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Mental Time Travel: Is Experience Everything?

By

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Honours Thesis
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April, 2012

Acknowledgements

For my consort, Brooke, and my two brilliant stars, Nolan and Navvàb. Your patience and understanding made this possible. Thanks to Azar and Nosrat for your unqualified support and love. Special thanks goes to Dr. Angie Birt. This project was a success because of your wisdom, commitment to excellence, and matchless leadership. Husayn and Samira – thanks for keeping me entertained.

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Abstract

According to research on mental time travel, differences between episodic memory and episodic future thought are due to temporal direction (i.e., past vs. future). Recently, it has been suggested that it is familiarity with memories and associated details that may affect such differences. Following the recombination methodology of Addis, Pan, Vu, Laiser, and Schacter (2009), participants (N = 27) were asked to recall episodic memories, and to imagine episodic events in the past, present, or future using memory details ranked for level of familiarity collected prior to the experiment. Data on both self-report (e.g., vividness, effortfulness) and objective (e.g., level of detail, coherence) characteristics of the remembered and imagined events were collected. It was predicted that familiarity with memories and associated details, not temporal direction, would account for the differences between episodic memory and future thought. Results did not support this hypothesis, but demonstrated that the variation between episodic memory and episodic future thought is due to the relationship between remembering and imagination. Suggestions are made to (a) change conceptualization of episodic future thought such that the focus is on the process of imagining and not on mental projection into the future, and (b) replicate the current design with a false memory condition to validate and expand upon the findings.

Mental Time Travel: Is Experience Everything?

Many of the complex processes that make up human memory continue to elude scientists, but one widely accepted theory of the structure of long-term memory maintains there are three systems involved: procedural, semantic, and episodic. Tulving (1972, 1985) described these three systems in detail. He explained that procedural memory is concerned with how things are done; specifically, how we acquire, retain, and use our various skills such as the motor movements involved in riding a bike or the cognitive processes required to read this sentence. He described semantic memory as symbolically representable knowledge, i.e., facts and knowledge we "know" about the world such as our phone numbers, the capital of Canada, or the alphabet. By contrast, episodic memory (EM) is memory of personally experienced events. When EM is accessed, we are, in fact, mentally travelling back through time to personal experiences from our past in order to recall details that might have been encoded into our memory when we first experienced the event. For instance, during a criminal investigation we may be asked to mentally revisit the scene of a crime to provide investigators with information that could be useful to their case such as physical details about the criminal, or how many gun shots we heard.

Tulving (1985) also introduced the concept of *Autonoetic Consciousness*, which he defined as an awareness of the "self." Tulving argued that EM is the process of mentally projecting the "self" into the past in order to remember a previously experienced event. In the same sense,

Tulving posited episodic future thought (EFT) as the process of projecting the "self" into the future. He then went on to label the process by which we mentally travel between our personal past and our personal future mental time travel (MTT), and in the last ten years numerous research studies dedicated to this topic have been published (e.g., Addis et al., 2009a,b; Anderson & Dewhurst, 2009; Arnold, McDermott, & Szpunar, 2011; Arzy, Molnar-Szakacs, & Blanke, 2008; Berntsen & Bohn, 2010; Caruso, Gilbert, & Wilson, 2008; D'Argembeau & Van der Linden, 2004).

Theoretically, the study of MTT gives us insight into an aspect of memory and consciousness that is uniquely human. Suddendorf and Corballis (2007a) argue that our closest genetic relatives, the great apes, demonstrate primitive behaviours that resemble MTT such as preparing for future needs (e.g., storing food for the winter). Human MTT, however, is far more complex because it allows us to voluntarily anticipate novel future events (e.g., anticipating one's future death or imagining ourselves on vacation in the tropics). Outside of comparative psychological research, scientists have studied MTT in relation to self-efficacy (Eren, 2009), personality disorders (Winfield & Kamboj, 2010), cognitive development (Perner, Kloo, & Rohwer, 2010), the subjective experience of time (Szpunar, 2011), stress-reduction (Quoidbach, Wood, & Hansenne, 2009), language (Corballis, 2009), personality (Quoidbach, Hansenne, & Mottet, 2008), and more (see Suddendorf & Corballis, 2007b for a review). Indeed, what we

have witnessed over the past decade is an "explosion" of interest in MTT (Suddendorf & Corballis, 2007b). The study of MTT has also provided researchers with new and important insights into the neurophysiological correlates of cognitive dysfunction. For instance, adults with cognitive impairment in EM (e.g., hippocampal damage, Alzheimer's disease, retrograde amnesia) also show deficits in EFT (Addis et al., 2009b; Costa et al., 2010; Klein, Loftus, & Kihlstrom, 2002; Kwan, Carson, Addis, & Rosenbaum, 2010).

Ongoing research is also committed to understanding how MTT is possible and how it is experienced. Namely, researchers have explored brain structures, cognitive processing, and phenomenological experience to better understand MTT. The specific aim of many of these studies has been to examine the similarities and differences between EM and EFT because the current paradigm suggests that these two processes are necessary for MTT to occur. The purpose of the current study will be better understood with a basic knowledge of the relationship between EM and EFT; therefore, the following section will review the most representative literature on EM and EFT from the past decade.

Similarities and Differences Between EM and EFT

Overlapping neural processes

The more widely accepted theory of MTT proposes that when we imagine ourselves in the future we do so by drawing on EM details from our past and recombining them into new events (Addis, Wong, and Schacter, 2007). For example, we might use details from our personal experiences with weddings in the past to imagine ourselves in our own wedding in the future. To help explain this overlapping relationship between EM and EFT, Addis et al. (2007) proposed the Constructive Episodic Simulation Hypothesis (CESH), which posits that EM provides a source of details for simulating episodic future events.

The CESH is supported by neuroanatomical research. For example, numerous studies have demonstrated that both EM and EFT activate a common neural network (e.g., Addis et al., 2007, 2008, 2009a; Hassabis, Maguire, Vann, & Kumaran, 2007b; Kwan et al., 2010; Squire, van der Horst, McDuff, Frascino, Hopkins, & Mauldin, 2010; Szpunar, Chan, & McDermott, 2009; Viard et al., 2011; Weiler, Suchan, & Daum, 2010). Moreover, during EM and EFT there are common areas of activation that are implicated in spatial and contextual processing, memory, and emotion found in the temporal lobes. Specifically, the hippocampus and the parahippocampal gyrus have been consistently implicated in EM and EFT (Addis et al., 2007, 2008, 2009a; Hassabis et al., 2007a,b; Kwan et al., 2010; Szpunar et al., 2009; Viard et al., 2011;

Weiler et al., 2010). Researchers have long suspected that the medial temporal lobes, which include the hippocampus and the parahippocampal gyri, are critical to episodic and semantic memory processes (Eichenbaum, 2001; Moscovitch, 2008; Squire, 1992). Numerous studies have demonstrated that the medial temporal lobes are activated during EFT (e.g., Addis et al., 2008, 2009a, 2010; D'Argembeau & Mathy, 2011; Kwan et al., 2010; Szpunar et al., 2009; Viard et al., 2011; Weiler, Suchan, & Daum, 2011), and that damage to the hippocampus will result in an impaired ability to generate contextual, spatial, and sensory details during EFT (Hassabis et al., 2007b; Kwan et al., 2010). In the context of MTT, it is possible that when a person generates an imagined future event during EFT the hippocampus and parahippocampal gyri are directly involved in retrieving memory details from EM, which is consistent with Addis et al.'s (2007) CESH.

Characteristic differences between EM and EFT

Although EM and EFT are overlapping processes, they each have distinct characteristics, and there is a growing collection of empirical data documenting the experiences of individuals engaged in EM and EFT. Table 1 displays the variables that have been found to be strongly and consistently related to MTT. Note that this review is not exhaustive, but is representative of the most recent literature.

Table 1

Characteristics of EM and EFT

Variable	EM	EFT
Sensory details	More	Less
Clarity of context	More	Less.
Coherence	More	Less
Emotional Valence	Inconsistent	More positive
Personal importance	Less	More
Vantage Point	Field	Observer
Specificity	More specific	Schematic

As is evident by Table 1, individuals report more sensorial detail (Berntsen & Bohn, 2010; Gordon, Gerrig, & Franklin, 2009; Quoidbach et al., 2008) better spatial coherence, and clearer contextual information (D'Argembeau & Van der Linden, 2004, 2006; Gordon et al., 2009; Quoidbach et al., 2008; Viard et al., 2011; Weiler et al., 2011) when remembering the past than they do when imagining the future. Furthermore, participants generally report that when they remember the past, their thoughts form a more coherent story (Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2004, 2006; Weiler et al., 2011), and they experience that story from a field perspective, i.e., visualizing the scene from the originally experienced perspective as opposed to seeing themselves in the scene (Berntsen & Bohn, 2010; D'Argembeau & Van der

Linden, 2004, 2006; Rathbone, Conway, & Moulin, 2011; Viard et al., 2011; Weiler et al., 2011).

Overall, remembering the past is a more specific and richer experience than is imagining the future. One explanation for this is that the cortical regions specific to remembering one's personal past are associated mostly with visual processes. These cortical regions include the posterior visual cortex (Addis et al., 2007; Weiler et al., 2011), occipital gyri, lingual and fusiform gyri, and the cuneus (Addis et al., 2009a; Weiler et al., 2010). Consequently, researchers argue that since these regions were involved in processing the original memory, remembering might include a process of recapitulation by which these regions are reactivated (Addis et al., 2007, 2008, 2009a; Viard et al., 2011; Weiler et al., 2010, 2011). In other words, when we are remembering we are not only recalling our experience of the past, but we are reactivating the neural mechanisms by which these experiences were processed, and, in turn, this often results in the re-experiencing phenomenon that characterizes EM.

By contrast, events associated with EFT are typically reported as more positive (Berntsen & Bohn, 2010; Caruso et al., 2008; D'Argembeau & Mathy, 2011; Hepburn, Barnhofer, & Williams, 2006), and more important and relevant to one's life story and sense of identity (Berntsen & Bohn, 2010; Caruso et al., 2008; D'Argembeau & Mathy, 2011) than are events associated with EM. Interesting, however, is the fact that even though future episodic events are

associated with high life importance, they tend to be less detailed and more schematic than are EM events (Anderson & Dewhurst, 2009; Berntsen & Bohn, 2010; D'Argembeau & Mathy, 2011; Viard et al., 2011).

A number of arguments have been made to explain why EFT tends to be more positive, more personally important, and more schematic than EM. For instance, D'Argembeau and Van der Linden (2004, 2006) argued that because our future is tied to our goals, motives, and purposes we tend to imagine it as positive, valuable and relevant to who we are and who we will become. Also, Berntsen and Bohn (2010) argued that memories are encoded and maintained over time through rehearsal whereas future thoughts are not (or are less likely to be). It is, therefore, the rehearsal that leads to richer, more specific EMs and lack of rehearsal that results in less specific, more schematic EFTs.

Research has also demonstrated that participants report having to engage in more mental effort to bring a future event to mind than they do to remember a past event (Addis et al., 2007; Arnold et al., 2011). Addis et al. (2007) use the CESH to argue that the greater neural activation during EFT can be explained by the greater cognitive effort required for drawing on EM details from our personal past when generating imagined future events. Another explanation for the increase in perceived effort during EFT is that the neural activation required for this process is more cognitively demanding than during EM. For instance, the cortical regions that are largely

involved in EFT are also implicated in the generation of semantic knowledge and executive functioning. These regions include the medial prefrontal cortex (Szpunar, et al., 2009; Viard et al., 2011), lateral prefrontal regions (Weiler et al., 2010), frontopolar cortex (Addis et al., 2007, 2008, 2009a), inferior frontal gyrus (Addis et al., 2007, 2009a; Viard et al., 2011), medial parietal cortex, posterior parietal cortex, postcentral gyrus, and the precentral gyrus (Addis et al., 2007, 2009a; Viard et al., 2011; Weiler et al., 2010). In fact, researchers have consistently reported that the construction of EFTs requires the activation of the above regions (Addis et al., 2007, 2008, 2009a; Viard et al., 2011; Weiler et al., 2010).

In summary, studies have demonstrated that EM and EFT are characteristically different processes that tap into the same memory store. However, in spite of the abundant research, the source of variation between EM and EFT is still ambiguous in that we do not know what accounts for the differences between them. The literature suggests that the variation between EM and EFT can be largely accounted for by temporal direction (TD: past versus future). For instance, EMs are generally regarded as richer in detail than are EFTs because of their "pastness," and EFTs are thought to have less sensory detail because of their "futureness." However, in 2011, Arnold et al. studied how familiarity with locations affected the clarity of our mental representations of events imagined in the near and distant future. They did this by asking participants (N = 160) to report how clearly they experienced familiar and unfamiliar locations in

EFTs for near and distant events. What they found was that familiarity with memory details exerted a larger effect on the clarity of our mental representation than did temporal distance (i.e., near and distant). This effect could also be generalized to TD. For example, a familiar location is easy to bring to mind and vivid regardless of whether it is remembered in the past or imagined in the future.

The idea that familiarity with memory details exerts a greater influence on the richness of our mental representations than do temporal factors has received little attention in the literature, and leads us to ask the following questions: Is EM a richer experience because of its "pastness" or because of our level of experience with it? Is EFT considered more positive, valuable, and more schematic because it deals with events that have yet to occur or because of our lack of direct experience with the future? Is the greater neural activity and perceived mental effort attributed to EFT due the difficulty of imagining something in the future or to factors related to the mental process of recombining familiar or unfamiliar memory details? This study attempted to answer these questions.

The Current Study

If it is found that our level of experience (LOE) with memory details accounts for the differences observed between EM and EFT, the theoretical model of MTT, which holds that TD accounts for the differences, will be challenged. If LOE is the primary source of variation

between EM and EFT, then MTT, regardless of whether it is directed toward the past or the future, is a single cognitive function. In other words, whether our minds are traveling into the past or into the future, the characteristics of MTT remain the same. It was the aim of this study, then, to demonstrate that it is our LOE with memories and their associated details, not TD, which accounts for the variation in vividness, vantage point, emotional valence (i.e., how emotionally positive or negative the experience was), emotional intensity, and mental effort between EM and EFT.

Methods

Design

The design of the study was a 2 (LOE: Low vs. High) x 3 (TD: Past, Present, vs. Future) complete within-subjects design. Participants were first required to complete a stimulus collection session (SCS) during which they recalled 48 EMs from between 1 and 5 years in the past. These EMs had to be specific in time and place, lasting no longer than one day. This constraint was used in most studies that investigated episodic processing (e.g., Addis et al., 2009a; Weiler et al., 2010; Williams, Ellis, Tyers, & Healy, 1996) because it ensures participants focus their attention on contextually specific EMs as opposed to more ambiguous events. For example, the delivery of a baby would be acceptable whereas the last month of a pregnancy would be too vague and too long. After recalling an EM, participants were asked to provide a

person, object, and location detail for each memory as well as a brief title to help them identify the memory at a later date. The participants also ranked each of the memory details on their LOE with them.

Before the experimental phase, the 48 memories and associated details collected during the SCS were grouped by the experimenters into High and Low LOE, and then manually recombined into 16 stimulus-sets to be used in the experiment. Each stimulus-set included a person, location, and object detail from three separate memories accompanied by each detail's corresponding memory title. See Appendix A for an illustration of the recombination procedure.

During the experimental phase of the study, participants were asked to either remember or to imagine an event using the recombined stimulus-sets. The imagined or remembered events had to involve the person, location, and object details specified in the stimulus-set. The experimental conditions included an Imagine-Future condition in which participants imagined future events, an Imagine-Present condition that required imagining present events, an Imagine-Past condition that entailed imagining past events, and a Recall condition during which participants recalled memories of past events that had occurred. Each condition was further broken down into a High and a Low LOE condition, such that during the High LOE conditions participants were required to generate events using High LOE memory details, and during Low LOE conditions participants were required to generate events using Low LOE memory details.

These stimulus-sets were presented randomly across the entire experiment. See Table 2 for the distribution of stimulus-sets across all experimental conditions. The above methodology is a modified version of a technique developed by Addis et al. (2009a). See Appendix B for the rationale behind their technique and the modifications made to that technique for the current study.

Table 2

Distribution of stimulus-sets across the eight experimental conditions.

	TD			
LOE	Recall	Imagine-Past	Imagine-Present	Imagine-Future
High	2 stimulus-sets	2 stimulus-sets	2 stimulus-sets	2 stimulus-sets
Low	2 stimulus-sets	2 stimulus-sets	2 stimulus-sets	2 stimulus-sets

Since the purpose of this study was to demonstrate that the variation between EM and EFT is due to LOE and not TD, it was necessary to identify dependent variables that had been shown to vary, consistently, between EM and EFT. Therefore, it was decided that vividness, vantage point, emotional valence, and the level of effort required for remembering or imagining events would be used because they varied the most consistently between EM and EFT. The experimenter was also interested in examining the effects of TD and LOE on the emotional intensity of EM and EFT, so this variable was also included.

Participants

The SCS

Undergraduate students (*N*=221) were recruited in order to ensure that there was a sufficient number of participants from the SCS who could take part in the experiment, given that meta-analyses of attrition rates in psychological research have been reported as high as 42% (e.g., Roberts & DelVecchio, 2000). Of the 221 students recruited, 172 responded through email, and 62 completed the SCS.

For the SCS, students were approached in classrooms and through an advertisement uploaded to their class websites. Via email, interested students were sent a short description of the study as well as a link to the online SCS (see Appendix C for the whole invitation to participate), and incentive details. The incentives for this study included being entered into a draw for a $50 gift certificate for a major bookstore as well as class participation or bonus points (at the discretion of professors).

The experiment

Those who indicated, during the SCS, an interest in participating in the experiment, and who provided sufficient memory details (so that memory recombination could be performed) were contacted. Consequently, 31 participants met the aforementioned criteria for the experiment.

Of those who qualified, two opted out of the experiment and 2 failed to respond to the invitation for the experiment.

Twenty-seven undergraduate students (23 female, 4 male; age range = 18-49 years; *M* = 24.1 years;) attending Mount Saint Vincent University during the 2011-12 academic year participated in the experimental portion of this study.

Materials

SCS

FluidSurveys

The SCS was conducted online using FluidSurveys, which is an online survey system that has servers based in Canada (Chide.it Inc., 2011). Participants were able to access an online session using a link that was emailed to them after they had requested to participate in the study. Each participant received a unique link so that they could take a break and revisit the SCS without losing their data.

Event cues

Providing participants with a list of event cues has proven effective for triggering the recall of specific EMs (Addis et al., 2009a, 2010; Viard et al. 2011), and event cues are more effective at activating EMs than are general word cues (Berntsen & Rubin, 2004). Therefore, a

list of 50 event cues was generated using Clark and Paivio's (2004) expanded norms for nouns normed on imagery, concreteness, and meaningfulness, as well as Bradley and Lang's (1999) Affective Norms for English Words (ANEW), which is a list of English words normed for emotional valence and intensity. Fifty event cues were provided to the participants to assist them in generating 48 memories during the SCS, but they were not limited to using these event cues and were free to include memories unrelated to the cues.

Since a primary manipulation in this experiment was LOE with event details, it was important that participants were not only providing highly distinct and familiar memories during the SCS because this would have resulted in far fewer Low LOE details. Given the fact that emotional stimuli tend to be highly distinct (e.g., Christianson, 1992; Ochsner, 2000) and remembered in greater detail than unemotional stimuli (e.g., Kensinger, 2004; Porter & Birt, 2001), an attempt was made to avoid unnecessarily biasing participants towards recollecting strongly emotional events. To accomplish this, words were selected from the ANEW list (1 = negative; 9 = positive) such that 30 words were neutral (valence rating = 3.51 - 6.49), 10 words were positive (valence = 6.5 – 9), and 10 words were negative (valence = 1 - 3.5). Also, given that it was important to avoid intentionally eliciting memories that were either too easy or too difficult to recall and would consequently confound with familiarity, the words in the event cue list were selected such that they were of medium familiarity (*M*= 5.55, *SD*= 67; 1 = low

familiarity, and 7 = high familiarity), and imageability (*M*=4.76, *SD*=1.17; 1 = low imageability, and 7 = high imageability), as per Clark and Paivio's (2004) extended norms for nouns. See Appendix D for the list of event cues and their normed ratings.

EM scales of familiarity

Obtaining information on level of familiarity was necessary to determine participants' subjective report of LOE. Frequency of contact and effortfulness were included to verify that any potential differences found in LOE were not due to differences in participants' lack of physical contact with, or difficulty in creating a mental representation of the person, object, or location detail. Therefore, for each event participants generated during the SCS, they were asked to indicate how familiar they were with the three specific details associated with the event: the person, location, and object. They were also asked to indicate how frequently they came in contact with the specified person, location, and object. Finally, they rated the level of ease associated with thinking about those event details. All three scales were 7-point Likert scales (see Appendix E for the EM scales of familiarity). These scales were adapted from Arnold et al.'s (2011) study in which scales were used to determine the participant's familiarity with locations set in the future and the past.

Recombination of memory details into experimental stimuli

The 48 memories and associated details collected during the SCS were grouped into High and Low LOE. Using the scores on the EM scales of familiarity for each memory detail, the memory details were grouped as Low (1-3), Medium (3.1-4.9), or High (5.0-7) in LOE. These memory details were then recombined into 16 stimulus-sets for each participant using the aforementioned recombination procedure developed by Addis et al. (2009a). See Appendix A.

The experiment

SuperLab software

The experiment was administered using a psychology-specific stimulus presentation software program, SuperLab (Cedrus Corporation, 2010). This software was used to deliver the stimulus-sets and the subjective ratings scales.

Subjective scales of phenomenological experience

During the experiment, participants were presented with five scales that measured their subjective experience of vividness (7-point scale; 1 = low to 7 = high), vantage point (dichotomous, 1= Field; 2 = Observer), emotional valence (7-point scale; 1 = negative to 7 = positive), emotional intensity (7-point scale; 1 = not intense to 7 = very intense), and how much effort was required to bring an event to mind (7-point scale; 1 = very easy to 7 = very effortful).

These scales have been used in previous studies measuring the differences between EM and EFT (Addis et al., 2009a,b, 2010; Arnold et al., 2011; Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2006). Also, all of these questions are similar to the rating scales found in the Memory Characteristics Questionnaire (MCQ; Johnson, Foley, Suengas, & Raye, 1988), which has been used in studies assessing memory characteristics (e.g., Gordon, et al., 2009; Mickley & Kensinger, 2009). See Appendix F for the subjective rating scales of phenomenological experience.

Objective coding of event elaborations

Since subjective scales are susceptible to human factors such as bias, interpretation, and reactivity, objective measures of vividness, vantage point, valence, emotional intensity, and level of effort were also employed in this study to corroborate the participants' subjective experience. Researchers have argued for mixing quantitative and qualitative methods to strengthen the accuracy and validity of research results, to corroborate results, to generate multifaceted insights, and to reveal contradictions (e.g., Brannen, 2005; Tashakkori & Teddlie, 1998; Watson & Welch-Ross, 2000).

Response time for event construction

The amount of time required for participants to remember or imagine an event in their mind was measured. During the experiment the participants were required to press a button when they were ready to think of their imagined or remembered event, and this time was recorded as the beginning of the event construction. After thinking of the event, participants would press a button to indicate that they had thought of the requested event, and this time was recorded as the end of event construction. It was anticipated that these response times (RT) would provide quantitative insights into the subjective ratings of perceived mental effort. The assumption here is that the longer it takes to think of an event, the more mental effort is involved (Bates & Stough, 1998; Hick, 1952; Jensen, 2005). The RT for event construction was also included to measure the participants' level of engagement in the task. Prolonged RTs might have indicated distraction or inattention, and impossibly short RTs might have indicated that participants were not engaging in the requested task.

Coding of event elaborations

During the experiment, participants were asked to elaborate on their memories and imagined events by typing them out in as much detail as possible. These event elaborations were then coded for features that corresponded with the subjective scales described above. For the objective measure of vividness the event elaborations were coded for number of words, details,

and sensory details as well as for level of coherence according to the criteria employed by Porter and Birt (2001). It is important to note that research has demonstrated rich sensory detail to be highly correlated with vivid phenomenological experiences (Nelson, Moskovitz, & Steiner, 2008). Coding of the event elaborations consisted of partitioning the typed up experience into single units of information, and then counting the total number of units. For example, the sentence "Mom was holding a blue purse and a scarf" has four details – one action (carrying) and three descriptives (Mom, blue purse, scarf). Sensory details were partitioned in the same way, but were determined by counting up the number of sensory components in the event elaboration (i.e., any mention of visual, auditory, olfactory, tactile, and gustatory details). Level of coherence was determined by rating whether the event elaboration followed a logical sequence with a beginning, middle, and end reported in that order (i.e., the information was presented in a logical, *story-like* manner as opposed to a bunch of random sentences). The overall coherence of the event elaboration was rated on a 1-7 scale (1= highly incoherent, 7= highly coherent). The event elaborations were also coded for number of references to emotion, which was determined by simply counting all emotional words and emotion-related expressions (e.g. 'I was so happy') (Porter & Birt, 2001). It was anticipated that this measure would correlate with participants' subjective reports of emotional intensity and valence.

Procedure

SCS

Approximately one month prior to the experiment, participants were invited to take part in the SCS. They accessed the SCS online via a link that was sent to their email account. After reading the informed consent form (see Appendix G for the SCS informed consent form) and pressing a button to indicate their consent, participants answered three demographic questions for age, sex, and handedness. In order to familiarize participants with the procedure of the SCS, they watched a short training session video. The video was followed by a practice trial. Next, participants were instructed to recollect an EM from between 1 and 5 years ago (see Appendix H for the specific instructions). A screen of 50 event cues followed the above instructions to help participants recall specific memories. After participants had successfully recalled the EM, they dated the memory as specifically as they could manage (to verify that the memory met the criteria of occurring between 1 and 5 years in the past), and specified three associated details: a person (other than themselves), an object featured in the memory, and the location at which the event occurred. For each memory detail, participants completed the EM scale of familiarity. Participants then generated a brief, but descriptive, title for the memory (which was used to facilitate recall during the experiment). As mentioned, this process was repeated 48 times in order to have detailed information on 48 EMs, 16 of which were to be recombined and used for

the experiment (remember that Addis et al.'s ratio of gathering three times as many memories during the SCS as required for the experimental sessions was used so that there were enough details for recombination). The SCS took approximately 2 hours to complete per participant.

The experiment

As mentioned, the experiment was administered using a psychology-specific stimulus presentation software program, SuperLab (Cedrus Corporation, 2010). Participants were tested in groups of two to five in a computer lab. Each participant was assigned to his/her own computer and completed the experiment independently. After the participant read the consent form (see Appendix I for the experiment informed consent form) and provided consent to participate by pressing a button at the bottom of the screen, the experimenter (with the help of research assistants) orally guided each participant through a practice trial.

Event construction phase

After the practice trials, participants were prompted by a "default screen" to press a button when they were ready to continue. This default screen was displayed before each experimental trial so that participants could pace themselves through the experiment. Upon pressing the button, participants were prompted to either recall a memory or to imagine an event

in their mind using the stimulus-set displayed on the screen. The specific instructions for the three "Imagine" conditions were as follows:

Imagine-Future condition: Imagine yourself in a plausible personal experience between 1 and 5 years in the FUTURE that involves (insert stimulus-set here). Event must be specific in time and place, lasting no longer than one day.

Imagine-Present condition: Imagine yourself in a plausible personal experience RIGHT NOW that involves (insert stimulus-set here). Event must be specific in time and place, lasting no longer than one day.

Imagine-Past condition: Imagine yourself in a plausible personal experience between 1 and 5 years in the PAST that involves (insert stimulus-set here). Event must be specific in time and place, lasting no longer than one day.

The specific instructions for the Recall condition were as follows:

Recall condition: RECALL your memory that involved the following details.

Remember that in this condition participants were presented with a non-recombined stimulus-set from their SCS (i.e., the person, object, and location details reported by participants during the SCS for a single memory) and were asked to remember the corresponding memory.

Event elaboration phase

Once the participants had thought of a remembered or imagined event, they were required to press a button to indicate that they were ready to elaborate on the mentally generated event by typing it out in detail. The following text then appeared below the stimulus-set (the stimulus-set remained on the screen for the remainder of the elaboration phase):

> In as much detail as you can, type out the experience that you have just created in your mind. Don't worry about spelling, punctuation, grammar, or typing errors. We want you to give us lots of detail. We're not concerned with how you type it up. You have 2 minutes to give as much detail as you can about the experience you created in your mind using the details above.

Participants then had two minutes to type out their remembered or imagined events in detail.

Subjective scales of phenomenological experience

Immediately following event elaboration, participants were asked to rate their remembered or imagined events on five subjective scales in the following order: vividness, vantage point taken (observer vs. field), emotional valence, intensity of emotion, and perceived level of effort for event construction. See Appendix F for the subjective scales of phenomenological experience.

The procedure (i.e., the presentation of a stimulus-set, the event construction phase, the event elaboration phase, and the subjective scales) was repeated 16 times—two times for each of the eight experimental conditions. The experiment took approximately one hour to complete.

Results

Preliminary Analyses: Manipulation Checks

Were the High and Low LOE rankings significantly different from one another?

The High and Low rankings of LOE were compared to establish that the High LOE rankings were in fact significantly higher than the Low LOE rankings. If the High and Low LOE rankings were found not to be significantly different from one another, this would indicate that the LOE manipulation failed. The means for the High LOE rankings were indeed significantly higher ($M = 6.35$, $SD = .41$) than the means for the Low LOE rankings ($M = 2.33$, $SD = .71$), $F(1, 430) = 5265.95$, $p<.000$.

Were the High and Low LOE rankings significantly different between TD conditions?

High and Low LOE rankings for each of the four TD conditions (i.e., Recall, Imagine-Past, Imagine-Present, and Imagine-Future) were compared to establish that they were the same between TD conditions. There were no significant differences in High and Low LOE rankings

between the Recall (M = 4.37, SD = 2.20), Imagine-Past (M = 4.40, SD = 2.03), Imagine-Present (M = 4.26, SD = 2.09), and Imagine-Future (M = 4.33, SD = 2.07) conditions, $F(3, 428) = .088$, p=.967.

Were the recombined details combined into cohesive sets?

The stimulus-sets were coded according to the following 3-point coding scheme: 3 = all three details coincide temporally and contextually into a coherent event, 2 = two details coincide temporally and contextually in to a coherent event, but one detail appears to belong to a separate event, and 1 = none of the three details coincide temporally and contextually into a coherent event because they are too different to even be considered as a possible coherent and cohesive event. The stimulus-sets were found to be sufficiently coherent, (M = 2.89, SD = .33), $F(1, 431) = 3599.56$, $p < .000$, $\eta_p^2 = .99$.

Addis et al. (2010) developed the above method, and in their study each of the recombined stimulus-sets were scored for level of cohesiveness, i.e., how cohesively the person, object, and location details were integrated into one temporally and contextually specific stimulus-set. If the stimulus-sets were found to be lacking in cohesiveness and coherence, it could be argued that the stimulus-sets confounded the dependent variables. For example, high perceived effort and RTs could be due to the difficulty of generating an imagined event using three details that did not fit together cohesively. When Addis et al. employed this coding scheme

they achieved high inter-coder reliability (Kendall's tau-b = .965); therefore, it is reasonable to assume that this measure is reliable and valid. However, due to time limitations inter-coder reliability was not calculated for level of coherence in this study.

Correlational Analysis of Dependent Variables

As discussed above (see the Objective measures and coding of event elaborations section), the purpose behind using both the subjective scales and the more objective measures was to corroborate the results and to gain broader insights into the dependent variables. Therefore, it was important that the degree of association between the subjective scales and the objective measures was determined. Also, a correlational analysis of the dependent variables was required so that it could be determined whether or not a multivariate analysis of variance (MANOVA) should be used for the major analysis. A MANOVA is typically used when an experiment has several dependent variables that measure various aspects of some cohesive construct or theme, and when there are moderate correlations between the dependent variables (Coolican, 2009). Therefore, it was necessary to determine the degree to which the dependent variables correlated in order to ascertain whether the use of MANOVA was the most suitable analysis for the data. The correlations between the subjective scales and objective measures were calculated using the bivariate correlation test (see Table 3).

Table 3

Summary of correlations between subjective scales and objective measures

	Objective measures					
Subjective scales	Word Count	Details	Sensory Details	Coherence	References to Emotion	RT[a]
Vividness	**.28****	**.32****	**.14****	**.15****	.22**	-.09
Valence	.54	.10*	.08	.11*	**-.03**	-.03
Emotionality	.19**	.24**	.11*	.14**	**.27****	-.14**
Perceived Effort	.18**	.22**	.13**	.14**	.16**	**-.20****

Note. Highlighted values are the target correlations that were predicted to exist between the subjective scales and the objective measures (n = 432).

[a] There were 3 outliers for RT. Two of these completed the event construction phase in under 1 second, and the third took nearly 2 minutes, which was far higher than the averages for the respective conditions. These outliers were changed to the averages corresponding with the respective conditions.

*p< .05. **p< .01.

As predicted, the subjective vividness scale was positively correlated with word count, number of details and sensory details, and the level of coherence of the event elaborations. A positive moderate correlation was also found between subjective ratings of vividness and number of references to emotion in the event elaborations, which makes intuitive sense since a vivid experience should also be more emotion than an experience that is not vivid. Emotionality (i.e., how intense of an emotional experience the mentally generated event was) was positively correlated with the number of references to emotion (as predicted) in the event elaborations, but valence was not. Finally, ratings of perceived effort were negatively correlated with RTs, which

is the opposite of what was originally predicted. The correlational analysis indicated that the dependent variables were sufficiently correlated to proceed with a MANOVA.

Is the Variation Between EM and EFT Due to LOE?

To examine whether the differences between EM and EFT were due to LOE or TD, a within-subjects MANOVA was conducted with the subjective scales and objective measures as dependent variables. No interaction was found between LOE and TD at the .05 alpha level, Wilks' Lambda = .94, $F(30, 1219) = .80$, $p = .769$, $\eta_p^2 = .02$. The MANOVA yielded a significant main effect for LOE, Wilks' Lambda = .92, $F(10, 415) = 3.42$, $p < .000$, $\eta_p^2 = .08$. As Table 4 demonstrates, a pairwise comparison of the effects of LOE indicated that, compared to events brought to mind using Low LOE details, events brought to mind using High LOE details were more vivid $F(1, 424) = 8.92$, $p = .003$, $\eta_p^2 = .02$, more positive $F(1, 424) = 5.87$, $p = .016$, $\eta_p^2 = .01$, more emotional $F(1, 424) = 21.94$, $p < .001$, $\eta_p^2 = .05$, were perceived as requiring more effort to bring to mind $F(1, 424) = 10.44$, $p = .001$, $\eta_p^2 = .02$, and resulted in more references to emotion in the elaborations $F(1, 424) = 6.18$, $p = .013$, $\eta_p^2 = .01$. Also, although there were fewer statistically significant differences between High and Low LOE memory details for the objective coding measures, the mean differences followed the same pattern as that found with the subjective reports, i.e., High LOE memory details resulted in faster, richer, and more coherent elaborations than Low LOE memory details. Using a Chi-Squared analysis, it was

found that the vantage point taken by participants as they imagined or remembered themselves in their mentally generated events did not differ between High and Low LOE conditions, $\chi^2(1, N = 432) = .63$, $p = .43$.

Table 4

Comparison of the characteristics of High and Low LOE events (means and standard deviations)

Dependent Variable	LOE	
	Low	High
Subjective Reports		
Vividness (1-7)**	4.43 (1.86)	**4.90 (1.81)**
Valence (1 = Neg, 7 = Pos)*	4.17 (1.42)	**4.53 (1.66)**
Emotionality (1-7)***	3.65 (1.74)	**4.35 (1.80)**
Perceived Effort (1-7)***	4.32 (1.91)	**4.84 (1.86)**
Vantage Point		
Field	131	139
Observer	85	77
Objective Coding		
Response Time (Sec)	24.28 (14.82)	22.20 (13.39)
Word Count	77.37 (28.57)	79.42 (29.98)
Number of Details	14.33 (5.31)	14.72 (5.55)
References to Emotion*	.82 (1.15)	**1.12 (1.36)**
Number of Sensory Details	3.07 (2.27)	3.11 (2.25)
Coherence (1-7)	5.39 (1.35)	5.56 (1.43)

*p<.05; **p<.01; ***p<.001

The MANOVA also yielded a significant main effect for TD, Wilks' Lambda = .59, $F(30, 1219) = 7.91$, $p < .000$, $\eta_p^2 = .16$. As Table 5 demonstrates, a pairwise comparison of the effects

of TD indicated that compared to imagined events (and regardless of temporal condition), recalled memories were more vivid $F(3, 424) = 36.16$, $p < .001$, $\eta_p^2 = .20$, were more emotional $F(3, 424) = 44.12$, $p < .001$, $\eta_p^2 = .24$, were perceived as requiring more effort to bring to mind $F(3, 424) = 34.59$, $p < .001$, $\eta_p^2 = .20$, took less time to generate $F(3, 424) = 19.85$, $p < .001$, $\eta_p^2 = .12$, and were more coherent $F(3, 424) = 5.94$, $p = .001$, $\eta_p^2 = .04$. Also, compared to imagined events (and regardless of temporal condition), the typed out event elaborations for recalled memories had higher word counts $F(3, 424) = 6.87$, $p < .001$, $\eta_p^2 = .05$, had more details $F(3, 424) = 6.99$, $p < .001$, $\eta_p^2 = .05$, and had more references to emotion, $F(3, 424) = 10.55$, $p < .001$, $\eta_p^2 = .07$. There was no significant difference between temporal conditions for valence and the number of sensory details coded in the event elaborations. Finally, participants were more likely to take a field perspective when they recalled a memory than when they imagined an event (regardless of temporal condition), $\chi^2 (3, N = 432) = 11.81$, $p = .008$.

Table 5

Comparison of the characteristics of mentally generated events between temporal conditions

Dependent Variable	TD			
	Recall	Imagine Past	Imagine Present	Imagine Future
Subjective Reports				
Vividness (1-7)***	**6.09 (1.25)** [bcd]	4.22 (1.73)	4.17 (1.80)	4.19 (1.80)
Valence (1 = Neg, 7 = Pos)	4.35 (2.07)	4.20 (1.39)	4.48 (1.27)	4.35 (1.35)
Emotionality (1-7)***	**5.48 (1.23)** [bcd]	3.38 (1.63)	3.63 (1.70)	3.52 (1.74)
Perceived Effort (1-7)***	**6.01 (1.55)** [bcd]	4.09 (1.76)	4.13 (1.81)	4.09 (1.73)
Vantage Point**				
Field	**81**	**69**	**61**	**59**
Observer	**27**	**39**	**47**	**49**
Objective Coding				
Response Time (ms)***	**14.76 (89.21)** [bcd]	26.61 (14.27)	25.15 (15.17)	26.45 (13.93)
Word Count***	**89.24 (29.28)** [bcd]	75.05 (29.15)	75.44 (29.59)	73.84 (26.61)
Number of Details***	**16.55 (5.55)** [bcd]	13.85 (5.15)	13.67 (5.48)	14.02 (5.06)
References to Emotion***	**1.53 (1.54)** [bcd]	.68 (.87)	.80 (1.00)	.88 (1.37)
Number of Sensory Details	3.31 (2.25)	3.24 (2.39)	3.03 (2.23)	2.77 (2.15)
Coherence (1-7)***	**5.94 (1.07)** [bcd]	5.23 (1.53)	5.41 (1.30)	5.31 (1.53)

Note. A letter superscript (a, b) indicates that the given mean was significantly different than the mean of the other temporal conditions (in order: a, b, c, d). *p<.05; **p<.01; ***p<.001

Discussion

Researchers have been investigating the similarities and differences between EM and EFT with the assumption that there is a distinction between MTT directed towards the future and MTT directed towards the past. The purpose of this study was to demonstrate that it is our LOE with memories and their associated details, not TD, which accounts for the differences between

EM and EFT. However, the results revealed a consistent differentiation between remembering and imagination. Specifically, the characteristics of remembering EMs were significantly different from those of imagining events regardless of whether the imagined events were in the past, present, or the future. More importantly, the fact that there were no significant differences between the three Imagine conditions demonstrates that imagination is functionally independent of temporality, and that our subjective notions of "time" have little to no influence on the expression of imagined episodic thoughts. Therefore, the results of this study suggest that the differences between EM and EFT are simply the difference between remembering and imagining.

Understanding the Differences Between Remembering and Imagining

The differences between EM and EFT (see the Characteristic differences between EM and EFT section for review) are consistent with the findings of previous studies that have demonstrated differences between remembering and imagining. Johnson and Raye (1981) conducted pioneering research indicating that memories for information generated from external sources (e.g., EMs) are easier to bring to mind, more rich in detail and coherent than are memories for information generated internally (e.g., imagination). Their Reality Monitoring (RM) framework has received substantial empirical support (e.g., Buda, Fornito, Bergström, & Simons, 2011; Johnson, 1988; Johnson et al., 1988; Memon, Fraser, Colwell, Odinot, & Mastroberardino, 2010; Roberts & Lamb, 2010). The RM framework helps to explain the

differences between memory and imagination that have been recently attributed to EM and EFT. For instance, memories for episodic events have been consistently found to be more vivid in detail, more coherent, and more specific than for events that are imagined (Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2004, 2006; Gordon et al., 2009; Quoidbach et al., 2008; Viard et al., 2011; Weiler et al., 2011). The ambiguity exists in the temporality of imagined events. Most studies examining the differences between EM and EFT have operationalized EFT as episodic events we imagine in our personal future, and that are characteristically different from memories of our past (Arnold et al., 2011; D'Argembeau & Mathy, 2011; Viard et al., 2011; Weiler et al., 2011). However, these studies neglected to consider the possibility that imagined events are characteristically the same regardless of TD. In fact, when studies have attempted to control for TD there is appears to be little difference between imagining an event in the past, present or the future (Addis et al., 2009a; Hassabis et al., 2007b). Specifically, Addis et al. (2009a) demonstrated that when an Imagine-Past condition was added to their design, two distinct neurological subsystems responsible for remembering and imagining were revealed. Therefore, Addis et al. suggested that the neural activity, which they had previously thought to be associated with future events, might instead reflect the imagining component of EFT rather than its temporal component.

Other supporting evidence can be found in research with individuals who have sustained damage to the hippocampus. As explained earlier (see the section on Overlapping neural processes), EM and EFT have both been found to activate the hippocampus (Addis et al., 2007, 2008, 2009a; Hassabis et al., 2007b; Kwan et al., 2010), and Addis et al. (2007) proposed the CESH to explain this overlap, i.e., EM provides a source of details for simulating episodic future events. In the same year, Hassabis et al. (2007b) studied mental imagery in patients with anterograde amnesia and concomitant damage to the hippocampal area (a region of the brain strongly associated with memory). The participants in Hassabis et al.'s study were asked to imagine both "commonplace" scenarios (involving a beach, museum, pub, port, market, forest, and castle setting) that were temporally neutral, as well as imagine episodic future events. Participants were then required to describe the events that they imagined in their mind and to rate their subjective experience of the imagined events for overall richness and coherence. The event descriptions provided by the participants were coded for the number of spatial, sensory, and emotional details reported. They found the hippocampus (an area known to be activated during EM tasks) was engaged to the same extent regardless of whether the imagined events were located in the past or the future. Not only does this finding support the CESH hypothesis by demonstrating that EM is engaged during mental imagery, but it also demonstrates that TD does not influence the expression of imagined episodic events. Further, Hassabis et al. (2007b) had

initially analyzed the two scenario types (i.e., temporally neutral events and episodic future events) separately; however, they found that both scenario types had identical patterns of results. Again, this suggests that TD does not influence our experience of an imagined episodic event.

The above findings are consistent with the results of this study, and together, provide strong support for the conclusion that the differences previously attributed to EM and EFT are actually the differences between EM and imagination. The variation exists between remembering and imagining, and temporal factors are of little to no consequence.

Why Were the Differences Between EM and EFT Apparent in This Study?

In this study, the differences between EM and imagination were evident to a greater extent than in previous studies because of the level of control employed. Specifically, this was the first study to employ a complex methodology that not only controlled for recasting, but also included an Imagine-Past condition *and* employed a temporally neutral condition (i.e., Imagine-Present). The combination of these controls made it possible to isolate the differential effects of imagination, remembering, and TD. Indeed, Addis et al. (2009a) and Hassabis et al. (2007a,b) found similar results to the ones found in this study; however, they were concerned with identifying the neural correlates of episodic thinking, and not with discovering the *source* of variation between EM and EFT.

Why Was Perceived Effort Negatively Correlated With RT?

If an event was perceived as being difficult to bring to mind, participants in this study tended to take less time generating the event during the event construction phase. This is counter-intuitive since one would expect high cognitive effort to be positively correlated with the amount of time required to perform a cognitive process. There are two potential explanations for this result. First, since High LOE and Recalled events took longer to generate it could be argued that participants were lingering on vivid experiences, i.e., they were re-experiencing events that they were familiar with, which resulted in greater musing. Consequently, Low LOE and imagined events are more difficult to generate and less vivid, so participants might have withdrawn from the construction of these events to avoid the increased cognitive exertion. For example, a participant would bring to mind a rich event and would linger on the experience because it was easy to generate (resulting in a high RT) and then, when asked to rate how hard it was to bring the event to mind, they would rate it as "easy." Second, since participants were asked to first think of an event, then to type out the event, and *then* to rate how hard they thought it was to think of the event, it is likely that participants were rating both the event construction and its elaboration as opposed to the event elaboration alone, which could potentially confound the results of this scale.

Why Were No Differences Found Between Conditions in Subjective Reports of Valence?

There are two explanations for why participants tended to rate their mentally generated events as neutral in valence. First, as was mentioned in the Event Cues section above, an attempt was made to avoid unnecessarily biasing participants towards recollecting strongly emotional events. As a result, participants were intentionally manipulated to generate neutral events. Second, because the recombination process was performed manually for this study, the researchers were able to ensure that the EM details used for simulating imagined events were drawn from unrelated experiences. Therefore, it is reasonable to expect that participants would have a difficult time assigning valence (i.e., attributions of positivity or negativity) to fictional events that they had never experienced.

Suggestions for Future Research

To further isolate the differential effects of EM and imagination, future research should replicate the design used in this study with the inclusion of an Imagine EM condition. This would require asking participants to imagine memories that did not actually occur, i.e., to generate false memories. Such a design could result in one of two outcomes: either imagined false memories are just another expression of imagination, or false memories result in experiences that are subjectively similar to EM, but objectively similar to imagining episodic events. The latter outcome would mean that participants believed that they were re-experiencing

a real memory when, in fact, they were imagining an episodic event, which would further demonstrate that the expression of episodic thought is only influenced by remembering and imagination – not TD.

What Does This Mean for MTT Research?

Much of the research on MTT works under the assumption that EM and EFT differ because of TD. There is a great deal of consensus that there is something "special" about mentally traveling into the future that is not shared by mentally projecting into the past (Schacter, Addis, & Buckner, 2008; Szpunar, 2010; Toomela, 2010). However, based on the findings of this study, researchers may want to consider the possibility that TD accounts for little, if any, of the variation between EM and EFT. More importantly, the differences between EM and EFT may have nothing to do with MTT. When researchers do find differences between EM and EFT they are likely observing the relationship between two basic cognitive processes: remembering and imagining. This explanation is not only justified by the evidence outlined above, but is also far more parsimonious than the suggestion that EFT acts as a distinct cognitive process from episodic thoughts imagined in the past and the present. Therefore, it is reasonable to argue that the term "episodic future thought" is misleading because it suggests that EFT can be distinguished from EM by its "futureness." In fact, remembered episodic events can be clearly distinguished from imagined episodic events in the absence of temporality. As a result, it is

suggested that the term Episodic Imagination (EI) might better represent the process of imagining episodic events in the past, present, and future than EFT.

Appendix A

Examples of events and details retrieved during the SCS:

Memory Title: Lamb at school **Person: Mary (High LOE)** **Location: School (Low LOE)** **Object: Lamb (High LOE)**	**Memory Title: Bridge fell** **Person: Steve (Low LOE)** **Location: London (High LOE)** **Object: Bridge (High LOE)**
Memory Title: The big jump **Person: Jack (High LOE)** **Location: Kitchen (High LOE)** **Object: Candlestick (Low LOE)**	**Memory Title: Curds and Whey** **Person: Miss Muffet (High LOE)** **Location: On a tuffet (High LOE)** **Object: Spider (High LOE)**

Examples of stimulus-sets for experiment created using memory details from SCS:

Recall Condition **(not recombined – High LOE)**	**Imagine-Past Condition** **(recombined – High LOE)**
RECALL your memory that involved the following details: **Miss Muffet: Curds and Whey** **On a tuffet: Curds and Whey** **Spider: Curds and Whey**	Imagine yourself in a plausible personal experience between 1 and 5 years in the PAST that involves: **Mary: Lamb at school** **Kitchen: The big jump** **Bridge: Bridge fell** Event must be specific in time and place, lasting no longer than one day.
Imagine-Present Condition **(recombined – High LOE)**	**Imagine-Future Condition** **(recombined – Low LOE)**
Imagine yourself in a plausible personal experience RIGHT NOW that involves: **Jack: The big jump** **London: Bridge fell** **Lamb: Lamb at school** Event must be specific in time and place, lasting no longer than one day.	Imagine yourself in a plausible personal experience between 1 and 5 years in the FUTURE that involves: **Steve: Bridge fell** **School: Lamb at school** **Candlestick: The big jump** Event must be specific in time and place, lasting no longer than one day.

Appendix B

As mentioned previously, one of the theories that help to explain the relationship between EM and EFT is the CESH, i.e., EFTs are formed when details are drawn from EMs and recombined into novel future events. In 2009(a), however, Addis et al. proposed that the similarity in neural activity between past and future episodic processing might be the result of participants simply recasting an EM as a future event. In other words, instead of recombining episodic memories to simulate future events, participants use complete memories from the past and recast them into the future. For example, when asked to imagine themselves in their own wedding in the future, participants may simply recast the complete memory of a wedding from their personal past. In this case, the similarity in neural activity for past and future episodic processing would simply be the result of thinking about the same event twice. Therefore, Addis and her colleagues designed a new experimental technique that controlled the recombination process and avoided recasting.

Recasting was not the only confound that Addis et al. addressed. Differences in neural activity while remembering the past and imagining future events could potentially be explained as the differences between imagining and remembering. Specifically, imagining the future requires more cognitive effort because it involves the active process of gathering and piecing together unrelated details to create a new event whereas EM is simply the re-experiencing of

memories. To control for this possibility, Addis et al. added an "Imagine-Past event" condition, which required participants to imagine a plausible personal experience that might have occurred in the past using their own recombined memory details (collected during the SCS).

The present study used an experimental design similar to Addis et al.'s (2009a) because their technique was the only one that addressed recasting and controlled for the potential differences between remembering and imagination. It is necessary, therefore, to outline a number of modifications made to their design in order to effectively test the potential differential effects of LOE and TD.

Time between stimulus collection and experiment

Rehearsal, which is the process by which we encode and maintain memories over time (e.g., Benjamin & Bjork, 2000; Rundus, 1971), and the recency effect, which is the phenomenon that makes recent items more likely to be recalled (e.g., Bjork & Whitten, 1974; Murdock, 1962; Watkins & Peynircioğlu, 1983), have the potential to confound our LOE with memory details by making these details more readily accessible for recall. In Addis et al.'s design, the SCS was conducted four days before the experimental sessions. By increasing the time between memory collection during the SCS and memory recall during the experiment, the potential for memory rehearsal and the recency effect to confound the participants' LOE with memory details is

substantially reduced. Therefore, a time delay between the SCS and the experimental trials of at least one month was chosen for this study to try and reduce the effects of these confounds.

Time frame for EM recall during SCS

Typically, in MTT research, participants are required to think of EMs and EFTs from within a particular time frame. A survey of the literature indicates that most researchers studying MTT have categorized *recent* as events occurring within 12 months from the present, and *distant* as events occurring more than 5 years from the present (e.g., Addis & Schacter, 2008; Arnold, et al., 2011; Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2004). During Addis et al.'s SCS, participants were asked to recall memories from the past five years. Given that the current study is examining participants' LOE with specific memory details, drawing on memories from within the last 12 months may have presented a confound in that, as mentioned above, recent memories are often more readily recalled (e.g., Murdock, 1962). Therefore, participants might have incorrectly rated a memory detail as High in LOE when, in fact, the detail was simply easier to access because it was experienced recently. A similar problem exists for distant memories. If the memory is from a long time ago, then participants might have found it too difficult to remember, or they might have selected a memory that was unusually distinct, emotional, or personally important (e.g., Brown & Kulik, 1977; Neath, 1993; Neath & Saint-Aubin, 2011). Therefore, participants might have incorrectly rated a detail as High in LOE when,

in fact, the detail was simply easier to identify than other, less distinct, distant memories. It was assumed that, since *distant* is often defined as "more than 5 years" and *recent* as "within 12 months" from the present, by requesting memory details between 1 and 5 years from the present the confounding effects of recency and distinctiveness were substantially avoided. Therefore, the time frame of 1 and 5 years was incorporated into the current methodology.

Fewer stimulus-sets

In Addis et al.'s (2009a) design, participants were presented with 20 stimulus-sets (i.e., the presentation of three memory details: person, object, and location) for each of their three conditions (i.e., Recall, Imagine-Past, Imagine-Future), which resulted in 60 experimental trials. The reason they needed 20 trials per condition was because they were conducting a brain imaging study, which typically requires multiple scans in order to isolate specific neurological processes and to establish reliability. However, because this study was under a time constraint, the most feasible design was to present participants with two stimulus-sets for each of the eight conditions in this study (total of 16 stimulus-sets per participant). It is important to note here that in order for Addis et al. (2009a) to generate 20 stimulus-sets for each of their three conditions, they had to collect three times as many memories during the SCS. This study employed the same ratio, but was adapted to fit the modified design by collecting 48 memories during the SCS in order to generate 16 stimulus-sets for the experiment.

Inclusion of an Imagine-Present condition

To date, an Imagine-Present condition has never been included in studies exploring the relationship between EM and EFT. An Imagine-Past condition has been used in previous studies to control for the fact that remembering may be different from imagining the future due to its "pastness." However, without an Imagine-Present condition, it cannot be concluded with certainty that the differences between imagining the future and imagining the past are due to TD because there is no condition in which TD is absent. A major goal of this study was to isolate the differential effects of LOE and TD on the relationship between EM and EFT. It was, therefore, necessary to include a temporally neutral condition that would demonstrate the effects of LOE in the absence of TD.

Modified Recall condition

For the Recall condition in Addis et al.'s study, participants were presented with a stimulus-set that included three memory details drawn from three different memories (as in the Imagine-Past and Imagine-Future conditions), and were expected to indicate how *each* detail featured in the corresponding memory (specified by the three corresponding memory titles). In other words, unlike the Imagine-Past and the Imagine-Future conditions, which required the production of a single event, the Recall condition required participants to generate three different events. It is unclear why Addis et al. chose to conduct the Recall condition in this way because it

was not directly comparable to the Imagine-Past and Imagine-Future conditions. For instance, recollecting and writing about three different events limits the amount of detail that can be generated for each event because the participants are under a time constriction, and would not have as much time as they would to generate details for one event.

For this study, it was important that the observed differences between EM and EFT (such as richness of detail) were the result of the manipulated differences in LOE or TD, and not because of methodological differences between conditions. Therefore, all three details in the Recall condition of this study were drawn from a single memory. For example, a Recall stimulus-set might have had the title "Car Accident," and have included the following details: Chev Truck (object), Mike (person), and Hammonds Plains Road (location), and these details would have been the original ones provided by the participant during the SCS. In this way, the Recall condition was methodologically similar to the Imagine conditions in that it only required the generation of a single event.

Event elaboration time constraint

For Addis et al.'s (2009a) experiment, participants were first asked to remember or imagine an event in their mind, and then were asked to elaborate on the event by thinking about it in detail. Because the present study was not concerned with brain imaging, participants were asked to type out their mentally generated events in detail after they had brought the event to

mind. Also, because of time constraints, it was important that participants were limited in the amount of time they could take to type out their event elaborations. Previous studies have used time constraints ranging between 1 (D'Argembeau & Van der Linden, 2004; Stokes, Dritschel, & Bekerian, 2008; Williams & Broadbent, 1986) and 3-minutes (Arnold et al., 2011; Quoidbach, et al., 2008) for writing out elaborations of mentally experienced events. Since the typed reports were important to the dependent variables in this study (i.e., objective coding), a 2-minute time constraint was chosen to provide participants with ample time to type out as much detail as they could while minimizing the overall amount of time it would take to complete the experiment.

Appendix C

Invitation to participate

Dear [Full Name],

Thanks for volunteering to participate! Remember that this study has two parts to it: a Memory Collection session and the actual Experiment. You're currently being asked to participate in the first session, the Memory Collection session. Once you have consented to participate you'll be asked to remember some events from your past and provide a few memory details (e.g., persons, objects, and locations) through an online program.

At the end of this session you will be asked if you would like to participate in the Experiment portion of this study (approximately one month from today). If you agree and you qualify by giving us enough detail today, we will contact you in about a month to schedule your participation.

For the Experimental session in a month's time you'll go to the Psychology Department's Research Lab where you will be shown our memory details back to you in a jumbled form, and you'll be asked to imagine or remember past or future events using these details.

If your professor offers bonus or participation points, then you will be eligible to receive them for both this session, the Memory Collection session, as well as for the Experiment session in about a month's time.

The Big Draw!

As an incentive for participating, you will be entered into a draw for a $50 Chapters gift certificate. Here's the catch: You will be entered into the draw for participating in the memory Collection session, but if you participate in the Experiment session as well, you will be entered twice! So, your chances of winning will be doubled.

To begin the Memory Collection sessions please click on the following link: [Invite Link]

If you have any questions or concerns please contact me directly at emad.talisman@msvu.ca

Appendix D

Normed Event Cues

Please note: Participants will be shown the event cues only—not the associated norms.

Event Cues	Imaginability	Familiarity	Valence
A disaster	5.1	5.88	1.73 (1.13)
A present	4.8	6.09	6.95 (1.85)
Bus ride	4.91	6.39	4.51 (1.57)
Food	5.39	5.88	7.65 (1.37)
Gardening	6.73	5.43	6.71 (1.74)
Losing something	3.73	3.9	2.82 (1.83)
A lie	3.85	4.47	3.87 (2.23)
Sporting event	2.90	6.14	6.00 (1.26)
Taxi ride	4.91	6.39	5.45 (1.96)
Trip to the dentist	6.22	4.46	4.46 (2.20)
A promotion	3.33	5.72	8.20 (1.15)
A robbery	5.00	5.76	2.18 (1.68)
Festivity	5.30	4.51	7.30 (2.26)
An Infection	4.87	5.11	1.66 (1.34)
Comfort	5.03	6.20	7.07 (2.14)
A beverage	5.87	6.06	6.83 (1.48)
Being annoyed	3.56	5.60	2.74 (1.81)
Church	6.63	5.96	6.28 (2.31)
The cottage	6.5	6.4	6.45 (1.52)
Decorating	5.37	5.57	6.93 (1.30)
Trip to the doctor	6.4	6	5.20 (2.54)
Errands	4.27	4.81	4.58 (1.74)
A farm	5.6	5.32	5.53 (1.85)
An insult	4.77	4.9	2.29 (1.33)
Feeling jealous	4.72	5.4	2.51 (1.83)
A key	6.18	6.52	5.68 (1.62)
Feeling lazy	4.28	6.27	4.38 (2.02)
Mail	5.48	4.3	6.88 (1.74)
The market	6.13	5.27	5.66 (1.02)
Mischief	4.03	4.53	5.57 (2.05)
Mold	4.54	3.93	3.55 (1.70)
Noisy	1.38	6.49	5.02 (2.02)
A storm	6.43	5.83	4.95 (2.22)
A teacher	5.77	6.38	5.68 (2.12)
Feeling anxious	3.44	5.84	4.80 (1.93)
Baking	4.97	5.89	6.32 (1.25)
A beggar	6.4	4.69	3.95 (2.04)
Clumsy	4.28	5.59	4.06 (2.07)
A crisis	3.43	5.61	4.17 (2.43)
A dream	4.6	5.94	6.73 (1.75)
Falling	4.29	5.67	4.09 (2.48)

A gloomy day	4.22	5.27	1.88 (1.23)
Something hidden	3.16	5.63	4.32 (1.91)
Feeling pressure	4.1	5.83	3.50 (1.19)
Doing something quietly	3.09	5.88	5.75 (1.54)
A shadow	5.63	5.63	4.50 (1.00)
Being startled	3.88	4.9	4.41 (1.12)
Something suspicious	3.38	5.63	4.00 (1.58)
Feeling tense	3.59	5.6	3.50 (1.18)
Using a tool	5.77	5.94	5.50 (1.24)
M (*SD*)	4.76 (1.17)	5.55 (.67)	4.83 (1.65)

Appendix E

EM Scales of Familiarity for SCS

Specify the following 3 details from the memory you just recalled:

A PERSON (other than yourself) _____

How well do you know this person?

1	2	3	4	5	6	7
Barely						Intimately

How often have you interacted with this person?

1	2	3	4	5	6	7
Rarely						All the Time

How easy is it for you to bring this person to mind?

1	2	3	4	5	6	7
Very Difficult						Very Easy

An OBJECT featured in the memory _____

How familiar are you with this object?

1	2	3	4	5	6	7
Unfamiliar						Very Familiar

How often have you come in contact with this object?

1	2	3	4	5	6	7
Rarely						All the Time

How easy is it for you to bring this object to mind?

1	2	3	4	5	6	7
Very Difficult						Very Easy

The LOCATION at which the experience occurred _____

How familiar are you with this location?

1	2	3	4	5	6	7
Unfamiliar						Very Familiar

How often have you have you visited this location?

1	2	3	4	5	6	7
Rarely						All the Time

How easy is it for you to bring this location to mind?

1	2	3	4	5	6	7
Very Difficult						Very Easy

Create a short title for the event that will help you recognize the memory easily at a later time:

_____

Appendix F

Subjective Rating Scales of Phenomenological Experience

Rate the vividness of your mental event representation, where "vividness" refers to how rich your experience of the remembered or imagined event was in terms of sensory detail and contextual clarity:

1	2	3	4	5	6	7
Low						High

While you imagine/remember the event in your mind, what vantage point do you take? (Check the appropriate option)

Own Eyes (You see the event through your own eyes)

See Self (You see your self from an external vantage point)

The emotions I have when I imagine/remember the event in my mind are:

1	2	3	4	5	6	7
Extremely Negative						Extremely positive

The emotions I have when I imagine/remember the event in my mind are intense:

1	2	3	4	5	6	7
Not at all						To a very high degree

Rate the level of effort required for you to bring this event to mind:

1	2	3	4	5	6	7
Very Easy						Very Effortful

Appendix G

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Back to the Future: a Study on Mental Time Travel

Online Informed Consent Form for Memory Collection Session

Primary Investigator(s)**: Emad Talisman** Email: Emad.Talisman@msvu.ca
Phone: (902) 440 3654

What is the purpose of this study? To look at differences between thinking about the future and thinking about the past.

What will I be asked to do? This study consists of two parts. You are being asked to participate in the first part, the Memory Collection session, which, as you know, will be conducted online. If you agree to participate, you will be asked to remember a number of events that have happened to you between 1 and 5 years ago. You will be shown a list of cues to help jog your memory in case you have difficulty recalling specific events. You will not have to describe any of the memories in full. All you have to write down are a few specific details, such as persons, objects, and locations that were involved in each event. After providing these details, you will rate them according to how familiar they are to you and how easy it is for you to bring them to mind.
At the end of this session, you will be asked to participate in a second experimental session about a month later. If you wish to participate, please indicate this by clicking "yes" on the last page of the current session. The researcher will contact you within a month to arrange an appointment.
How long will the experiment take? Approximately 2 hours.
Are there any risks involved? There are no significant risks associated with this study. While remembering events in your past, you may, however, recall an unpleasant experience. It is important to keep in mind that you choose which events to remember. It is completely up to you. Your participation is voluntary. If, for any reason, you wish to quit and discontinue your participation, you are completely free to do so without consequence or penalty. Most people who have participated in similar research find it an interesting experience and suffer no negative consequences.

Nevertheless, if you do feel distressed as a consequence of remembering an unpleasant event from your past, MSVU offers help through Counselling Services and the Health Office. Psychological counselling is located on the 2nd floor of Evaristus, Room 218. You may also contact Julie Fillmore at 457-6567 or by email at counselling@msvu.ca for counselling services and personal counselling emergencies. If you can't reach anyone at these numbers and you feel you are experiencing a crisis that calls for immediate attention, phone the Queen Elizabeth II Health Science Centre at 902-473-2043. This contact information will be given to you again on the last page of online program. Furthermore, the researcher, Emad Talisman (emad.talisman@msvu.ca), has completed a crisis prevention training program and has extensive experience handling crises in his former job as a support worker for individuals with acquired brain injuries.

Who will see my responses? No one other than the researchers involved in the study will have access to your responses. All of the data collected in this study will be stored either electronically and password protected or kept in a locked cabinet in a locked room in the Psychology Department at MSVU. We are aware of the personal nature of the data we are collecting and it will be kept completely confidential. If you agree to participate in the second experiment, we will keep your email address in our records to contact you for scheduling purposes. Only the researcher will have access to this information and will not use your email for any other purpose. Once the experiment is over, your email address will be destroyed and no identifying information will be connected to your data. If, however, you choose not to participate in the second experiment, we will remove your email address from our database immediately and all data will be erased/ destroyed.

Bonus points and $50 Chapters gift certificate: Everyone who participates in this Memory Collection session will be entered into a draw for a $50 Chapters gift certificate. Also, if you participate in the follow-up experiment, we will enter your name into the draw for a second time giving you a greater chance of winning the gift certificate.

Your professor may have decided to offer you bonus points or participation credit in exchange for taking part in this study. If so, you will need you to email me (emad.talisman@msvu.ca) your student ID, professor's name, and the name of the course you're earning the points for so I can inform your professor of your participation. This information will not be connected to your data in any way.

Who can I speak to if I have questions or concerns about the study? If you have questions before you decide to participate or if they arise afterward, please feel free to contact the researcher by email (Emad.Talisman@msvu.ca). Alternatively, you can contact Dr. Angie Birt, the faculty supervisor of the study, through email (Angela.Birt@msvu.ca) or by telephone (457-6667). If you would like to know the results of this study, please feel free to attend the

Psychology Department's Research Day conference in the Spring of 2012, in the Psychology Department at the Mount. Otherwise, a poster will be displayed on the fourth floor of the Evaristus building across from the psychology laboratory at the end of the semester. If neither of these options works for you, then feel free to email either the researcher (Emad.Talisman@msvu.ca) or the supervisor (Angela.Birt@msvu.ca) in April of 2012 for a summary of the study results.

This study has been reviewed and approved by the Psychology Department Research Ethics Committee at the Mount as well as the Mount Saint Vincent University Review Ethics Board. If you have questions about how this study is being conducted and wish to speak with someone who is not directly involved in the study, you may contact the Chair of the University Research Ethics Board (UREB) c/o MSVU Research and International Office, at 457-6350 or via email at research@msvu.ca.

I agree to participate

I am confirming that I have read and understand the above information and wish to voluntarily participate. I also realize that I can stop at any time without any negative repercussions or penalty. By clicking the "next" button and continuing on to the experiment, I affirm that I have given my consent to participate just as if I had signed my name.

Appendix H
Instructions for SCS

"Think of a personal experience that you were involved in no less than a year ago and no longer than five years ago, i.e., between November of 2006 and November of 2010. This memory must be specific in time and place, lasting no longer than 1 day. At the end of these instructions, you will be asked to press the 'next' button and then you will be presented with a list of different events to help you recall a memory. However, do not feel that you are limited to these events – you can use whatever memory comes to mind as long as it meets the criteria above. Once you have recalled a memory please press the 'next' button again to fill out the questionnaire.

Press the 'next' button when you are ready."

Appendix I

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Back to the Future: A Study on Mental Time Travel

Online Informed Consent Form for The Experiment

Primary Investigator(s)**: Emad Talisman** Email: Emad.Talisman@msvu.ca
Phone: (902) 440 3654

What is the purpose of this study? To look at differences between thinking about the future and thinking about the past.

What will I be asked to do? This study consists of two parts. You have already completed the first part, the Memory Collection session. Now you are being asked to participate in the Experiment. The entire experiment will be completed on a computer in the Psychology Lab, and you will be provided with a login code to access your experiment. Next, the memory details that you provided in Phase I (about a month ago) will be presented back to you in a somewhat jumbled form. Using the combination of memory details, you will be asked to either imagine a future event, a present event, or to remember a past event that include these details. For each event you will type out what you can remember or envision happening, and then answer a few questions about the event such as "My memory for this event involves visual detail: 1 = little or none; 7 = a lot."

How long will the experiment take? Approximately 1 hour and 40 minutes.

Are there any risks involved? There are no significant risks associated with this study. While remembering events in your past, you may, however, recall an unpleasant experience. It is important to keep in mind that you choose how you want to remember or envision the events shown to you. It is completely up to you. Your participation is voluntary. If, for any reason, you wish to quit and discontinue your participation, you are completely free to do so without consequence or penalty. Most people who have participated in similar research find it an interesting experience and suffer no negative consequences.

However, if you do feel distressed as a consequence of remembering an unpleasant event from your past, MSVU offers help through Counselling Services and the Health Office. Psychological

counselling is located on the 2nd floor of Evaristus, Room 218. You may also contact Julie Fillmore at 457-6567 or by email at counselling@msvu.ca for counselling services and personal counselling emergencies. If you can't reach anyone at these numbers and you feel you are experiencing a crisis that calls for immediate attention, phone the Queen Elizabeth II Health Science Centre at 902-473-2043. This contact information will be given to you again at the end of the study if you request it. Furthermore, the researcher, Emad Talisman (emad.talisman@msvu.ca), has completed a crisis prevention training program and has extensive experience handling crises in his former job as a support worker for individuals with acquired brain injuries.

Who will see my responses? No one other than the researchers involved in the study will have access to your memory details. All of the data collected in this study will be stored either electronically and password protected or kept in a locked cabinet in a locked room in the Psychology Department at MSVU. We are aware of the personal nature of the data we are collecting and it will be kept completely confidential

Bonus points and $50 Chapters gift certificate: Everyone who participates in this experiment will be entered into a draw for a $50 Chapters gift certificate. Because you already took part in the first part of this experiment, today's participation doubles your chance of winning the gift certificate because your name will be entered again for the draw.

Your professor may have decided to offer you bonus points or participation credit in exchange for taking part in this study. If so, please write down your student ID number, professor's name, and your class on the sheet of paper provided by the experimenter so that your professor can be informed of your participation.

Who can I speak to if I have questions or concerns about the study? If you have questions before you decide to participate or if they arise afterward, please feel free to contact the researcher by email (Emad.Talisman@msvu.ca). Alternatively, you can contact Dr. Angie Birt, the faculty supervisor of the study, through email (Angela.Birt@msvu.ca) or by telephone (457-6667). If you would like to know the results of this study, please feel free to attend the Psychology Department's Research Day conference in the Spring of 2012 in the Psychology Department of the Mount. Otherwise, a poster displaying the results of our study will be posted on the fourth floor of the Evaristus building across from the psychology laboratory at the end of the semester. If neither of these options works for you, then feel free to email either the researcher (Emad.Talisman@msvu.ca) or the supervisor (Angela.Birt@msvu.ca) in April of 2012 for a summary of the study results.

This study has been reviewed and approved by the Psychology Department Research Ethics Committee at the Mount as well as the Mount Saint Vincent University Review Ethics Board. If you have questions about how this study is being conducted and wish to speak with someone

who is not directly involved in the study, you may contact the Chair of the University Research Ethics Board (UREB) c/o MSVU Research and International Office, at 457-6350 or via email at research@msvu.ca.

I agree to participate

I am confirming that I have read and understand the above information and wish to voluntarily participate. I also realize that I can stop at any time without any negative repercussions or penalty. By clicking the "next" button and continuing on to the experiment, I affirm that I have given my consent to participate just as if I had signed my name.

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