to future thinking. Therefore, Experiment 1 will follow a similar method to Dewhurst et al., but will require participants to imagine past, typical, and future events that are positive, negative, and neutral in emotional valence. Following this, participants will rate a list of object nouns for relevance to the event they have just imagined. Lastly, participants will complete a recognition test consisting of old and new items, including critical lures that are related to the remembered/imagined events.

Based on the findings of Dewhurst et al., it is expected that participants in the future thinking condition will falsely recognise more critical lures than those in the past or typical conditions. Additionally, emotion and false memory literature has found a general increase in false memories for negative over neutral stimuli (Bookbinder & Brainerd, 2016). Therefore, it is hypothesised that

participants imagining negative events will falsely recognise more critical lures than those imagining neutral events, regardless of temporal condition. It is also hypothesised that these effects may be additive, whereby the highest levels of false recognition will be observed for lures after imagining negative events in the future condition. As recent research has found an enhancement in correct memory for negative stimuli over neutral stimuli (Bookbinder & Brainerd, 2017), it is also expected that there will be more correctly recognised items after imagining negative events compared to positive or neutral events.

Experiment 2 will extend the research of Dewhurst et al. (2019) by investigating whether the effect of future thinking on false memory occurs with other aspects of an imagined event. Participants in Experiment 2 will rate a list of action phrases instead of a list of object nouns. Additionally, participants will imagine the events with reference to the things they may do in those scenarios, rather than imagining the items they may see. Investigating the effect of future thinking on action phrases should provide additional insight into the effect of future thinking on false memory as events do not simply consist of objects, they also consist of actions. That is, when individuals think about events that have or will occur, they may also think about actions that they have carried out or will carry out. Therefore, investigating false memory for actions would also increase the ecological validity of the experiments and hence, could help to provide a clearer depiction of the effect of future thinking on false memories. Therefore, the main aim of Experiment 2 is to investigate whether the effects on false memory and future thinking extend to action phrases.

It is predicted that the effects of temporal direction and emotion seen in Experiment 1 will also be observed in Experiment 2.

Experiment 1

Method

Participants

157 participants (*M* age = 21.9; *SD* = 5.49; 126 female) were first and second year undergraduate students, at the University of Hull, and were all native English speakers. Participants were recruited via an advertisement on the University's research participant system, Sona. Participants were awarded one course credit as compensation for their participation, which is required for completion of one of their undergraduate modules.

Stimuli

All stimuli were generated by the author and supervisor and were based upon the stimuli used in Dewhurst et al. (2019) experiment. Six paragraphs provided instructions for participants to imagine two positive events (going on holiday; having a picnic), two negative events (trip to the hospital; taking an exam one is unprepared for), and two neutral events (supermarket trip; train journey). Each of the six events were phrased in three different ways to reflect the temporal condition participants were placed in. This means participants either received instructions to remember the events as occurring in the past or the future. A third set of participants received instructions to imagine a typical event, that had no reference to the past or future. Examples of instructions for one past, future, and typical event that are positive, negative, or neutral in emotional valence are provided below. For examples of each set of instructions for all scenarios, see Appendix A.

Past condition, with positive emotional valence emphasised

Think back and remember a time in your past when you went on a beach holiday abroad. Remember how excited you were when you arrived and what a fantastic time you had. Think about the fun things you did, the people you met, the wonderful weather, and so on. Please spend a few moments remembering this holiday. While you are remembering this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it was that each of these items was at the holiday you remember. For some items, it may be very likely that they were there. For others, it may be unlikely. It is up to you to decide.

Future condition, with negative emotional valence emphasised

Think ahead and imagine a time in your future when you have to stay in hospital. Imagine that you feel very worried. Think about the pain you might experience, how lonely you will feel, the boredom, and so on. Please spend a few moments imagining your time in hospital. While you are imagining this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that each of the items will be at the hospital. For some

items, it may be very likely that they will be there. For others, it may be unlikely. It is up to you to decide.

Typical condition, with neutral valence

Use your imagination to form a picture of a supermarket. What items appear in the image that you have created of the supermarket? While you are imagining this supermarket, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that each of these items is at the supermarket that you have imagined. For some items, it may be very likely that they appear in your image. For others, it may be unlikely. It is up to you to decide.

Each event was accompanied by a list of object nouns. Each list comprised items that were related or unrelated to the event the participant had just imagined. For the event of 'holiday', a related item was 'sunblock' and an unrelated item was 'hammer'. There were 10 related items and four unrelated items per event in the study phase of the experiment. In the testing phase of the experiments, participants were presented with a total of 84 object nouns, half of which were previously shown in the study phase ('old' items) and half of which were not previously shown in the study phase ('new' items). A total of 30 'old' items (five per event) were related to the six events and 12 'old' items (two per event) were unrelated to the six events. The remaining items comprised of 30 'new-related' items (five per event) and 12 'new-unrelated' items (two per event). An example of a new-related item for the holiday scenario was 'suitcase' and these items were the critical lures (see Appendix B).

Ethical Considerations

Participants were required to think about negative life events; going to the hospital and taking an exam they were unprepared for. This could have led some participants to become upset. Participants were warned of this prior to starting the experiment in the participant information sheet (see Appendix C). If participants thought this would be a problem, they had the option to choose not to take part. However, in case they became upset during or after the experiment, contact details for the University's wellbeing services, as well as external wellbeing services (the Samaritans), were provided in the debrief form (see Appendix D).

After reading the information sheet and deciding to take part, participants gave informed consent, indicated by the completion of the consent form prior to starting the experiment (see Appendix E). The consent form and information sheet noted that participants were free to withdraw from the experiment at any time without having to provide a reason. However, participants were informed that they could not withdraw their data after completion of the experiment as the data would be anonymised upon completion.

This experiment required some deception as participants were not informed in advance of the recognition test. This deception was required so that participants engaged with the rating task rather than intentionally trying to remember the items presented to them during this task. This was explained to participants after completion of the experiment in the debrief form.

Design and Procedure

The experiment's design and procedure were based upon that of Dewhurst et al. (2019), with the addition of a valence manipulation. The present experiment employed a 3 (temporal condition: past, future, typical) x 3 (emotional valence: positive, negative, neutral) x 2 (rating type: related, unrelated) mixed factorial design. Temporal condition was manipulated between groups, but the remaining two factors were manipulated within groups. The order in which participants imagined the emotional scenarios was counterbalanced. One half of participants firstly imagined the positive scenarios, followed by neutral and then negative scenarios. The second half of participants firstly imagined the negative scenarios, followed by the neutral and then positive scenarios.

The experiment was programmed in PsychoPy and conducted online via Pavlovia. After participants were recruited, they were able to click on a link that took them to the consent form prior to starting the experiment. After completing the consent form, participants were automatically directed to the experiment. Participants were randomly allocated to one of three temporal conditions which required them to think about either past, future, or typical events. Participants were instructed to think about six life events, two for each emotional valence type (positive, negative, neutral). If participants were instructed to remember a past event that they had not personally experienced, they were instructed to imagine that they had experienced such an event. Participants were instructed to remember or imagine their first scenario. Afterwards, they were presented with the first set of object nouns, and rated the likelihood that the objects would appear in the event they had just remembered or imagined on a scale of one (not very likely) to five (very likely). Items were presented one by one and remained on screen for five seconds, regardless of the participants' response time. Participants repeated this cycle for the remaining five scenarios. After each scenario had been imagined and the object nouns rated, participants completed a distractor task comprising of simple mathematical sums that lasted until all sums had been completed or stopped after five minutes. Then, participants completed the surprise recognition test that included the presentation of 'old' and 'new' items, presented one at a time. Participants indicated, via simple keypress, whether an item was 'old' ('z' key) or 'new' ('m' key). Upon responding, the item disappeared and the next item was presented. When a participant incorrectly recognised a critical lure as an 'old' item, it was noted as a false alarm and this represented a false memory. Upon completion of the recognition test, participants read the debrief form and received their course credit.

Results

Four participants were removed from the sample due to recognition rates at chance level. Therefore, a total of 153 participants were included in the analyses, with n = 55 in the past condition, n = 46 in the typical condition, and n = 52 in the future condition. Numbers of falsely recognised critical lures and correctly recognised old items were all subject to separate 3 (temporal group: past, typical, future) x 3 (emotional valence: positive, negative, neutral) mixed ANOVA's, with temporal group manipulated between groups. All pairwise comparisons were Bonferroni adjusted.

False Recognition

For the means and standard deviations for the levels of falsely recognised critical lures, see Table 1.

Table 1. *Means and standard deviations showing the amount of falsely recognised critical lures for each emotional valence and temporal group (a maximum false recognition rate of 10 per category)*.

	Positive		Negative		Neutral	
Temporal Group	M	SD	M	SD	M	SD
Past	1.26	1.32	1.66	1.66	2.38	1.78
Typical	1.24	1.61	1.37	1.08	1.93	1.25
Future	1.83	1.94	1.56	1.64	2.04	1.90

For false recognition rates, results showed that the main effect of temporal group was not significant, $F(2, 150) = .718$, $p = .489$, $\eta_p^2 = .009$. However, the main effect of emotional valence was significant, $F(2, 150) = 15.08$, $p < .001$, $\eta_p^2 = .091$. Pairwise comparisons showed a significantly greater amount of falsely recognised critical lures after imagining neutral events ($M = 2.12$, $SD = 1.68$) compared to positive ($M = 1.44$, $SD = 1.65$) and negative ($M = 1.53$, $SD = 1.50$) events, both p's $<.001$. However, there was no difference between the amount of falsely recognised critical lures after imagining positive and negative events, $p = 1.00$. The interaction between temporal group and emotional valence was not significant, $F(4, 150) = 2.194$, $p = .070$, $\eta_p^2 = .028$. Therefore, results are contrary to the prediction that there would be an increase in false memories in the future condition

compared to the past and typical conditions and that there would be an overall negativity effect for false memories.

A one way, between-subjects ANOVA was conducted to analyse the effect of Temporal Group on the false recognition of unrelated lures. There were slightly more falsely recognised unrelated lures in the future condition ($M = 1.13$, $SD = 2.19$) compared to the past condition ($M = .855$, $SD = 2.14$) and the typical condition ($M = .848$, $SD = 1.23$). However, this main effect of temporal group was not significant, $F(2, 150) = .523$, $p = .594$, $\eta_p^2 = .007$, indicating that temporal group did not significantly affect false recognition rates of unrelated lures.

Correct Recognition

For correct recognition rates, the means and standard deviations of related and unrelated object nouns are presented in Table 2.

Table 2. *Means and standard deviations showing the amount of correctly recognised 'old' words for each emotional valence type and temporal group. There was a maximum of 10 related items and four unrelated items per category.*

	Positive		Negative		Neutral	
			Related			
Temporal Group	M	SD	M	SD	M	SD
Past	8.96	1.45	9.20	1.42	9.25	1.07
Typical	8.94	1.14	9.41	1.00	9.00	1.14
Future	8.91	1.52	9.56	.850	8.90	1.59
			Unrelated			
Past	3.40	.993	3.45	.741	3.51	.663
Typical	3.35	.849	3.70	.662	3.48	.888
Future	3.39	.690	3.67	.585	3.58	.723

For old-related items that were correctly recognised, the main effect of temporal group was not significant, $F(2, 150) = .022$, $p = .978$, $\eta_p^2 = .000$, but the main effect of emotional valence was significant, $F(2, 150) = 12.70$, $p < .001$, $\eta_p^2 = .078$. Pairwise comparisons showed a significantly

greater number of correctly recognised items after imagining negative events (M = 9.39, SD = .850) compared to positive events (M = 8.91, SD = 1.38), p <.001. Additionally, there were more correctly recognised items after imagining negative events compared to neutral events (M = 9.05, SD = 1.29), p = .002. However, there was no difference between the amount of correctly recognised items after imagining positive and neutral events, p = .425.

The interaction between temporal group and emotional valence was significant $F(4, 150)$ = 2.518, p = .041, η_p^2 = .032. Further investigating this, pairwise comparisons showed that, for the future temporal condition, there were more correctly recognised items after imagining negative events than positive events, p <.001 and neutral events, p = .002. However, there was no difference between the recognition of items after imagining positive and neutral events, p = 1.00. In the typical temporal condition, more items were correctly recognised after imagining negative events than positive events, p = .025. However, there was no difference between the level of correctly recognised items after imagining negative and neutral events, p = .068 or between positive and neutral events, p = 1.00. In the past condition, there was no difference between the levels of correctly recognised items between any emotional valence type, all p's >.05. Therefore, these results are partially in support of the prediction that there would be more correctly recognised items after imagining negative events than positive and neutral events. However, they are also slightly contrary to this prediction as the negativity effect was only seen in the typical and future temporal groups, rather than across all groups as expected.

When analysing the correct recognition rates for the unrelated, old items, the main effect of temporal group was not significant, $F(2, 150)$ = .341, p = .711, η_p^2 = .005, However, the main effect of emotional valence was significant, $F(2, 150)$ = 5.268, p = .006, η_p^2 = .034. Pairwise comparisons showed significantly more old unrelated items were correctly recognised after imagining negative events (M = 3.61, SD = .672) compared to positive events (M = 3.38, SD = .851), p = .005. However, there was no difference in correct recognition for items after imagining negative and neutral events (M = 3.52, SD = .753), p = .666 or between positive and neutral events, p = .149. The interaction between emotional valence and temporal group was not significant, $F(4, 150)$ = .975, p = .421, η_p^2 = .013.

Study Ratings

The preliminary analysis for the study ratings was a 3 (temporal group: past, typical, future) x 3 (emotional valence; positive, negative, neutral) x 2 (rating type: related, unrelated) mixed ANOVA, with temporal group as the between-subjects factor. To analyse these ratings, four participants were excluded from the analyses as some of their responses were not recorded due to a program error. Therefore, the total sample size was 153, with n = 56 in the past condition, n = 47 in the typical condition, and n = 50 in the future condition. The preliminary analysis showed a significant main effect of relatedness, $F(1, 150) = 5135.77$, $p < .001$, $\eta_p^2 = .972$, indicating that participants thought that the related items ($M = 3.84$, $SD = .539$) were more related to the scenarios they had just imagined than the unrelated items ($M = 1.29$, $SD = .345$).

Subsequent analyses focused on related items, so a 3 x 3 mixed ANOVA was conducted to analyse the effects of temporal group and emotional valence on the participant ratings. The main effect of temporal group was not significant $F(2, 150) = .047$, $p = .954$, $\eta_p^2 = .001$. However, the main effect of emotional valence was significant, $F(2, 150) = 90.19$, $p < .001$, $\eta_p^2 = .375$. Pairwise comparisons showed that the items related to negative events ($M = 4.12$, $SD = .458$) were rated as more related than items related to the neutral ($M = 3.93$, $SD = .565$) and positive ($M = 3.48$, $SD = .596$) events, both p's <.001. Additionally, the items related to neutral events were rated as more related than the items related to the positive events, $p < .001$. However, the interaction between temporal group and emotional valence was not significant, $F(4, 150) = 1.815$, $p = .126$, $\eta_p^2 = .024$.

Discussion

The aim of Experiment 1 was to extend Dewhurst et al. (2019) study by investigating the effect of future thinking on false memories when using a more ecologically valid procedure. To do this, a similar method was used, but the emotional valence of the events participants imagined was manipulated in the present experiment. As it was based on Dewhurst et al. study, it was predicted that there would similarly be a greater number of falsely recognised critical lures when participants imagined future events over imagining past or typical events. However, this hypothesis was not supported as there was no difference between the three temporal groups in the number of falsely recognised critical lures. The present finding also differs from Dewhurst et al. (2016), who found an increase in false memories for those who thought about future events, compared to past or atemporal events, when using the DRM procedure. Therefore, the present findings are at odds with previous literature investigating false memories and future thinking.

However, this null finding is consistent with Calvillo et al. (2019), who used the imagination inflation procedure to investigate future thinking and false memories. Participants rated a list of scenarios for their certainty that they had experienced the scenarios previously in their lives. Two weeks later, participants imagined some of those events with reference to them occurring in the past or future. Then, they rated the same list of scenarios to see whether the certainty ratings increased after imagining the events. It was found that both imagining a future event and remembering a past event led to increased certainty that an event had been previously experienced by participants when they initially indicated that the events had not been experienced. Therefore, this suggests that participants had a false memory of having experienced the events. However, there was no difference between those who remembered past events and those who imagined future events in the levels of certainty ratings, suggesting there was no increase in false memories formed for those who imagined future events compared to those who imagined past events. Therefore, these findings are consistent with the present research as the present experiment also found no increase in false memories after imagining future events compared to remembering past events. However, it should be noted that Calvillo et al. used a very different paradigm to the present research and that the type of false memories produced in their study were different to the type produced in the present research. For example, participants in Calvillo et al. study produced false memories of events, whereas participants in the present experiment produced more spontaneous false memories of object nouns. As a result of this, it cannot be suggested that future thinking does not lead to more false memories than thinking about the past solely based on the findings of the present experiment and Calvillo et al. experiment. As there is a limited amount of research investigating the effect of future thinking on false memories, much more research should investigate this effect using various paradigms in order to observe a clearer pattern of results.

Another possibility for the lack of replication of Dewhurst et al. results could have been due to the inclusion of emotional valence as a factor. Emotional valence was controlled for in this experiment in order to add ecological validity to the experiment. So, it could be considered that in a more ecologically valid procedure like this one, future thinking may not lead to an increase in false memories over thinking about past or typical events. Although, if this was true, there still should have been an effect of temporal group after imagining the neutral events. However, this was not the case. Therefore, it is unlikely that the null effects of temporal group were a result of the inclusion of emotional valence. Potential explanations for these null effects will be described in the general discussion.

For the effect of temporal group on correct recognition rates, results were consistent with previous literature as no effects of temporal group on correct recognition were found (Dewhurst et al., 2016; Dewhurst et al., 2019). Therefore, this suggests that temporal group may not affect correct

recognition rates. Hence, these findings provide additional evidence that correct recognition may not be affected by imagining past, typical, or future events. However, this is at odds with some literature investigating future thinking and solely true memory. For example, Klein et al. (2010) found that imagining future events led to an increase in correct recognition rates compared to imagining past or atemporal events. An explanation for this difference will be considered in the general discussion.

Another prediction for the present experiment was that there would be a negativity effect on false memory. Previous false memory literature that has investigated emotional valence tended to find an increase in false memories for negative stimuli compared to neutral stimuli (see Bookbinder & Brainerd, 2016). So, it was predicted that there would be a greater number of critical lures falsely recognised after imagining negative events compared to neutral and positive events. However, this hypothesis was not supported as it was found that more critical lures were falsely recognised after imagining neutral events compared to positive or negative events.

This finding is, however consistent with a small amount of literature investigating emotion and false memories that found a reduction in false memories for emotional stimuli compared to neutral stimuli (e.g. Choi et al., 2013; Kensinger & Corkin, 2004; Pesta et al., 2001). For example, Choi et al. asked participants to study positive, negative, or neutral items. Then, participants completed a recognition test for those items after either 30 minutes (Experiment 1) or 24 hours (Experiment 2). No difference in the amount of false recognition was found between any of the emotional conditions for the 30 minute retention period. However, after 24 hours, participants falsely recognised more neutral stimuli than negative stimuli. Choi et al. suggested that the emotional stimuli could have been more distinctive than the neutral stimuli which may have led participants to have a better memory of the emotional stimuli than the neutral stimuli. So, it was suggested that participants were less susceptible to false memories for emotional stimuli in comparison to neutral stimuli. Therefore, the findings of the present experiment could be explained in a similar manner. Participants in the present experiment may have better remembered the items in the study lists after imagining emotional events compared to neutral events due to the emotional events being the most distinct. This would be consistent with the 'recollection-rejection' strategy proposed by Brainerd et al. (2003), whereby participants can reject a critical lure by recollecting the studied items. Hence, the better memory for the items after imagining emotional events may have made participants less susceptible to false memories after imagining the emotional events compared to neutral events. This provides a potential explanation for why there was a greater amount of false memories after imagining neutral events compared to emotional events in the present experiment.

One potential limitation that should be noted in regard to emotional valence was that the participant relatedness ratings of the study items were not equal. This study required participants to rate the items for the levels of relatedness to the scenarios they had just imagined. Ideally, these

ratings of relatedness would be the same across each emotional valence type in order to avoid the potentially confounding effects that may occur (Bessette-Symons, 2018). For example, if one emotional valence type is rated as more related as another, it is possible that any effects of emotional valence on false memory may instead be a result of relatedness, rather than emotional valence. However, the increase in false memories after imagining neutral events compared to negative events seen in the present experiment may not be a result of relatedness ratings as there was an increase in relatedness ratings after imagining negative, not neutral, events. So, if the results were due to relatedness alone, the greatest increase in false memories should have been for stimuli after imagining negative, not neutral, events. Therefore, this suggests that the increase in false memories for stimuli after imagining neutral events may be a result of emotional valence rather than participants' relatedness ratings. Hence, the findings of the present study support Choi et al. (2013) suggestion that emotional stimuli may reduce false memories in comparison to neutral stimuli due to the emotional stimuli being more memorable and distinctive.

Previous research investigating false memories has found inconsistent results concerning emotional valence and true memory. So, it was uncertain as to whether or not there would be an effect of emotional valence on correct recognition. However, the present study found an overall increase in the correct recognition of study items after imagining negative events compared to neutral events. The general increase in correct recognition for stimuli after imagining negative events over positive and neutral events supports a large amount of research investigating the effect of emotion on true memory. For example, early research has found an enhancement in memory for negative events over neutral events (for central details of the events) (e.g. Christianson & Loftus 1987, 1991; Yuille & Cutshall, 1986). It has since been suggested that this negativity effect has been well established amongst a variety of research using various paradigms (see Kengsinger, 2007). However, contradictory research has found no differences between true memory and emotion valence (e.g. El Sharkway et al., 2008; Porter et al., 2010; Van Damme & Smets, 2014). Due to these contrary findings, Bookbinder and Brainerd (2016) reviewed a body of emotion and false memory research. They suggested that the mixed findings regarding true memory for negative stimuli within false memory research is unclear and may be a result of differing procedures and a lack of control for certain variables, such as emotional arousal. So, Bookbinder and Brainerd (2017) created a procedure that controlled for variables that had been inconsistently controlled for in previous literature (e.g. emotional arousal). In this well controlled study, they found an increase in true memory for negative stimuli over positive and neutral stimuli. Therefore, the correct recognition findings of the present study are consistent with recent literature investigating false memory and emotion (e.g. Bookbinder & Brainerd, 2017).

Together, the effects of emotional valence on true and false recognition found in the present study are also consistent with Choi et al. (2013). As explained previously, Choi et al. found a greater number of false memories for neutral stimuli compared to emotional stimuli. In the same study, there was also a greater number of correctly recognised negative, compared to neutral, stimuli. Choi et al. suggested that an increased distinctiveness for emotional stimuli compared to neutral stimuli would both increase true memory (as the stimuli would be better remembered) and reduce false memory for emotional stimuli. Therefore, this distinctiveness explanation posited by Choi et al. could also account for why the present study found an increase in the number of correctly recognised items after imagining negative events, but also found a decrease in false memories after imagining emotional events.

Further explanations of the present experiment's results will be considered in the general discussion. Prior to this, Experiment 2 will be presented. It will follow on from Dewhurst et al. (2019) in another direction. The same method as the present experiment will be used, but the object noun stimuli will be replaced with phrases describing actions. Therefore, the aim of Experiment 2 is to investigate whether the effects of future thinking on false memory seen in Dewhurst et al. study extend to action phrases.

Experiment 2

Research investigating memory for action phrases has largely investigated the enactment effect (Cohen, 1981; Engelkamp & Krumnacker, 1980). This suggests a memory enhancement for action phrases when they are acted out by the participant (or an enacted phrase is viewed by the participant) compared to action phrases that are simply read or listened to. In these studies, participants are generally given a list of action phrases to read, enact, or view the experimenter enact (e.g. Engelkamp & Jahn, 2003; Engelkamp & Krumnacker, 1980). Then, participants are given recognition or recall tests for those items. It is often found that participants remember more action phrases when they acted out the phrases themselves compared to viewing someone else acting them out, or simply reading or listening to them (Engelkamp, 1998; Engelkamp & Zimmer, 2001). The enactment effect has also been shown to be present in children from the ages of four to 11 (Hainselin et al., 2017; Yang & Wang, 2020), suggesting that this effect could be present regardless of age. As the enactment effect has been consistently replicated in both children and adults, the effect has been suggested to be robust.

However, some research has suggested that the enactment effect may also lead to inaccuracies in other aspects of memory for the action phrases. For example, Hornstein and Mulligan (2004) presented participants with a list of action phrases and participants either acted the phrases out themselves (with or without their eyes closed), watched themselves perform the action in front of a mirror, or watched the phrases being acted out by the experimenter. Then, participants were asked to indicate the source of the action phrase (i.e. if they performed it or the experimenter performed it) or whether the action phrase was new (not previously seen in study). It was found that performing the action themselves (for all enactment conditions) led to an enhancement in memory for the action phrases compared to viewing the experimenter perform the action. Despite this memory enhancement for the action phrases themselves, it was found that participants also made errors in remembering the correct source of the action phrases. For each enactment condition, it was found that participants made errors in remembering whether the action phrase was performed by themselves or by the experimenter. However, it was found that participants who viewed themselves performing the actions in front of a mirror were more likely to make source errors than participants who simply viewed the experimenters perform the actions. Therefore, it was suggested that source memory for actions enacted by the participants may be impaired. Additional studies have since investigated memory for the source of the action phrases using similar paradigms and have reported similar impairments in source memory for the enacted phrases (e.g. Ianì et al., 2019; Lange et al., 2017).

Impairments in memory for the source of an item has often been used in explanations for the formation of false memories (e.g. Johnson et al., 1993). Despite this, research has not specifically investigated false memories for action phrases in the enactment effect. However, different research

has investigated false memories for actions themselves, such as in imagination inflation procedures (Garry et al., 1996; Goff & Roediger, 1998).

False Memory for Actions

In the Introduction (see Page 5), memory implantation studies, such as 'lost in the mall' procedures (Loftus & Pickrell, 1995) were described. Such studies provide evidence that false memories for one's own life events can be produced (i.e. one may gain a false memory of being lost in a shopping mall as a child). Adding on to this line of research, 'imagination inflation' procedures have been used to investigate whether imagining an event occurring can lead to false memories of those events (Garry et al., 1996). For example, Garry et al. gave participants a list of various childhood events (e.g. 'gave someone a haircut', 'broke a window with your hand') and were asked to rate whether or not they had experienced each event as a child. Participants also rated how certain they were that they either had or had not experienced the event. Two weeks later, participants were instructed to imagine four of the events as vividly as possible. Afterwards, they were given the same list of items again to rate whether or not they experienced the events as children. It was found that after imagining the events, participants who initially rated an event as having not occurred were more likely to rate the event as having occurred compared to participants who did not imagine the events. Therefore, this suggests that false memories of personal life events can be produced. Garry et al. named the effect 'imagination inflation', whereby the repeated imagination of an event may lead to false memories of that event having actually occurred. However, a problem with this procedure was that there was no way of knowing whether or not the events did occur to the participants as children. It could have been possible that participants rated a low likelihood of the event occurring in the initial phase of the experiment, but later realised that the event truly occurred. So, the effect may have been in part due to participants remembering the event, rather than falsely producing a memory of the event.

As a result of this, Goff and Roediger (1998) adapted this procedure to ensure that the memories participants produced were actually false. To do this, Goff and Roediger investigated false memories for actions. In this experiment, participants were firstly presented with a list of common actions (e.g. 'flip a coin') that they either listened to, performed, or imagined performing the actions. In another session, participants were provided with another list of actions; some of which were old and some of which were new (i.e. not previously presented to them in the first session). Participants then imagined performing these actions only once, or multiple times. In another session, participants were given a recognition test for the list of action phrases and identified how the action phrase was initially encoded in the first session (listened to, performed, or imagined performing). It was found that the more participants imagined performing the actions, the more likely they were to falsely report

remembering carrying out the action in the first session when they did not. So, it was suggested that repeated imagination of carrying out an action can lead to a false memory of initially performing the action. Hence, it supported the 'imagination inflation' work of Garry et al. (1998), whilst ensuring that the false memories produced were truly false as the actions that were and were not performed were known by the researchers.

This finding was replicated in a follow up study using a similar method, conducted by Thomas and Loftus (2002). However, Thomas and Loftus also included bizarre actions that one would not normally carry out (e.g. 'kiss the magnifying glass') as well as for common actions. It was found that participants reported carrying out both common and bizarre actions. Participants also reported previously performing actions that were 'new' (i.e. not presented in the first session). Therefore, it was suggested that imagining performing actions can lead to false memories for common and uncommon actions. This has more recently been supported by Li et al. (2020), who used a similar procedure and replicated the results. It was suggested that this effect may be a result of source monitoring errors (Johnson et al., 1993). For example, repeated imagination of an action may have led participants to mistake the imagination of the action for having actually performed it, leading to false memories for having performed those actions.

Following on from Thomas and Loftus (2002), research has investigated whether imagination inflation occurs for bizarre actions when using this procedure outside of laboratory settings (Seamon et al., 2006). Seamon et al. used a similar procedure to Thomas and Loftus, but conducted the experiment whilst participants were going on a familiar walk around their University's campus. In addition to imagining themselves perform the actions, a different group of participants either watched or imagined the researcher perform the actions. The imagination inflation effect was replicated for both bizarre and regular events, supporting prior research. It was also found that imagining the researcher perform the action led to false memories of the researcher carrying out the action for both bizarre and common actions. Additionally, there was no difference between the false recollection of those who performed or imagined themselves performing actions compared to those who viewed or imagined the researcher perform the actions. Hence, it was suggested that the imagination inflation effect may extend to imagining others perform actions in real life settings.

Furthermore, Linder and Echterhoff (2015) investigated whether imagining the researcher performing an action could lead to false memories of oneself performing the action. Linder and Echterhoff used the imagination inflation procedure, but participants also imagined someone else performing the action. It was found that imagining another individual performing the actions led to the same pattern of results found when the individual imagines themselves performing the actions. That is, imagining another individual performing the actions lead to the participants generating a false memory of themselves performing the action. Hence, it was suggested that imagining carrying out an

action can lead to false memories; both for actions that are imagined in regard to the self and in regard to another individual. Furthermore, as this imagination inflation effect has been consistently reproduced over the years, it has been suggested to be a robust effect (Li et al., 2020; Linder & Echterhoff, 2015).

Aims and Hypotheses

As mentioned in the introduction, Experiment 2 aims to investigate whether the false memory effects reported by Dewhurst et al. (2019) extend to stimuli other than object nouns because individuals often think about the things they do when imagining life events. Therefore, the present experiment will use the same design and method as Experiment 1 but, the object noun stimuli will be replaced with phrases describing actions. As the same design as Experiment 1 will be used, the effect of future thinking and emotional valence on false memories will also be investigated for action phrases. To my knowledge, this would be the first study investigating the effect of future thinking on false memories for action phrases.

As prior research has found memory impairments for the source of action phrases (e.g. Hornstein & Mulligan, 2004) and that false memories can occur for actions themselves (e.g. Goff & Roediger, 1998), it is expected that false memories for action phrases using the present experimental paradigm will occur in a similar manner that they occur when object nouns are used. Therefore, if the false memory effects reported by Dewhurst et al. (2019) extend from object nouns to action phrases, it is predicted that there will be a greater amount of false memories in the future thinking condition compared to the past or typical conditions. Based on the findings and predictions of Experiment 1, it is also predicted that there will be more correctly and falsely recognised action phrases after imagining negative events compared to positive or neutral events.

Method

Participants

105 participants (*M* age = 26.8, *SD* = 10.3; 63 female) were recruited via Prolific, a psychology research participation system. Participants were UK students, native English speakers, and UK residents. As compensation, participants received payment at a rate of £6 per hour.

Stimuli

The stimuli for Experiment 2 were very similar to Experiment 1, but with some modifications to emphasise action phrases rather than object nouns. Participants were given instructions to imagine the same six events as Experiment 1, but they were instead instructed to imagine the events with reference to the actions they may complete, rather than imagining the objects they may see. Again, these instructions were adapted from Dewhurst et al. (2019) instructions. For examples of the instructions for one past, future, and typical condition with either positive, negative, or neutral emotional valence emphasised, see below. For the entire set of instructions, see Appendix F.

Past condition, with positive emotional valence emphasised

Think back and remember a time in your past when you went on a beach holiday abroad. Remember how excited you were when you arrived and what a fantastic time you had. Think about the fun things you did, the people you met, the wonderful weather, and so on. Please spend a few moments remembering this holiday. While you are remembering this experience, I am going to present you with a list of words describing actions that you may or may not have performed on this holiday. I would like you to rate how likely it was that each of these actions occurred on this holiday. For some actions, it may be very likely that they happened. For others, it may be unlikely. It is up to you to decide.

Future condition, with negative emotional valence emphasised

Think ahead and imagine a time in your future when you have to stay in hospital. Imagine that you feel very worried. Think about the pain you might experience, how lonely you will feel, the boredom, and so on. Please spend a few moments imagining your time in hospital. While you are imagining this experience, I am going to present you with a list of phrases describing actions you may or may not perform at the hospital. I would like you to rate how likely it is that each of these actions will occur. For some actions, it may be very likely that they will happen. For others, it may be unlikely. It is up to you to decide.

Typical condition, with neutral valence

Use your imagination to form a picture of a supermarket. What happens in the image that you have created of the supermarket? While you are imagining this supermarket, I am going to present

you with a list of phrases describing actions that you may or may not carry out at a supermarket. I would like you to rate how likely it is that each of these actions occurs at a typical supermarket. For some actions, it may be very likely that they happen. For others, it may be unlikely. It is up to you to decide.

Additionally, the stimuli for the rating task and recognition test were adapted to include action phrases rather than object nouns. For example, for the event of 'holiday', a critical lure was 'pack suitcase' rather than simply 'suitcase' (see Appendix G).

Ethical Considerations

Ethical considerations were the same as Experiment 1, but contained slight changes to the wellbeing contact information in the debrief form (See Appendix H). Experiment 1 provided contact details to the University's wellbeing services as well as external services. However, the sample of Experiment 2 did not contain individuals from the University of Hull. Therefore, this contact detail was removed and replaced with the contact details of external wellbeing services, such as Samaritans and MIND.

Design and Procedure

Experiment 2 followed the same study design and method as Experiment 1, with some slight modifications. The design was a 3 (temporal condition: past, typical, future) x 3 (emotional valence: positive, negative, neutral) x 2 (rating type: related, unrelated) mixed design that followed the same format and procedure as Experiment 1. The main modifications were made to the stimuli. For example, participants similarly imagined the events in reference to one temporal condition and to each emotional valence type, but these events were imagined with reference to the actions they might perform in those scenarios, rather than the objects they might see. Then, participants rated a list of action phrases for the likelihood that they would carry out those actions within the events they had just imagined on a scale of 1 (not very likely) to 5 (very likely). After a mathematical filler task, they completed the recognition test comprising of 'old' and 'new' action phrases that were either related or unrelated to the six events they had imagined in study. After completion of the experiment, participants read the debrief form and received payment, rather than course credit, for their contribution.

Results

In order to analyse the levels of correct and false recognition of the action phrases, one participant was removed due to recognition rates at the chance level. A total of 104 participants were included in these analyses, with n = 26 in the past condition, in the n = 35 in the typical condition, and n = 43 in the future condition. As with Experiment 1, the numbers of falsely recognised critical lures and numbers of correctly recognised old action phrases were subject to separate 3 (temporal group: past, typical, future) x 3 (emotional valence: positive, negative, neutral) mixed ANOVA's, with temporal group manipulated between-subjects. All pairwise comparisons were Bonferroni corrected.

False Recognition

For the means and standard deviations for the levels of falsely recognised critical lures, see Table 3.

Table 3. *Means and standard deviation showing the amount of falsely recognised critical lures for each emotional valence and temporal group (with a maximum false recognition rate of 10 per category).*

	Positive		Negative		Neutral	
Temporal Group	M	SD	M	SD	M	SD
Past	3.08	1.67	2.15	1.80	4.08	2.12
Typical	2.74	1.44	2.77	1.61	4.00	2.30
Future	2.44	1.50	3.19	1.59	3.58	2.11

For false recognition rates, the main effect of temporal group was not significant, F (2, 101) = .048, p = .953, η_p^2 = .001. However, the main effect of emotional valence was significant, F(2, 101) = 25.45, p <.001, η_p^2 = .201. Pairwise comparisons showed significantly more falsely recognised critical lures after imagining neutral events (M = 3.89, SD = 2.18) compared to positive (M = 2.75, SD = 1.53) and negative (M = 2.70, SD = 1.66) events, both p's <.001. However, there was no difference between the amount of falsely recognised critical lures after imagining positive and negative events, p = 1.00.

The interaction between emotional valence and temporal group was significant, $F(4, 101) = 4.07$, $p = .004$, $\eta_p^2 = .075$. Pairwise comparisons for emotional valence showed that, in the past condition, there was an increase in falsely recognised critical lures after imagining neutral events compared to positive events, $p = .022$ and negative events, $p < .001$. There was also an increase in the number of falsely recognised lures after imagining positive events compared to negative events, $p = .025$. In the typical condition, there was an increase in the number of falsely recognised lures after imagining neutral over positive events, $p < .001$ and negative events, $p = .001$. There was no difference between the number of falsely recognised lures in the typical condition after imagining positive and negative events, p = 1.00. In the future condition, there was an increase in the number of falsely recognised lures for negative over positive events, $p = .019$. There was also an increase in the number of falsely recognised lures after imagining neutral over positive events, $p < .001$, but no difference between neutral and negative events, $p = 1.00$. These results were largely contrary to the prediction that there would be an increase in the amount of falsely recognised critical lures for negative over neutral events as the opposite was seen in the past and typical temporal groups. However, the prediction was slightly supported in the future condition, as there was an increase in the number of falsely recognised critical lures after imagining negative events compared to positive events.

Additionally, pairwise comparisons for temporal group showed a significant increase in falsely recognised critical lures in the future condition over the past condition for negative emotional events, $P = .041$. However, there was no significant difference between the number of falsely recognised critical lures in the future condition compared to the typical condition, $p = .820$ or between the typical and past conditions, $p = .457$ for negative events. No other pairwise comparisons were significant, indicating that there was only an increase in false memories for the future thinking condition compared to the past condition for negative events, rather than across all emotional valence types. This slightly supports the prediction that there would be an increase in false memories for those in the future thinking condition compared to the past or typical conditions. However, the results are contrary to the prediction that this would be seen across all emotional valence types.

As with Experiment 1, a One-way, between-subjects ANOVA was conducted to analyse the effect of Temporal Group on the false recognition of unrelated lures. There were slightly more falsely recognised unrelated lures in the past condition ($M = 1.50$, $SD = 1.58$) compared to the future condition ($M = 1.35$, $SD = 1.63$) and the typical condition ($M = 1.30$, $SD = 1.38$), but this main effect of temporal group was not significant, $F(2, 101) = .149$, $p = .862$, $\eta_p^2 = .003$.

Correct Recognition

For correct recognition rates, the means and standard deviations of related and unrelated action phrases are presented in Table 4.

Table 4. *Means and standard deviations showing the amount of correctly recognised 'old' action phrases for each emotional valence type and temporal group. There was a maximum of 10 related items and four unrelated items per category.*

	Positive		Negative		Neutral	
			Related			
Temporal Group	M	SD	M	SD	M	SD
Past	8.85	1.12	9.00	.98	9.15	1.26
Typical	8.91	1.15	8.94	1.1	9.00	1.09
Future	8.56	1.59	8.77	1.34	8.91	1.25
			Unrelated			
Past	2.58	.945	2.69	.928	2.58	1.10
Typical	2.74	1.04	2.83	.985	2.63	1.26
Future	2.63	1.13	2.81	1.05	2.86	1.01

For correct recognition of related action phrases, the main effect of temporal group was not significant, $F(2, 101) = .783$, $p = .460$, $\eta_p^2 = .015$. The main effect of emotional valence was also not significant, $F(2, 101) = 1.51$, $p = .223$, $\eta_p^2 = .015$, and neither was the interaction between emotional valence and temporal group, $F(4, 101) = .188$, $p = .945$, $\eta_p^2 = .004$. Therefore, these results go against the prediction that there would be an increase in correct recognition rates for action phrases after imagining negative events compared to positive and neutral events as emotional valence did not affect correct recognition rates of old-related action phrases.

For correct recognition rates of old-unrelated items, the main effect of temporal group was not significant, $F(2, 101) = .332$, $p = .718$, $\eta_p^2 = .007$. Additionally, the main effect of emotional valence was not significant, $F(2, 101) = .533$, $p = .587$, $\eta_p^2 = .005$ and neither was the interaction

between emotional valence and temporal group, $F(4, 101) = .394$, $p = .813$, $\eta_p^2 = .008$. Again, this indicates that temporal group and emotion valence did not affect the levels of correctly recognised unrelated action phrases.

Study Ratings

The preliminary analysis for participant study ratings used a 3 (temporal group: past, typical, future) x 3 (emotional valence; positive, negative, neutral) x 2 (rating type: related, unrelated) mixed ANOVA, with temporal group as the between-subjects factor. Three participants' responses were removed from the analyses due to a program error. Therefore, the total sample size was 102, with n = 26 participants in the past condition, n = 34 in the typical condition, and n = 42 in the future condition. Results showed a significant main effect of relatedness, $F(1, 99) = 4719.9$, $p < .001$, $\eta_p^2 = .979$. Hence, indicating that participants thought that the related action phrases ($M = 4.26$, $SD = .496$) were more related to the scenarios than the unrelated action phrases ($M = 1.14$, $SD = .322$).

Subsequent analyses focused on related items, therefore a 3 x 3 mixed ANOVA was used to analyse the effects of temporal group and emotional valence on the participant ratings. The main effect of temporal group was significant, $F(2, 99) = 4.475$, $p = .014$, $\eta_p^2 = .083$. Pairwise comparisons showed significantly higher ratings in the future condition ($M = 4.15$, $SD = .640$) compared to the typical condition ($M = 4.40$, $SD = .580$), $p = .012$. However, there was no difference in ratings between the typical and past conditions ($M = 4.25$, $SD = .730$), $p = .915$ or the past and future conditions, $p = .304$.

For the factor of emotional valence, Mauchly's test was significant, so the values were read from the Greenhouse-Geisser correction, $X^2(2) = 29.336$, $p < .001$. The main effect of emotional valence was significant, $F(1.59, 99) = 30.601$, $p < .001$, $\eta_p^2 = .236$. Pairwise comparisons showed significantly higher ratings for action phrases related to negative ($M = 4.49$, $SD = .374$) compared to positive ($M = 4.04$, $SD = .630$) and neutral ($M = 4.26$, $SD = .475$) events, both p's $< .001$. Additionally, there were significantly higher ratings for action phrases related to neutral over positive events, $p = .005$.

The interaction between emotional valence and temporal group was also significant, $F(3.18, 99) = 3.385$, $p = .018$, $\eta_p^2 = .064$. Pairwise comparisons for emotional valence showed that, in the past condition, there were significantly higher ratings for the action phrases related to negative ($M = 4.55$, $SD = .334$) events compared to positive ($M = 4.02$, $SD = .664$) and neutral events ($M = 4.16$, $SD = .629$), both p's $< .001$. However, there was no difference between ratings of action phrases related

to positive and neutral events, p = .906. In the typical condition, there were higher ratings for action phrases related to negative events (M = 4.30, SD = .443) compared to positive (M = 3.84, SD = .652) events, p <.001. There were also higher ratings for action phrases related to neutral (M = 4.30, SD = .380) compared to positive events, p <.001. However, there was no difference in ratings between action phrases related to negative and neutral events, p = 1.00. In the future condition, there were higher ratings for action phrases related to negative (M = 4.61, SD = .305) events compared to positive (M = 4.26, SD = .558) and neutral (M = 4.32, SD = .403) events, both p's <.001. However, there was no difference ratings between action phrases related to positive and neutral events, p = 1.00.

Pairwise comparisons of temporal group showed that, for positive events, there were higher ratings in the future condition compared to the typical condition, p = .011 but, not more than the past condition, p = .374. There was also no difference between the typical and past conditions, p = .761. For negative events, there were higher ratings in the past condition compared to the typical condition, p = .026 and higher ratings in the future condition compared to the typical condition, p = .001. However, there was no difference between the ratings in the past and future conditions, p = 1.00. For neutral events, there was no significant difference between ratings in the past, typical, or future conditions, all p's >.05.

Discussion

Experiment 2 investigated the effect of future thinking on false memory when action phrases were used as stimuli instead of object nouns. As it followed on from Dewhurst et al. (2019), it was similarly predicted that there would be a greater number of false memories in the future thinking condition compared to the past and typical conditions. Also, it was predicted that there would be an increase in false and correct recognition for action phrases after imagining negative events compared to positive and neutral events. However, another aim of the present experiment was to investigate whether false memories could be produced when using action phrases as stimuli. This is because no prior research investigating the effect of future thinking on false memories have used stimuli other than object nouns in their experiments. As false memories were produced, it suggests that false memories of action phrases can be formed when using the present experimental paradigm.

However, the main aim of Experiment 2 was to investigate whether the previously seen effects of future thinking on false memory would extend to action phrases. This was partially supported. Previous literature has found an increase in false memories for those who think about future events compared to past or atemporal events (Dewhurst et al., 2016; Dewhurst et al., 2019). However, Experiment 2 found an increase in false memories for the future condition over the past condition, but only for negative emotionally valanced stimuli. This is slightly discrepant with previous research as prior research has investigated the effect of future thinking on false memories, but without

emphasising the emotional valence. So, the present experiment should have found an effect of temporal group for the neutral stimuli as well. A speculative explanation for why there was only an effect of temporal group for negative stimuli will be considered in the general discussion.

For correct recognition rates, there were no effects of temporal group. It was found that participants were equally as likely to correctly recognise the action phrases regardless of the temporal direction they imagined the scenarios in. This is consistent with previous literature investigating future thinking and false memories. For example, Dewhurst et al. (2016) and Dewhurst et al. (2019) both found no effects of temporal group on correct recognition. Additionally, this finding is consistent with Experiment 1, where no differences in correct recognition were found between the three temporal conditions. Therefore, the null effects of temporal group on correct recognition are consistent with previous findings suggesting that thinking about the future may not increase correct recognition rates. As noted in the Experiment 1 discussion, research solely investigating true memory and future thinking has found an increase in correct recognition after imagining a future event compared to remembering a past event. However, an explanation for these contrary findings will be considered in the general discussion.

Another aim of the present research was to investigate the effect of emotion on false memories for action phrases. As previous literature has found an increase in false memories for negative stimuli compared to positive or neutral stimuli (Bookbinder & Brainerd, 2016), it was predicted that there would be more critical lures falsely recognised after imagining negative events compared to positive or neutral events, regardless of temporal condition. However, this effect was only seen in the future temporal group. It was found that there were more falsely recognised critical lures after imagining negative events compared to positive events, but only in the future condition. This is consistent with some literature that found an increase in false memories for negative stimuli over positive stimuli (see Bookbinder & Brainerd, 2016). However, a large amount of previous literature tended to find an increase in false memories for negative over neutral stimuli, not just positive. So, the fact that the present experiment only saw a greater amount of false memories after imagining negative over positive events, but not neutral events, is slightly at odds with previous literature. A potential explanation for this discrepancy will be considered in the general discussion.

Despite there being a negativity effect on false memories in the future condition, an increase in false memories for action phrases after imagining neutral events compared to emotional events was found in the past and typical conditions. Therefore, this finding is inconsistent with prior research that has found a negativity effect of false memories, as previously mentioned (e.g. Bookbinder & Brainerd, 2016, 2017). However, this result is consistent with the findings of Experiment 1 and Choi et al. (2013), which both found an increase in false memories for neutral stimuli compared to emotional stimuli. As mentioned in the discussion of experiment 1, Choi et al. suggested that the

emotional stimuli may be more distinctive and memorable than the neutral stimuli. So, the increased memorability of the emotional events may have led to a reduction in false memories for the action phrases after imagining the emotional events in comparison to the less memorable, neutral events. Therefore, the findings of Experiment 2 are largely consistent with Choi et al. suggestion that emotional stimuli may reduce false memories in comparison to neutral stimuli.

Based on the findings of Experiment 1, it was also predicted that there would be an increase in the number of correctly recognised action phrases after imagining negative events compared to positive or neutral events. However, no effects of emotional valence on correct recogniton were found. This contrasts from Experiment 1 and hence, is against the prediction that there would be a negativity effect on true memory. Additionally, this finding is inconsistent with previous literature that has found a memory enhancement for negative stimuli compared to neutral stimuli (Bookbinder & Brainerd, 2017). However, a review of emotion and false memory literature found a large amount of research reporting null effects of emotional valence on correct recognition rates (Bookbinder & Brainerd, 2016). Therefore, the null findings of the present experiment are consistent with the findings of some previous research. A potential explanation for the discrepancy between the findings of Experiment 1 (that found a negativity effect on correct recognition) and Experiment 2 (that found null effects of emotion on correct recognition) will be considered in the general discussion.

General Discussion

Experiments 1 and 2 aimed to investigate the effect of future thinking on false memory when controlling for the emotional valence of the stimuli in order to use a more ecologically valid method than those previously used. Experiment 1 extended Dewhurst et al. (2019) study by asking participants to imagine past, future, or typical events that were positive, negative, and neutral in emotional valence. Participants then rated object nouns for their relevance to the events. Then, participants completed recognition tests for those items and for unseen critical lures. Experiment 2 followed the same format, but used action phrases as stimuli instead of object nouns in order to investigate whether the false memory effects that were seen in previous research would extend to stimuli beyond object nouns.

The main prediction for both experiments was that there would be an increase in false memories for those who thought about future events compared to those who thought about past or typical events. However, there was no effect of temporal group on false recognition in Experiment 1. In Experiment 2, there was an increase in false memories for those in the future condition compared to the past, but only after imagining negative events. So, the prediction that there would be an overall effect of temporal group on false memories was not seen in either experiment. However, this lack of overall effect of temporal group could be due to methodological differences between the present

experiments and Dewhurst et al. (2019). As the present experiments followed on from Dewhurst et al., there were many similarities between the instructions and stimuli that were used. However, a large methodical difference was that the present study was conducted online, whereas Dewhurst et al. study was conducted in person in the laboratory. As the present studies were conducted online, there was no way of knowing whether or not participants took a few moments, as instructed, to properly imagine their events. So, it could be possible that participants simply read the instructions with minimal imagination of the scenarios before moving onto the rating task. If this occurred, then it could explain the null effects of temporal group on false memories as the group participants were in would not have mattered if the imagination of the events was only brief. So, future research could replicate this experiment in the laboratory to ensure that participants are taking moments to imagine the different scenarios in order to investigate whether the null effects of temporal group were due to a potential lack of imagination of the scenarios.

Even though there was a lack of overall effects of temporal group on false memory, Experiment 2 found an increase in false memories for those in the future thinking condition compared to the past condition after imagining negative events. A speculative explanation for this could be due to the amount each participant previously thought about each of the scenarios in their everyday life. For example, it is possible that the effects of temporal group were only seen in the negative condition as participants may have been thinking about the occurrence of one or both of the negative scenarios prior to the study more than the positive or neutral scenarios. One negative scenario was to imagine taking an exam that one was unprepared for and the other was a hospital visit. As the sample of participants were all students and the responses for this particular study were given in exam season, it is possible that the participants were planning for their exams and thinking about taking their exams often. Additionally, participants may also have often thought about hospitals due to the COVID-19 pandemic. For example, it has been shown that there has been constant media coverage concerning the COVID-19 pandemic in the UK concerning the treatment of COVID-19 in hospitals as well as broadcasting information regarding hospital admissions (Yang et al., 2021). As a result of this media coverage, it is possible that participants were often thinking about hospital visits. Therefore, it could be that participants were planning for the potential occurrence of the two negative events. These negative events may have been thought about more than the positive or neutral events. For the positive scenarios (holiday abroad and a picnic), COVID-19 heavily restricted holidays abroad (Department for Transport, 2021) and did not recommend meeting with individuals with whom they did not live (i.e. for a picnic) at the time of the data collection (UK Government, 2021). Therefore, it is unlikely that participants would have been thinking about these events as much as the negative events due to the COVID-19 restrictions at the time of the experiment. Additionally, the neutral scenarios (a supermarket trip and train journey) are not often events that require lots of prior planning and are

unlikely to occupy one's mind as much an upcoming exam, for example. So, if participants were thinking about the negative events more than the positive or neutral events, it could be that they mistook their own previous thoughts of the negative scenarios for seeing the critical lures in the study phase of Experiment 2. Therefore, participants may have made source errors in the recognition test of the experiment as a result of previously thinking about the negative scenarios, in line with a source monitoring account of false memories (Johnson et al., 1993). Therefore, this potential prior planning of the negative scenarios could explain why there was only an effect of future thinking after imagining negative scenarios, rather than after imagining all scenarios. It should be noted that this explanation is highly speculative. However, future research could control for this potential problem by asking participants at the end of the study how much they thought about each scenario prior to starting the experiment.

For correct recognition, neither experiment found a reliable effect of temporal group. This is consistent with previous literature investigating future thinking and false memory (e.g. Dewhurst et al., 2016; Dewhurst et al., 2019). Therefore, these combined results suggest that there may be no effect of future thinking on correct recognition. However, this contrasts research that investigated true memory and future thinking. For example, Klein et al. (2010) specifically investigated true memory for past and future events and found an increase in true memory for participants who imagined planning a future event compared to those who remember a past event. Klein et al. suggested that this memory enhancement for stimuli after imagining future events compared to past events may be an adaptive advantage. It was suggested that planning for a future event may lead to better memory of the stimuli compared to imagining past events as it would be more adaptive to remember stimuli that would be relevant in a future, potentially survival scenario. Klein et al. also argued that this potential adaptive advantage is a very important function of memory. So, it is important to consider the potential reasons as to why the present research did not find a memory enhancement for stimuli in the future condition compared to the past or typical conditions.

In Dewhurst et al. study, it was speculated that the null effects of temporal group on correct recognition may be due to differences in the item lists used. Klein et al. only investigated true memory, so the study lists did not need to exclude any items that were very strongly related to the theme of the lists (i.e. critical lures). However, as Dewhurst et al. study did investigate false memories, the strongly related items were excluded from the study lists to act as critical lures in the recognition test. As a result of this, Dewhurst et al. speculated that the increase in correct recognition for the future thinking condition seen in Klein et al. study could have been a result of relational encoding as that has been shown to enhance true memory (Guynn et al., 2014; Hunt & Einstein, 1981). However, the memory enhancing effect of relational encoding was suggested to transfer to false memory in Dewhurst et al. study due to the exclusion of the strongly related, critical lures in the study lists. A

problem with this explanation for the present research is that there were no overall effects of temporal group on false memory in either experiment. Therefore, any effects of temporal group that may have been seen on correct recognition did not transfer to false recognition in the present experiments. As this literature is mixed, future studies could specifically investigate the effect of future thinking on true memory by comparing the effects found in true and false memory paradigms.

Despite this general lack of false memory effects on temporal group, participants did produce false memories. This general false memory effect could be explained by activation monitoring theory (AMT; Roediger & Balota et al., 2001; Roediger & Watson et al., 2001). For example, when participants rated words in the study lists for their relation to the events they imagined, AMT would suggest that participants automatically generated the critical lures upon reading the items in the list. Then, in the recognition test, participants mistook the items they generated for items they actually rated in the study lists as a result of source monitoring errors (Johnson et al., 1993). Hence, producing false memories of the critical lures. However, AMT was designed to explain spontaneous false memories, such as those produced in the DRM paradigm, and cannot be used to explain any recognition effects on true memory. Therefore, when relating the results of the present research to false memory theory, fuzzy trace theory (FTT; Brainerd & Reyna, 2002; Reyna 1998) will be used instead.

Emotional Valence and False Recognition

Another aim of both experiments was to investigate the effects of emotional valence and future thinking on false memories. Based on previous research into false memory and emotion, it was predicted that there would be an increase in false memories for items after imagining negative events compared to neutral events. However, this prediction was not seen in either experiment. In Experiment 1, there was an increase in false memories after imagining neutral events over positive and negative events. Despite this going against the majority of false memory and emotion research (see Bookbinder & Brainerd, 2016), it was consistent with Choi et al. (2013). As explained in the discussion of the first experiment, Choi et al. investigated the effect of emotion on false memories and found an increase in false memories for neutral stimuli over negative stimuli. As a result of this, it was suggested that emotional stimuli potentially reduce the number of false memories compared to neutral stimuli as emotional stimuli are more distinct and memorable. Due to the increased memorability of the emotional stimuli, participants would be less susceptible to false memories than for the neutral stimuli, possibly a result of the ‘recollection-rejection’ strategy discussed previously (Brainerd et al., 2003). Hence, potentially explaining why there was a reduction in false memories after imagining emotional events and an increase in false memories after imagining neutral events in Experiment 1.

This idea could be supported by considering the fact that the emotional events differed from the neutral events on a temporal basis. For example, the emotional events generally take place over many hours or days (e.g. holiday abroad, hospital trip), whereas the neutral events generally last shorter periods of time (e.g. a supermarket trip). This could have led participants to form richer episodic memories of the emotional events compared to the neutral events, and richer episodic memories are more distinctive. Therefore, it is possible that the increase in false memories for neutral events over emotional events could have been due to both the general distinctiveness of emotional events as well as the length of time that the events occurred over. Hence, this could lead participants to form clearer memories of the emotional events compared to the neutral events. As a result of this, future research should consider using events that all occur over similar time periods.

A similar reduction in false memories after imagining emotional events in comparison to neutral events was also seen in Experiment 2, but only for the past and typical temporal conditions. In the future thinking condition, there was a negativity effect as predicted, but there were only more false memories for action phrases after imagining negative events in comparison to positive, not neutral events. Therefore, in the future condition, the negativity effect is consistent with the majority of previous emotion and false memory literature that has found an increase in false memories for negative stimuli in comparison to neutral or positive stimuli (see Bookbinder & Brainerd). This negativity effect could be explained by fuzzy trace theory (Brainerd & Reyna, 2002; Reyna 1998) which suggests that negative emotional stimuli increases gist memory. In reference to the present experimental paradigm, this would mean that participants tended to remember the general theme of the study lists (the gist), which would increase susceptibly to the critical lures in the recognition tests. Bookbinder and Brainerd suggested that this would occur for negative emotional stimuli more than for positive or neutral stimuli, but this effect was only seen in the future temporal condition in Experiment 2. In the past and typical conditions, there was a greater number of false memories after imagining neutral over emotional events.

Along with the distinctiveness suggestion by Choi et al., another speculative explanation that is more specific to the present research could also help to explain the increase in false memories for items after imagining neutral over emotional events. For example, the neutral scenarios may be more familiar to the participants than the emotional scenarios as the neutral scenarios (a supermarket trip and train journey) may be more frequently experienced than the positive (a picnic or holiday abroad) or negative scenarios (exam and hospital visit). Therefore, if the neutral scenarios were more familiar to participants compared to the negative and positive scenarios, it is possible that participants would be more susceptible to false memories. This is because participants may be more likely to make source errors for familiar stimuli, hence potentially leading to an increase in false memories. This idea could be supported as it has been suggested that thinking about familiar events may lead to false memories

of those events (Bower et al., 1979; Dewhurst et al., 2008). For example, in Experiment 1 of Dewhurst et al. study, participants were told the same story describing an event, but participants were given two separate titles prior to hearing that story. Participants were told that the story corresponded to one of two familiar events; either a football match or a wedding via the title that was given prior to hearing the story. Participants then completed a recognition test for the story, including critical lures that were not presented in the story, and provided remember or know responses (Tulving, 1985). It was found that participants falsely recognised more critical lures relating to title of the story they were given compared to lures relating to the title that they did not see. For example, those who were given the title of a wedding falsely recognised more critical lures relating to a wedding than to a football match, despite the stories being exactly the same aside from the difference in title. Similarly, those who received the title of a football match falsely recognised more critical lures relating to a football match than a wedding. Therefore, it was suggested that participants made inferences as to what may have occurred at a typical wedding or football match and that those inferences made may have led to false memories of hearing those words in the stories in the study phase of the experiment. This is because those words were consistent with the general script of what would normally occur during those events. A potential explanation for this was that participants could have mistaken the words that they thought of when initially hearing the stories for words that they actually heard in the stories, in line with a source monitoring account. Therefore, these source errors could have led to the false recognition of the critical lures in the recognition test. Additionally, this provides some evidence that thinking about familiar events may lead to false memories. With regard to the present study, it could therefore be possible that the familiarity of the events in Experiment 2 of the present research may have influenced the number of critical lures that were falsely recognised in the recognition test. If the neutral scenarios were more familiar than the emotional scenarios, it could be possible that the increase in false memories seen for items after imagining neutral over emotional events may have been a result of the increased familiarity, rather than the emotional valence, of the events.

However, this may not be likely as further research has investigated the effect of future thinking on false memories for unfamiliar, simulated events and found the same pattern of results when familiar events have been used previously. For example, in Dewhurst et al. (2019) second experiment, participants imagined past, typical and future unfamiliar scenarios, such as going into space. Then, participants rated items for their relevance to the events and completed a recognition test that included critical lures. It was found that there was an increase in false memories for those who thought about the events as occurring in the future compared to the past or those in the atemporal condition. Although, it should be noted that this research did not investigate the effect of familiarity on emotional valence. However, the results did suggest that the common future thinking effects on false memory occur for even unfamiliar, simulated events. Therefore, it may not be accurate to

suggest that the increase in false memories after imagining neutral events over emotional events in the present experiment were simply due to familiarity rather than emotional valence. However, Dewhurst et al. study did not compare the difference between false memories for familiar events with unfamiliar events. So, it is still possible that imagining more familiar events may lead to more false memories than imagining unfamiliar events when directly compared. Therefore, future research should directly compare the number of false memories formed when imagining familiar, compared to unfamiliar, events in order to establish whether increased familiarity increases false memories.

Another point to note is that the mean proportions seem quite low (ranging from .12 to .4 across both studies) in comparison to other false memory studies. For example, a seminal study investigating false memories found an average false recall mean proportion of .55 (Roediger & McDermott, 1995). Therefore, it could be suggested that the low mean proportions in this study indicate that the false memory manipulation was not strong enough which may account for the general lack of false memory effects seen. However, this is unlikely as the means are consistent and sometimes higher than the range of means found in previous studies utilising very similar methods to the present research. For example, Dewhurst et al. (2019) found mean proportions in the range of .06 to .18 and found many significant false memory effects on future. Therefore, this suggests that the false memory manipulation in the present study was sufficient, so the lack of false memory effects on temporal group may not have largely contributed to the null effects seen.

Emotional Valence and Correct Recognition

For correct recognition, previous research investigating true and false memory is mixed as to whether studies have found increases in correct memory for emotional stimuli over non-emotional stimuli. However, more recent and controlled research has suggested that there is an increase a memory for negative stimuli over neutral stimuli (e.g. Bookbinder & Brainerd, 2017). So, it was predicted that there would be an increase in correct recognition for stimuli after imagining negative events over positive and neutral events. This prediction was supported in Experiment 1, but not Experiment 2. Experiment 1 found an overall increase in correct recognition after imagining negative events compared to positive and neutral events. As mentioned in the Experiment 1 discussion, this supports a wide variety of research in investigating solely true memory and emotion (see Kensinger, 2007) as well as research investigating true memory and emotion as part of false memory research (e.g. Bookbinder & Brainerd, 2016; 2017). Bookbinder and Brainerd suggested that fuzzy trace theory could explain a memory enhancement for negative stimuli compared to positive or neutral stimuli. It was suggested that negative emotional stimuli increase correct recognition more than neutral stimuli as negative emotion helps one to correctly identify target items in the recognition test due to an increase in verbatim memory for the target items. Therefore, this could explain why participants in

Experiment 1 of the present research correctly recognised the most items after imagining negative events. However, the findings of Experiment 1 are slightly discrepant with FTT as it also posits that there should be an increase in false memory for negative stimuli as well as true memory. According to FTT, negative emotional stimuli should increase gist traces of memory, which would increase susceptibility to false memories. This is because negative emotional stimuli should increase the familiarity of the stimuli, which should both increase verbatim memory (to account for the increase in correct recognition) and gist memory (to account for the increase in false recognition). However, Experiment 1 found an increase in false memory for items after imagining neutral, not negative events. So, the FTT explanation could only provide an explanation for the effects of emotion on true memory, not false memory, in Experiment 1.

Despite this, the correct recognition results of Experiment 1 are consistent with a variety of literature investigating both true and false memory for emotional stimuli. This negativity effect on correct recognition could have some advantages. For example, it has been suggested that a memory enhancement for negative emotion could be an adaptive advantage. Kensinger (2007) suggested that correctly remembering the details of traumatic, negative events, would be adaptive as it would allow one to use that information in the future if a similar scenario were to occur. So, the negativity effect seen in Experiment 1 supports the adaptive explanation for a memory enhancement for negative stimuli.

However, the second experiment did not find any effects of emotional valence on correct recognition for action phrases. Means here? As previous literature investigating this is mixed, there is supporting research that also found no effect of emotion on true memory (e.g. El Sharkway et al., 2008; Porter et al., 2010; Van Damme & Smets, 2014). Bookbinder and Brainerd (2016) suggested that these contrary findings may have been in part due to a lack of control for the emotional arousal of the stimuli. When addressing this, their study investigating false memory and emotion found a negativity effect on true memory (as well as false memory) (Bookbinder & Brainerd, 2017). As emotional arousal was not controlled for in the present experiments, it is possible that the differing stimuli in both experiments (object nouns vs actions phrases) led to differing levels of emotional arousal, hence why Experiment 1 found a negativity effect and Experiment 2 did not. So, future research should control for the emotional arousal of the stimuli in order to rule out whether or not the effects were due to differing levels of emotional arousal.

However, it could also be possible that the lack of correct memory effects seen in the Experiment 2 may be because action phrases were used instead of concrete object nouns (which were used in Experiment 1). Previous research has investigated the effect of rating stimuli for their relevance to survival scenarios compared to non-survival scenarios on memory (Nairne et al., 2007; see Nairne & Pandeirada, 2008, for a review). Generally, it has been found that rating stimuli for

relevance to survival leads to a memory enhancement in comparison to rating stimuli for relevance to a non-survival scenario. Although this is not the same as the present research, imagining survival scenarios are inherently negative and require elements of future thinking as one must imagine the event as if it were to occur in the future. However, some research has found that the memory enhancement seen after rating stimuli for the relevance to survival may be limited to concrete object nouns. For example, Bell et al. (2013) Experiment 3 asked participants to rate either concrete object nouns or abstract words for their relevance to a survival or non-survival scenario. Then, participants completed a recall test for the items. It was found that there was a memory enhancement for the survival scenario compared to the non-survival scenario for only the concrete object nouns. Additionally, Kroneisen and Makerud (2017) further investigated the survival processing effect using similar methods to Bell et al., but used high imaginability items (i.e. easily visualised concrete object nouns) compared to low imaginatively words (i.e. abstract words one cannot visualise easily). Like Bell et al., the survival processing effect was also only found for highly imaginable, concrete nouns, but not for abstract, low imaginability words. Therefore, it was suggested that the survival processing effect seen may only be present for concrete items, not abstract stimuli. To explain this, it was suggested that it may be adaptive to remember objects relevant to survival as it would be useful to remember the relevant objects if a survival scenario were to occur in the future. However, it would not be particularity useful to remember abstract words if a survival scenario were to occur. So, the survival processing effect seen may only occur for object nouns.

In relation to the present research, there was a negativity effect seen for object nouns (Experiment 1), but not for action phrases (Experiment 2). Although different to the survival processing effect, the results of the present experiment could also be explained by the difference in stimuli used in the two experiments. Similar to the suggestion made by Kroneisen and Makerud (2017), it could be possible that a negativity effect on correct recognition could be limited to object nouns and does not extend to other stimuli, such as action phrases, as it may be more useful to better remember objects relating to negative events than it would be to remember action phrases relating to those events. To provide an example using the present experiments' stimuli, it may be more useful to remember one's 'ID card' for an exam than it is to remember placing the ID card on the desk. Therefore, it could be possible that the negativity effect seen in Experiment 1 may not extend to action phrases as it may not be as useful to remember action phrases as is to remember objects. This is highly speculative, so future research could investigate whether the negativity effect often seen in correct recognition research extends to stimuli other than object nouns, such as abstract words.

Conclusion

In conclusion, the present research aimed to follow on from Dewhurst et al. (2019) by investigating the effect of future thinking and emotion on false memories. Emotional valence was included as a factor in order to make the research more ecologically valid than previous research. Experiment 1 investigated the effect of future thinking and emotion on false memory using object nouns as stimuli; Experiment 2 used the same method, but with action phrases as stimuli. The key prediction for both experiments was that there would be an increase in false memories for participants who thought about future events, compared to those who thought about past or typical events. However, an overall increase in false memories for those in the future thinking condition was not found in either experiment. This is inconsistent with previous research that has found an increased susceptibility to false memories for those who think about future events compared to those who remember past events (e.g. Dewhurst et al., 2016; Dewhurst et al., 2019). However, this null finding may have been a result of methodological problems. For example, it was unknown whether or not participants took the time to imagine the scenarios with reference to their temporal group as instructed due to the study being conducted online. Additionally, there were no effects of temporal group on correct recognition rates in either experiment. However, this result is consistent with previous findings, hence providing additional evidence for this null hypothesis that temporal group may not affect correct recognition.

The second key prediction was that there would be an increase in false memories after imagining negative events compared to positive and neutral events. However, both experiments found an overall increase in false memories after imagining neutral events over negative events. This finding was consistent with some prior research which suggested that emotional stimuli may suppress false memories as they may be more distinctive and memorable than neutral stimuli (Choi et al., 2013). For the effect of emotional valence on correct recognition, there were more correctly recognised items after imagining negative events than positive or neutral events in Experiment 1. This finding is consistent with a large amount of research finding a memory enhancement for negative stimuli compared to positive and neutral stimuli (see Bookbinder & Brainerd, 2016). This has been suggested to be an adaptive advantage. For example, it may be more adaptive to better remember the items relevant to negative, traumatic events compared to positive events as the items may be more useful in the future if a similar, negative event were to occur (Kensinger, 2007). However, there was no negativity effect seen in Experiment 2. Potentially, this may have been due to the fact that action phrases, instead of object nouns, were used. Therefore, it is possible that the negativity effect for correct recognition does not extend to action phrases from object nouns. However, this is speculative, so future research should investigate this further using different types of stimuli to object nouns in order to investigate whether the negativity effect is limited to object nouns.

Overall, the null effects of temporal group on false memory seen are inconsistent with previous research. To investigate whether these null findings were due to methodological problems, such as the study being conducted online, future research should replicate the present research in a laboratory in order to ensure participants properly engage with the imagination tasks. Therefore, this could indicate whether or not the null effects of temporal group seen were simply due to methodological problems.

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Appendix A

Experiment 1 instructions

POSITIVE SCENARIOS

PAST

Picnic

Think back and remember a time in your past when you went on a picnic. Remember what a great time you had. Think about the food you ate, the games you played, the beautiful scenery, and so on. Please spend a few moments remembering this picnic. While you are remembering this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it was that each of these items was at the picnic. For some items, it may be very likely that they were there. For others, it may be unlikely. It is up to you to decide.

Holiday

Think back and remember a time in your past when you went on a beach holiday abroad. Remember how excited you were when you arrived and what a fantastic time you had. Think about the fun things you did, the people you met, the wonderful weather, and so on. Please spend a few moments remembering this holiday. While you are remembering this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it was that each of these items was at the holiday you remember. For some items, it may be very likely that they were there. For others, it may be unlikely. It is up to you to decide.

FUTURE

Picnic

Think ahead and imagine a time in your future when you will go on a picnic. Imagine what a great time you will have. Think about the food you will eat, the games you will play, the beautiful scenery, and so on. Please spend a few moments imagining this picnic. While you are imagining this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that each of these items will be at the picnic. For some items, it may be very likely that they will be there. For others, it may be unlikely. It is up to you to decide.

Holiday

Think ahead and imagine a time in your future when you will go on a beach holiday abroad. Imagine how excited you will be when you arrive and what a fantastic time you will have. Think about the fun things you will do, the people you will meet, the wonderful weather, and so on. Please spend a few moments imagining this holiday. While you are imagining this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that each of these items will be on the holiday. For some objects, it may be very likely that they will be there. For others, it may be unlikely. It is up to you to decide.

TYPICAL

Picnic

Use your imagination to form a picture of a picnic. What items appear in the image that you have created of the picnic? While you are imagining this picnic, I am going to present you with a list of words describing objects and people. I would like you to rate

how likely it is that each of the items is at the picnic that you have imagined. For some items, it may be very likely that they appear in your image. For others, it may be unlikely. It is up to you to decide.

Holiday

Use your imagination to form a picture of a beach holiday. What items appear in the image that you have created of the holiday? While you are imagining this holiday, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that each of these items is on the holiday that you have imagined. For some items, it may be very likely that they appear in your image. For others, it may be unlikely. It is up to you to decide.

NEGATIVE SCENARIOS

PAST

Hospital

Think back and remember a time in your past when you had to stay in hospital. Remember how worried you felt. Think about the pain you experienced, how lonely you felt, the boredom, and so on. Please spend a few moments remembering your time in hospital. While you are remembering this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it was that each of these items was at the hospital. For some items, it may be very likely that they were there. For others, it may be unlikely. It is up to you to decide.

Exam

Think back and remember a time in your past when you took an exam. Remember how unprepared you felt when you arrived. Think about how nervous you were, the fear that you had revised the wrong topics, and so on. Please spend a few moments remembering this exam. While you are remembering this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it was that each of these items was at the exam. For some items, it may be very likely that they were there. For others, it may be unlikely. It is up to you to decide.

FUTURE

Hospital

Think ahead and imagine a time in your future when you have to stay in hospital. Imagine that you feel very worried. Think about the pain you might experience, how lonely you will feel, the boredom, and so on. Please spend a few moments imagining your time in hospital. While you are imagining this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that each of the items will be at the hospital. For some items, it may be very likely that they will be there. For others, it may be unlikely. It is up to you to decide.

Exam

Think ahead and imagine a time in your future when you will take an exam. Imagine that you feel completely unprepared. Think about how nervous you will be, the fear that you have revised the wrong topics, and so on. Please spend a few moments imagining this exam. While you are imagining this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that these items will be at the exam. For some objects, it may be very likely that they will be there. For others, it may be unlikely. It is up to you to decide.

TYPICAL

Hospital

Use your imagination to form a picture of a hospital. What items appear in the image that you have created of the hospital? While you are imagining this hospital, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that each of these items is at the hospital that you have imagined. For some items, it may be likely that they appear in

your image. For others, it may be unlikely. It is up to you to decide.

Exam
Use your imagination to form a picture of an exam. What items appear in the image that you have created of the exam? While you are imagining this exam, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that each of these items is at the exam that you have imagined. For some items, it may be likely that they appear in your image. For others, it may be unlikely. It is up to you to decide.

NEUTRAL SCENARIOS

PAST
Train journey
Think back and remember a time in your past when you went on a train journey. Remember how the train looked. Think about the things you saw, the people you met, the passing scenery, and so on. Please spend a few moments remembering this train journey. While you are remembering this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it was that each of these items was on the train journey. For some items, it may be very likely that they were there. For others, it may be unlikely. It is up to you to decide.

Supermarket
Think back and remember a time in your past when you went to the supermarket. Remember how supermarket looked. Think about the items you bought, the people you saw, how the supermarket looked, and so on. Please spend a few moments remembering this trip to the supermarket. While you are remembering this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it was each of these items was at the supermarket. For some items, it may be very likely that they were there. For others, it may be unlikely. It is up to you to decide.

FUTURE
Train journey
Think ahead and imagine a time in your future when you will go on a train journey. Imagine how the train will look. Think about the things you might see, the people you might meet, the passing scenery, and so on. Please spend a few moments imagining this train journey. While you are imagining this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that you each of these items would be on the train journey. For some items, it may be very likely that they will be there. For others, it may be unlikely. It is up to you to decide.

Supermarket
Think ahead and imagine a time in your future when you will go to the supermarket. Imagine how the supermarket will look. Think about the items you might buy, the people you might see, how the supermarket will look, and so on. Please spend a few moments imagining this trip to the supermarket. While you are imagining this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that each of these items will be at the supermarket. For some items, it may be very likely that they will be there. For others, it may be unlikely. It is up to you to decide.

TYPICAL

Train journey

Use your imagination to form a picture of a train journey. What items appear in the image that you have created of the train journey? While you are imagining this experience, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that each of the items is on the train journey that you have imagined. For some items, it may be very likely that they appear in your image. For others, it may be unlikely. It is up to you to decide.

Supermarket

Use your imagination to form a picture of a supermarket. What items appear in the image that you have created of the supermarket? While you are imagining this supermarket, I am going to present you with a list of words describing objects and people. I would like you to rate how likely it is that each of these items is at the supermarket that you have imagined. For some items, it may be very likely that they appear in your image. For others, it may be unlikely. It is up to you to decide.

Appendix B
Experiment 1 Stimuli

STUDY ITEMS (RELATED)						
PICNIC	HOLIDAY	HOSPITAL	EXAM	TRAIN	SUPERMARKET	
corkscrew	beach towe	bandages	answer boo	buffet car	alcohol	TARGETS
hikers	guidebook	injection	chair	hand rail	basket	
plates	shorts	stitches	clock	reservation	cashier	
sunshade	sunblock	ward	exam hall	station	pharmacy	
tablecloth	toiletries	x-ray	library card	ticket mach	shopping list	
cakes	air tickets	anaesthetic	water bottl	barriers	cereal	LURES
cutlery	hotel detail	doctor	calculator	newspaper	clothes	
fruit	sandals	medication	invigilator	seat	frozen goods	
glasses	sunglasses	pyjamas	pen	ticket	lottery tickets	
wine	travel plug	visitors	ruler	toilet	tills	
STUDY ITEMS (UNRELATED)						
glue	chalk	lawyer	harp	gloves	soldier	TARGETS
laptop	hammer	golf clubs	scooter	candle	screwdriver	
slippers	piano	scarf	microwave	sofa	skis	LURES
sword	chalk	spear	sponge	telescope	trainers	
Target items = present in recognition test						

TEST ITEMS (RELATED)						
PICNIC	HOLIDAY	HOSPITAL	EXAM	TRAIN	SUPERMARKET	
corkscrew	beach towe	bandages	answer boo	buffet car	alcohol	TARGETS
hikers	guidebook	injection	chair	hand rail	basket	
plates	shorts	stitches	clock	reservation	cashier	
sunshade	sunblock	ward	exam hall	station	pharmacy	
tablecloth	toiletries	x-ray	library card	ticket mach	shopping list	
blanket	**currency**	**bed**	**desk**	**carriage**	**bakery**	LURES
drinks	**passport**	**gown**	**exam pape**	**guard**	**checkout**	
hamper	**suitcase**	**nurses**	**pencil case**	**passesnger**	**freezers**	
napkins	**swimwear**	**painkillers**	**seat numbe**	**platform**	**shoppers**	
sandwiches	**tourists**	**surgeon**	**students**	**timetable**	**trolley**	
TEST ITEMS (UNRELATED)						
glue	chalk	lawyer	harp	gloves	soldier	TARGETS
laptop	hammer	golf clubs	scooter	candle	screwdriver	
cushion	**iron**	**lawnmowe**	**mirror**	**scissors**	**string**	LURES
athlete	**guitar**	**torch**	**paintbrush**	**plumber**	**kite**	

Appendix C

Experiment 1 Participant Information Sheet

Title of study: Thinking about emotional and neutral events

I would like to invite you to participate in a research project which forms part of my MRes Psychology research. Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information.

What is the purpose of the study?

The purpose of the study is to investigate how adults think about various life events when the emotional valence of those life event differs (e.g. positive, negative, or neutral).

Why have I been invited to take part?

You are being invited to participate in this study because you are an undergraduate Psychology student and are willing to think about various life events for the experiment.

What will happen if I take part?

If you decide to take part, you will be able to follow a hyperlink to the consent form. Once all boxes on the consent form are ticked, a hyperlink will appear which confirms your consent and directs you to the experiment. As this is an online study, this experiment should take place in a quiet room of your choice that is free from distractions, such as mobile phones. When the experiment starts, you will be asked to either imagine six life events or remember six of your own life events. Of these events, two will be positive (a picnic and a holiday), two will be negative (taking an exam for which you are unprepared and spending time in hospital), and two will be neutral (a train journey and a trip to the supermarket). If you have not experienced an event that you are asked to remember, you will be asked to imagine that the event has happened instead. You will be given 30 seconds to think about each event. After each event is described, you will be presented with a list of object nouns, one at a time, and asked to rate how likely you are to encounter each object within that event. The experiment will last approximately 45 minutes. As part of participation you will be asked to provide your age and gender, which will only be collected with your consent.

Do I have to take part?

Participation is completely voluntary. You should only take part if you want to and choosing not to take part will not disadvantage you in any way. Once you have read the information sheet, please contact us if you have any questions that will help you make a decision about taking part. If you decide to take part we will ask you to sign a consent form prior to starting the experiment.

Payment/Incentives

1 RPS credit will be awarded in exchange for participation in this experiment.

What are the possible risks of taking part?

You will be required to think about events that are negative which could be upsetting. If you feel upset, you may withdraw from completing the study at any point. Additionally, if further support is needed, please contact the University of Hull wellbeing services via e mail at studentwellbeing@hull.ac.uk or by calling 01482 462222.

What are the possible benefits of taking part?

Data received from completion of the experiment will contribute towards new psychological research.

Data handling and confidentiality

Your data will be processed in accordance with the General Data Protection Regulation 2016 (GDPR).

Data provided will be anonymised through use of participant numbers, instead of using personal names. Therefore, personal data (age, sex etc) will only be associated with a participant number upon completion of the experiment. Therefore, the researcher will not be able to associate your name with your data after submission. After submission, you will no longer be able to withdraw the data as it will be unknown which dataset belongs to you.
All information collected about you and your participation will be kept private and confidential. Personal data will be shared within the research team and will not be shared outside of the EU. Anonymised data may be shared with other researchers in the EU. If the findings of the study are only to be used as part of a Master's degree thesis, then all data and consent forms will be destroyed when the researcher has received the final grade for the thesis. If findings are deemed punishable as part of a larger project, then all data will be stored by the supervisor for 10 years after the publication date and will be destroyed once the 10 year period is over.

Data Protection Statement

The data controller for this project will be the University of Hull. The University will process your personal data for the purpose of the research outlined above. The legal basis for processing your personal data for research purposes under GDPR is a 'task in the public interest' You can provide your consent for the use of your personal data in this study by completing the consent form that has been provided to you. Information about how the University of Hull processes your data can be found at https://www.hull.ac.uk/choose-hull/university-and-region/key-documents/data-protection.aspx

You have the right to access information held about you. Your right of access can be exercised in accordance with the General Data Protection Regulation. You also have other rights including rights of correction, erasure, objection, and data portability. Questions, comments and requests about your personal data can also be sent to the University of Hull Data Protection Officer [dataprotection@hull.ac.uk]. If you wish to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk.

What if I change my mind about taking part?

You are free withdraw at any point during the study, without having to give a reason. Withdrawing from the study will not affect you in any way. You are able to withdraw your data from the study up until after completion of the experiment, after which withdrawal of your data will no longer be possible due to the data being fully anonymised and added to the dataset. After this point, the

researcher will not know which data is yours to withdraw. If you choose to withdraw from the study, we will not retain the information you have given thus far.

What will happen to the results of the study?
The results of the study will be summarised in the researcher's MRes Psychology thesis. These anonymised data may then be published in part of a larger paper.

Who has reviewed this study?

Research studies are reviewed by an independent group of people, called a Research Ethics Committee, to protect your interests. This study has been reviewed and been given a favourable opinion by the Department of Psychology ethics committee, at the University of Hull.

Who should I contact for further information?

If you have any questions or require more information about this study, please contact me using the following contact details: e-mail: G.vella-2017@hull.ac.uk

What if I have further questions, or if something goes wrong?

If you wish to make a complaint about the conduct of the study, you can contact the University of Hull using the details below for further advice and information:

Prof. Steve Dewhurst, Psychology department, University of Hull, HU6 7RX. Office telephone number 01482 465931; E-mail: S.Dewhurst@hull.ac.uk

Alternatively, please contact registrar@hull.ac.uk

Thank you for reading this information sheet and for considering taking part in this research.

Appendix D

Debriefing Information Sheet Experiment 1

Study Title: Thinking about emotional and neutral events

Student Researcher: Georgia Vella; **Supervising Researcher:** Prof. Steve Dewhurst

Thank you for taking part in this study. The participant information sheet gave you a general overview of the study. Now you've completed the study we can provide you with a more detailed description of our research.

False memories are very common in everyday life and can be described as incorrect memories of events or memories of events that never happened. The susceptibility to false memories can be influenced by various factors, such as emotion and thinking about the future. The main aim of this study is to investigate the relationship between false memory formation, emotion, and thinking about the future. The amount of false memories formed were measured in this study via the recognition test.

To do this, you were asked to think about either past, typical, or future events that were positive, negative, and neutral in emotional valance. You were then given a list of items to rate how likely those items were to have appeared in your imagined events. Then, you were given a surprise recognition test for those items. However, the recognition test contained 'critical lures' which did not appear in the studied list, but were related to the events you imagined (e.g. a 'critical lure' for the holiday scenario was 'suitcase' as it did not appear in the original list, but is related to a holiday). If you recognised these 'critical lures' as having appeared in the original list, then this is an example of a false memory.

It is expected that participants will recognise the most 'critical lures' when thinking about future events and when those events are emotionally valanced.

This study involved some deception as you were not informed prior to staring the experiment that there would be a recognition test. However, this was necessary in order to measure the amount of false memories formed.

Contacts for further information:

If you have any questions about this study then please contact the lead investigator at s.dewhurst@hull.ac.uk

This study required you to think about events that are negative. It is possible that this may have caused you some emotional discomfort. If you wish to discuss any issues with someone in confidence then the following details may be useful:

University of Hull Health & Wellbeing Service: 01482 462222 or studentwellbeing@hull.ac.uk

Let's Talk (Depression & Anxiety Services Hull): 01482 335627 or pws.letstalk.hull@nhs.net

The Samaritans: 116 123 or jo@samaritans.org

Appendix E

Experiment 1 Consent Form

CONSENT FORM

Title of study: Thinking about emotional and neutral events

Name of Researcher: Georgia Vella; Supervising Researcher: Professor Steve Dewhurst.

Please read each of the statements below, and check each box to confirm.

	Please check each box to confirm each statement.
1. I confirm that I have read the information sheet 'Thinking about emotional and neutral events' (dated 28/09/2020) for the above study. I have had the opportunity to consider the information, ask questions and have had any questions answered satisfactorily.	○
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.	○
3. I understand that the research data, which will be anonymised (not linked to me) will be retained by the researchers and may be shared with others and publicly disseminated to support other research in the future. I understand that it will not be possible to withdraw my research data once they have been anonymised.	○

4. I understand that my personal data will be kept scurely in accordance with data protection guidelines, and will only be available to the immediate research team. Consent forms will be destroyed as soon as the study is completed.

5. I give permission for the collection and use of my anonymised research data to answer the research question(s) of this study.

6. I agree to take part in the above study.

→

Appendix F

Experiment 2 Instructions

PAST SCENARIOS

POSITIVE

Picnic

Think back and remember a time in your past when you went on a picnic. Remember what a great time you had. Think about the food you ate, the games you played, the beautiful scenery, and so on. Please spend a few moments remembering this picnic. While you are remembering this experience, I am going to present you with a list of words describing actions that you may or may not have performed on this picnic. I would like you to rate how likely it was that each of these actions occurred on the picnic. For some actions, it may be very likely that they happened. For others, it may be unlikely. It is up to you to decide.

Holiday

Think back and remember a time in your past when you went on a beach holiday abroad. Remember how excited you were when you arrived and what a fantastic time you had. Think about the fun things you did, the people you met, the wonderful weather, and so on. Please spend a few moments remembering this holiday. While you are remembering this experience, I am going to present you with a list of words describing actions that you may or may not have performed on this holiday. I would like you to rate how likely it was that each of these actions occurred on this holiday. For some actions, it may be very likely that they happened. For others, it may be unlikely. It is up to you to decide.

NEUTRAL

Train journey

Think back and remember a time in your past when you went on a train journey. Remember how the train looked. Think about the things you saw, the people you met, the passing scenery, and so on. Please spend a few moments remembering this train journey. While you are remembering this experience, I am going to present you with a list of actions that you may or may not have performed on this train journey. I would like you to rate how likely it was that each of these actions occurred on this train journey. For some actions, it may be very likely that they happened. For others, it may be unlikely. It is up to you to decide.

Supermarket

Think back and remember a time in your past when you went to the supermarket. Remember how supermarket looked. Think about the items you bought, the people you saw, how the supermarket looked, and so on. Please spend a few moments remembering this trip to the supermarket. While you are remembering this experience, I am going to present you with a list of actions that you may or may not have performed at the supermarket. I would like you to rate how likely it was each of these actions occurred at the supermarket. For some actions, it may be very likely that they happened. For others, it may be unlikely. It is up to you to decide.

NEGATIVE

Hospital

Think back and remember a time in your past when you had to stay in hospital. Remember how worried you felt. Think about the pain you experienced, how lonely you felt, the boredom, and so on. Please spend a few moments remembering your time in hospital. While you are remembering this experience, I am going to present you with a list of actions that you may or may not have performed at the hospital. I would like you to rate how likely it was that each of these actions occurred at the hospital. For some actions, it may be very likely that they happened. For others, it may be unlikely. It is up to you to decide.

Exam
Think back and remember a time in your past when you took an exam. Remember how unprepared you felt when you arrived. Think about how nervous you were, the fear that you had revised the wrong topics, and so on. Please spend a few moments remembering this exam. While you are remembering this experience, I am going to present you with a list of actions that you may or may not have performed at the exam. I would like you to rate how likely it was that each of these actions occurred at the at the exam. For some actions, it may be very likely that they happened. For others, it may be unlikely. It is up to you to decide.

TYPICAL SCENARIOS

POSITIVE

Picnic
Use your imagination to form a picture of a picnic. What happens in the image that you have created of the picnic? While you are imagining this picnic, I am going to present you with a list of list of phrases describing actions that you may or may not carry out on a picnic. I would like you to rate how likely it is that each of the actions occurs at a typical picnic. For some actions, it may be very likely that they happen. For others, it may be unlikely. It is up to you to decide.

Holiday
Use your imagination to form a picture of a beach holiday. What happens in the image that you have created of the holiday? While you are imagining this holiday, I am going to present you with a list of phrases describing actions that you may or may not carry out on holiday. I would like you to rate how likely it is that each of these actions occurs on a typical holiday. For some actions, it may be very likely that they happen. For others, it may be unlikely. It is up to you to decide.

NEUTRAL

Train journey
Use your imagination to form a picture of a train journey. What happens in the image that you have created of the train journey? While you are imagining this experience, I am going to present you with a list of phrases describing actions that you may or may carry out on a train journey. I would like you to rate how likely it is that each of these actions occurs on a typical train journey. For some actions, it may be very likely that they happen. For others, it may be unlikely. It is up to you to decide.

Supermarket
Use your imagination to form a picture of a supermarket. What happens in the image that you have created of the supermarket? While you are imagining this supermarket, I am going to present you with a list of phrases describing actions that you may or may not carry out at a supermarket. I would like you to rate how likely it is that each of these actions occurs at a typical supermarket. For some actions, it may be very likely that they happen. For others, it may be unlikely. It is up to you to decide.

NEGATIVE

Hospital

Use your imagination to form a picture of a hospital. What happens in the image that you have created of the hospital? While you are imagining this hospital, I am going to present you with a list of phrases describing actions that you may or may carry out in a hospital. I would like you to rate how likely it is that each of these actions occurs at a typical hospital. For some actions, it may be very likely that they happen. For others, it may be unlikely. It is up to you to decide.

Exam

Use your imagination to form a picture of an exam. What happens in the image that you have created of the exam? While you are imagining this exam, I am going to present you with a list of phrases describing actions that you may or may not carry out during an exam. I would like you to rate how likely it is that each of these actions occurs in a typical exam. For some actions, it may be very likely that they happen. For others, it may be unlikely. It is up to you to decide.

FUTURE SCENARIOS

POSITIVE

Picnic

Think ahead and imagine a time in your future when you will go on a picnic. Imagine what a great time you will have. Think about the food you will eat, the games you will play, the beautiful scenery, and so on. Please spend a few moments imagining this picnic. While you are imagining this experience, I am going to present you with a list of phrases describing actions you may or may not perform during this picnic. I would like you to rate how likely it is that each of these actions will occur. For some actions, it may be very likely that they will happen. For others, it may be unlikely. It is up to you to decide.

Holiday

Think ahead and imagine a time in your future when you will go on a beach holiday abroad. Imagine how excited you will be when you arrive and what a fantastic time you will have. Think about the fun things you will do, the people you will meet, the wonderful weather, and so on. Please spend a few moments imagining this holiday. While you are imagining this experience, I am going to present you with a list of phrases describing actions you may or may not perform during this holiday. I would like you to rate how likely it is that each of these actions will occur. For some actions, it may be very likely that they will happen. For others, it may be unlikely. It is up to you to decide.

NEUTRAL

Train journey

Think ahead and imagine a time in your future when you will go on a train journey. Imagine how the train will look. Think about the things you might see, the people you might meet, the passing scenery, and so on. Please spend a few moments imagining this train journey. While you are imagining this experience, I am going to present you with a list of phrases describing actions you may or may not perform during this train journey. I would like you to rate how likely it is that you each of these actions will occur. For some actions, it may be very likely that they will happen. For others, it may be unlikely. It is up to you to decide.

Supermarket

Think ahead and imagine a time in your future when you will go to the supermarket. Imagine how the supermarket will look. Think about the items you might buy, the people you might see, how the supermarket will look, and so on. Please spend a few moments imagining this trip to the

supermarket. While you are imagining this experience, I am going to present you with a list of phrases describing actions you may or may not perform at the supermarket. I would like you to rate how likely it is that each of these actions will occur. For some actions, it may be very likely that they will happen. For others, it may be unlikely. It is up to you to decide.

NEGATIVE

Think ahead and imagine a time in your future when you have to stay in hospital. Imagine that you feel very worried. Think about the pain you might experience, how lonely you will feel, the boredom, and so on. Please spend a few moments imagining your time in hospital. While you are imagining this experience, I am going to present you with a list of phrases describing actions you may or may not perform at the hospital. I would like you to rate how likely it is that each of these actions will occur. For some actions, it may be very likely that they will happen. For others, it may be unlikely. It is up to you to decide.

Exam

Think ahead and imagine a time in your future when you will take an exam. Imagine that you feel completely unprepared. Think about how nervous you will be, the fear that you have revised the wrong topics, and so on. Please spend a few moments imagining this exam. While you are imagining this experience, I am going to present you with a list of phrases describing actions you may or may not perform at the exam. I would like you to rate how likely it is that each of these actions will occur. For some actions, it may be very likely that they will happen. For others, it may be unlikely. It is up to you to decide.

Appendix G
Experiment 2 Stimuli

STUDY ITEMS (RELATED)					
PICNIC	HOLIDAY	HOSPITAL	EXAM	TRAIN	SUPERMARKET
Prepare the food	Arrive at airport	Arrive at hospital	Arrive at exam hall	Check train time	Make shopping list
Find somewhere to sit	Check in luggage	Talk to nurse	Place ID card on desk	Collect ticket	Choose shopping trolley
Lay out the food	Go through security check	Get into bed	Read exam questions	Find seat on train	Place shopping on conveyor belt
Chat to friends	Show boarding pass	Feel drowsy	Check time	Listen to music	Take the recipt
Throw away the rubbish	Get taxi to hotel	Wake up in recovery room	Close answer booklet	Charge your phone	Load shopping into car
Drive to picnic area	Go to passport control	Follow directions to ward	Chat to other students	Put bag on luggage rack	Drive to supermarket
Pour the drinks	Confirm departure time	Change into hospital gown	Write name on exam paper	Go to restaurant car	Place shopping in trolley
Play games	Go to departure lounge	Comb onto trolley	Listen to invigilator	Watch tv show	Browse homeware isles
People watch	Look around duty free shops	Arrive in theatre	Decide which questions to answer	Write in notebook	Drive home
Chill out	Land at destination	Feel the anesthetic	Answer rest of questions	Arrive at destination	Put shopping away
STUDY ITEMS (UNRELATED)					
Polish your shoes	Make a doctors appointment	Water the plants	Fry an egg	Paint the fence	Put the kettle on
Turn the TV off	Bake a cake	Clean the car	Watch a DVD	Make the bed	Feed the cat
Fall asleep	Mow the lawn	Order a takeaway	Read a newspaper	Post a letter	Check your email
Wash your face	Turn the heating on	Clean the windows	Tell a joke	Look in the mirror	Text a friend
Target items = present in recognition test					

TEST ITEMS (RELATED)					
PICNIC	HOLIDAY	HOSPITAL	EXAM	TRAIN	SUPERMARKET
Prepare the food	Arrive at airport	Arrive at hospital	Arrive at exam hall	Check train time	Make shopping list
Find somewhere to sit	Check in luggage	Talk to nurse	Place ID card on desk	Collect ticket	Choose shopping trolley
Lay out the food	Go through security check	Get into bed	Read exam questions	Find seat on train	Place shopping on conveyor belt
Chat to friends	Show boarding pass	Feel drowsy	Check time	Listen to music	Take the receipt
Throw away the rubbish	Get taxi to hotel	Wake up in recovery room	Close answer booklet	Charge your phone	Load shopping into car
Lay the blanket	**Pack suitcase**	**Go to reception**	**Enter exam hall**	**Arrive at station**	**Choose items from shelves**
Drink wine	**Check passport**	**Talk to doctor**	**Find seat number**	**Go to platform**	**Go to checkout**
Eat the food	**Find seat on plane**	**Feel anxious**	**Turn over exam paper**	**Board the train**	**Put shopping into carrier bags**
Admire the view	**Arrive at hotel**	**Talk to surgeon**	**Answer first question**	**Show ticket to conductor**	**Pay for shopping**
Watch the sunset	**Relax on the beach**	**Take painkiller**	**Stop writing**	**Read a book**	**Return trolley**
TEST ITEMS (UNRELATED)					
Polish your shoes	Make a doctors appointmer	Water the plants	Fry an egg	Paint the fence	Put the kettle on
Turn the TV off	Bake a cake	Clean the car	Watch a DVD	Make the bed	Feed the cat
Play a video game	**Blow your nose**	**Ride a bicycle**	**Walk the dog**	**Load the dishwasher**	**Write a letter**
Close the curtains	**Vacuum the house**	**Sing a song**	**Play scrabble**	**Go for a run**	**Turn the lamp off**

Appendix H

Debriefing Information Sheet Experiment 2

Study Title: Thinking about emotional and neutral events

Student Researcher: Georgia Vella; **Supervising Researcher:** Prof. Steve Dewhurst

Thank you for taking part in this study. The participant information sheet gave you a general overview of the study. Now you've completed the study we can provide you with a more detailed description of our research.

False memories are very common in everyday life and can be described as incorrect memories of events or memories of events that never happened. The susceptibility to false memories can be influenced by various factors, such as emotion and thinking about the future. The main aim of this study is to investigate the relationship between false memory formation, emotion, and thinking about the future. The amount of false memories formed were measured in this study via the recognition test.

To do this, you were asked to think about either past, typical, or future events that were positive, negative, and neutral in emotional valance. You were then given a list of phrases describing actions to rate how likely those actions were to occur in your imagined events. Then, you were given a surprise recognition test for those action phrases. However, the recognition test contained 'critical lures' which did not appear in the studied list, but were related to the events you imagined (e.g. a 'critical lure' for the holiday scenario was 'pack suitcase' as it did not appear in the original list, but is related to a holiday). If you recognised these 'critical lures' as having appeared in the original list, then this is an example of a false memory.

It is expected that participants will recognise the most 'critical lures' when thinking about future events and when those events are emotionally valanced.

This study involved some deception as you were not informed prior to staring the experiment that there would be a recognition test. However, this was necessary in order to measure the amount of false memories formed.

Contacts for further information:

If you have any questions about this study then please contact the lead investigator at s.dewhurst@hull.ac.uk

This study required you to think about events that are negative. It is possible that this may have caused you some emotional discomfort. If you wish to discuss any issues with someone in confidence then the following details may be useful:

The Samaritans: 116 123 or jo@samaritans.org
MIND: 0300 123 3393 or info@mind.org.uk

Appendix I
Participant Information Sheet Experiment 2

Title of study: thinking about emotional and neutral events

I would like to invite you to participate in a research project which forms part of my MRes Psychology research. Before you decide whether you want to take part, it is important for you to understand why the research is being done and what your participation will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information.

What is the purpose of this study?

The purpose of the study is to investigate how adults think about various life events when the emotional valence of those life event differs (e.g. positive, negative, or neutral).

Why have I been invited to take part?

You are being invited to take part in this study because you are a UK student and willing to think about various life events for the experiment.

What will happen if I take part?

If you decide to take part, you will firstly view the consent form. Once all boxes on the consent form are ticked, you may click the arrow which confirms your consent and directs you to the experiment. When the experiment starts, you will be asked to imagine six life events. Of these events, two will be positive (a picnic and a holiday), two will be negative (taking an exam for which you are unprepared and spending time in hospital), and two will be neutral (a train journey and a supermarket trip). If you have not experienced an event that you are asked to remember, you will be asked to imagine that the event has happened instead. You will be given 30 seconds to think about each event. After each event is described, you will be presented with a list of phrases describing actions, one at a time, and asked to rate how likely the set of actions are to occur within that event. The experiment will last approximately 35 minutes. As part of participation, you will be asked to provide your age and gender, which will only be collected with your prior consent.

Do I have to take part?

Participation is completely voluntary. You should only take part if you want to and choosing not to take part will not disadvantage you in any way. Once you have read the information sheet, please contact us if you have any questions that will help you make a decision about taking part. If you decide to take part we will ask you to sign a consent form prior to starting the experiment.

Payment

You will receive £3.50 for your participation. You should expect to be paid for completing the experiment within 24-48 hours. If you do not fully complete the experiment, or if you answer randomly, you will not receive payment.

What are the possible risks of taking part?

You will be required to think about events that are negative which could be upsetting. If you become upset, you may withdraw from completing the study at any point. If further support is needed, here are some contact details that may be useful:

MIND: *0300 123 3393* or *info@mind.org.uk*
The Samaritans: 116 123 or jo@samaritans.org

What are the possible benefits of taking part?
Data received from completion of the experiment will contribute towards new psychological research.

Data handling and confidentiality

Your data will be processed in accordance with the General Data Protection Regulation 2016 (GDPR).

Data provided will be anonymised through use of participant numbers, instead of using personal names. Therefore, personal data (age, sex etc) will only be associated with a participant number upon completion of the experiment. Therefore, the researcher will not be able to associate your name with your data after submission. After submission, you will no longer be able to withdraw the data as it will be unknown which dataset belongs to you.
All information collected about you and your participation will be kept private and confidential. Personal data will be shared within the research team and will not be shared outside of the EU. Anonymised data may be shared with other researchers in the EU. If the findings of the study are only to be used as part of a Master's degree thesis, then all data and consent forms will be destroyed when the researcher has received the final grade for the thesis. If findings are deemed punishable as part of a larger project, then all data will be stored by the supervisor for 10 years after the publication date and will be destroyed once the 10 year period is over.

Data Protection Statement

The data controller for this project will be the University of Hull. The University will process your personal data for the purpose of the research outlined above. The legal basis for processing your personal data for research purposes under GDPR is a 'task in the public interest' You can provide your consent for the use of your personal data in this study by completing the consent form that has been provided to you. Information about how the University of Hull processes your data can be found at https://www.hull.ac.uk/choose-hull/university-and-region/key-documents/data-protection.aspx

You have the right to access information held about you. Your right of access can be exercised in accordance with the General Data Protection Regulation. You also have other rights including rights of correction, erasure, objection, and data portability. Questions, comments and requests about your personal data can also be sent to the University of Hull Data Protection Officer [dataprotection@hull.ac.uk]. If you wish to lodge a complaint with the Information Commissioner's Office, please visit www.ico.org.uk.

What if I change my mind about taking part?

You are free withdraw at any point during the study, without having to give a reason. You are able to withdraw your data from the study up until after completion of the experiment. Once you complete the experiment, the withdrawal of your data will no longer be possible due to the data being fully anonymised from that point. This means the researcher will not know which data is yours to withdraw. If you choose to withdraw from the study, we will not retain the information you have given thus far.

What will happen to the results of the study?

The results of the study will be summarised in the researcher's MRes Psychology thesis. These anonymised data may then be published as part of a larger paper.

Who has reviewed this study?

Research studies are reviewed by an independent group of people, called a Research Ethics Committee, to protect your interests. This study has been reviewed and been given a favourable opinion by the Department of Psychology ethics committee, at the University of Hull.

Who should I contact for further information?

If you have any questions or require more information about this study, please contact me using the following contact details: e-mail: G.vella-2017@hull.ac.uk

What if I have further questions, or if something goes wrong?

If you wish to make a complaint about the conduct of the study, you can contact the University of Hull using the details below for further advice and information:

Professor Steve Dewhurst, Psychology department, University of Hull, HU6 7RX. Office telephone number 01482 465931; E-mail: S.Dewhurst@hull.ac.uk

Alternatively, please contact registrar@hull.ac.uk

Thank you for reading this information sheet and for considering taking part in this research.

Appendix J

Consent Form Experiment 2

CONSENT FORM

Title of study: Thinking about emotional and neutral events

Name of Researcher: Georgia Vella; Supervising Researcher: Professor Steve Dewhurst.

Please read each of the statements below, and check each box to confirm.

	Please check each box to confirm each statement.
1. I confirm that I have read the information sheet 'Thinking about emotional and neutral events' (dated 01/02/2021) for the above study. I have had the opportunity to consider the information, ask questions and have had any questions answered satisfactorily.	○
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason.	○
3. I understand that the research data, which will be anonymised (not linked to me) will be retained by the researchers and may be shared with others and publicly disseminated to support other research in the future. I understand that it will not be possible to withdraw my research data once they have been anonymised.	○

4. I understand that my personal data will be kept scurely in accordance with data protection guidelines, and will only be available to the immediate research team. Consent forms will be destroyed as soon as the study is completed.	○
5. I give permission for the collection and use of my anonymised research data to answer the research question(s) of this study.	○
6. I agree to take part in the above study.	○

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