



AARHUS UNIVERSITY



Coversheet

This is the accepted manuscript (post-print version) of the article.

Contentwise, the post-print version is identical to the final published version, but there may be differences in typography and layout.

How to cite this publication

Please cite the final published version (APA):

Özbek, M., Bohn, A., & Berntsen, D. (2017). Imagining the personal past: Episodic counterfactuals compared to episodic memories and episodic future projections. *Memory and Cognition*, 45, 375-389. DOI: [10.3758/s13421-016-0671-2](https://doi.org/10.3758/s13421-016-0671-2)

Publication metadata

Title:	Imagining the personal past: Episodic counterfactuals compared to episodic memories and episodic future projections
Author(s):	Özbek, M., Bohn, A., & Berntsen, D.
Journal:	Memory and Cognition
DOI/Link:	10.3758/s13421-016-0671-2
Document version:	Accepted manuscript (post-print)

General Rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Imagining the personal past: Episodic counterfactuals compared to episodic memories and episodic future projections

Müge Özbek, Annette Bohn, Dorthe Berntsen

Center on Autobiographical Memory Research, Department of Psychology and Behavioural Sciences, Aarhus University

Correspondence concerning this article should be addressed to Müge Özbek, Center on Autobiographical Memory Research (CON AMORE), Department of Psychology and Behavioural Sciences, School of Business and Social Sciences, Aarhus University, Bartholins Allé 9, Aarhus C, 8000, Denmark. Telephone: +4587164428 E-mail: muge@psy.au.dk

Abstract

Episodic counterfactuals are imagined events that could have happened, but did not happen, in a person's past. Such imagined past events are important aspects of mental life, affecting emotions, decisions, and behaviors. However, studies examining their phenomenological characteristics and content are few. Here we introduced a new method to systematically compare self-generated episodic counterfactuals to self-generated episodic memories and future projections with regard to their phenomenological characteristics (e.g., imagery, emotional valence, rehearsal) and content (e.g., reference to cultural life script), and how these were affected by temporal distance (1 month, 1 year, 5+ years). The findings showed that the three types of events differed phenomenologically. First, episodic memories were remembered more easily, with more sensory details, and from a dominantly field perspective compared to both future projections and episodic counterfactuals. Second, episodic future projections were more positive, more voluntarily rehearsed, and more central to life story and identity than both episodic memories and episodic counterfactuals. Third, episodic counterfactuals differed from both episodic memories and future projections by neither having the positivity bias of the future events nor the enhanced sensory details of the past events. Across all three event types sensory details decreased, whereas importance, reference to cultural life script, and centrality increased with increasing temporal distance. The findings show that imagined events are phenomenologically different from memories of experienced events, consistent with reality monitoring theory, and that imagined future events are different from both actual and imagined past events, consistent with some theories of motivation.

Imagining the personal past: Episodic counterfactuals compared to episodic memories and future projections

“My sister almost lost her life because of the doctor’s fault. Her operation was delayed due to a late diagnosis and the situation was fatal. If it had gone unnoticed for a longer time, I might have had a life without her.” (Woman, 19 years)

“When I went to the embassy for my visa application, the officer said that my application had been rejected. If it had been approved, I would have traveled to the USA that summer and this might have been an important experience for me.” (Man, 24 years)

When people are asked to imagine important personal events that could have happened but did not happen in their lives, they think about various alternatives to what actually happened, as shown in the examples above. A quick introspection as to how frequently we engage in thought experiments involving what if, even if, if only etc. about the ways things might have turned out may give us an idea about how often this mental activity occurs. Roese, Sanna, and Galinsky (2005) defined the outcome of this mental activity as “thoughts of what might have been” and stated that “they are imaginative constructions fabricated from stored representations, typically embracing a blend of traces from both episodic and semantic memory” (p. 138).

These imaginative constructions, also known as counterfactuals, have been studied extensively in reasoning and decision-making literatures. Byrne (2005) reviewed the consistent ways in which people mentally change parts of what actually happened in order to come up with alternatives that might have happened. Byrne noted that counterfactuals may encompass “actions, controllable events, unacceptable actions, causal relations, and recent events” (p. 14) and people often experience different emotions, such as regret, relief, anticipation, shame, or guilt after counterfactual thinking.

Although counterfactuals are considered important aspects of our mental life, affecting our emotions, decisions, and behaviors (for a review see Byrne, 2016), naturalistic studies examining their phenomenological characteristics and content are few. For example, Landman and Manis (1992) explored counterfactuals about personal events by asking people: “If you could start all over, what would you do differently?” In their descriptive study, most people reported having something

they wished they would have done differently. However, content of counterfactual alternatives were limited to education, career/extracurricular activities, marriage/romance, and children/family since people were specifically probed for these domains. Other studies targeted specific samples to examine emotional regulation of negative personal experiences, which could have ended worse (e.g., survivors of the tsunami disaster; Teigen & Jensen, 2011) or better (e.g., bereaved individuals contemplating personal in/actions to prevent the death of a loved one; Davis, Lehman, Wortman, Silver, & Thompson, 1995).

These seminal studies raise many important questions about episodic counterfactuals (Schacter, Benoit, De Brigard, & Szpunar, 2015). First, little is known about episodic counterfactuals' phenomenological characteristics compared to episodic memories and episodic future projections because no studies have compared the characteristics of episodic counterfactuals to episodic memories and future projections, when all three categories are generated in an unconstrained and open-ended fashion. Second, it therefore is not known whether the characteristics of such episodic counterfactuals are affected by experimental manipulations, such as temporal distance, in the same ways as the characteristics of episodic memories and episodic future projections. Third, it is not known whether episodic counterfactuals differ from episodic memories and episodic future projections concerning the semantic influences on their content.

Here, we aim to answer these questions by employing a new method to sample naturalistic episodic counterfactuals, that is, episodic counterfactuals that people freely generate in response to a short instruction. We conceptualize episodic counterfactuals as constructive mental activities, initiated by mental time travel (MTT) ability, just like episodic memories and episodic future projections (De Brigard, 2014; Epstude & Peetz, 2012). At the same time, we investigate possible differences between these three types of constructive mental activities since each has a unique position on the temporal direction (past vs. future) and reality (real vs. imagined) dimensions. Studying episodic counterfactuals therefore can inform us of potential interactions of these two dimensions.

Past and future mental time travel

The idea that people are able to mentally travel in time to remember events from their pasts and imagine events that might occur in their futures was introduced by Tulving (1983, 1985, 2002) and examined thoroughly since by other memory researchers (e.g., Atance & O'Neill, 2001; Berntsen & Bohn, 2010; Buckner & Carroll, 2007; Suddendorf & Corballis, 1997, 2007; Szpunar,

2010). Numerous MTT studies have compared phenomenological, functional, and neurological characteristics of remembering the past and imagining the future in both healthy and clinical populations (e.g., Botzung, Denkova, & Manning, 2008; D'Argembeau & Van der Linden, 2004, 2006; Okuda et al., 2003; Spreng & Levine, 2006; Williams et al., 1996). Findings seem to converge on the conclusion that these processes share similar underlying neurocognitive mechanisms (for reviews see D'Argembeau, 2012; Szpunar, 2010).

Despite similarities, several studies also have shown important differences between past and future MTT (e.g., Berntsen & Bohn, 2010; Berntsen & Jacobsen, 2008; D'Argembeau & Van der Linden, 2004; Kane, Van Boven, & McGraw, 2012; Newby-Clark & Ross, 2003; Painter & Kring, 2015; Rasmussen & Berntsen, 2013). These studies showed marked differences between past and future events for emotional valence, sensory details, and idealized/schema-based construction, which manifest themselves as higher importance and centrality to life story and identity as well as reliance on schematic content for future relative to past events. Relatedly, Rubin (2014) found that negative future events were rated as more extreme on a number of dimensions, consistent with schema-based construction. Additionally, differences between temporally close and distant events concerning phenomenology and content were observed in several studies (Addis, Wong, & Schacter, 2008; Berntsen & Bohn, 2010; Berntsen & Jacobsen, 2008; D'Argembeau & Van der Linden, 2004).

Newby-Clark and Ross (2003) showed in a series of studies that people conceive future events as more positive than past events; they take longer time to imagine negative events in their futures; and they consider future events to have more personal importance. This idealization and positivity of the future was also found in a study by Berntsen and Bohn (2010), in which people's future projections were more positive and idyllic than their memories. Berntsen and Bohn concluded that this was due to people's "uncorrected positive illusions" (p. 275) for imagined future events. Their findings were replicated and extended by Rasmussen and Berntsen (2013), who specifically asked participants to describe both negative and positive past and future events. They found that phenomenological differences between negative and positive events were larger for future events than for memories. Moreover, Szpunar, Addis, and Schacter (2012) found that details from simulated negative future scenarios were more difficult to remember than details from simulated positive and neutral future scenarios after a long delay (10 min. vs. 1 day). Grysman, Prabhakar, Anglin, and Hudson (2013) examined self and other (close friend and non-close friend)

narratives of past and future events and found, consistent with Berntsen and Bohn (2010), that past events had higher phenomenological quality, whereas future events were more positive.

Furthermore, extending Berntsen and Bohn's (2010) work, their results showed that people rely on cultural life scripts (CLSs) to imagine not only their own, but also others' future. CLSs are semantic knowledge about the important events that are expected to happen in a prototypical individual's life in a given culture and their expected timeline (Berntsen & Rubin, 2004; Rubin & Berntsen, 2003). Studies have shown that CLSs guide MTT into both the past and future (e.g., Berntsen & Bohn, 2010; Berntsen & Jacobsen, 2008). Moreover, findings on temporal distance indicate that distant events are experienced as more scripted and personally significant, whereas close events have higher levels of sensory detail, regardless of temporal direction (e.g., Addis, et al., 2008; Berntsen & Bohn, 2010; D'Argembeau & Van der Linden, 2004). These findings are in line with the "temporal construal theory" (Trope & Liberman, 2003), which suggests that events are represented in more abstract terms as the temporal distance from the present increases.

Episodic counterfactuals: A matter of temporal direction or reality?

While an abundance of studies have compared naturalistic (freely, self-generated) future projections with naturalistic episodic memories, naturalistic episodic counterfactuals have been largely unexamined in the MTT literature. At the same time, several theorists have acknowledged their similarities to other types of episodic constructions. De Brigard (2014) argues that human memory may constitute a larger system than previously thought, not only processing what was and what might be but also what could have been. The definition of counterfactuals by Roese et al. (2005) already implies that imagining the past (i.e., generating counterfactuals) is supported by the same system that gives rise to episodic memories and episodic future projections.

Consequently, our current knowledge about the characteristics of episodic counterfactuals (Schacter, et al., 2015) in comparison to episodic memories and episodic future projections is limited because studies have not yet examined whether differences might occur because of temporal direction or reality status of the represented event. Following the taxonomy by Szpunar, Spreng, and Schacter (2014), one can argue that episodic counterfactuals are more similar to episodic future projections because both are hypothetical episodic simulations. Nonetheless, considering the marked differences between past and future MTT, one can also argue that episodic counterfactuals are more similar to episodic memories, because both involve past-oriented cognition and are constrained by real events that actually occurred.

Findings from studies of episodic counterfactuals

There are few empirical studies comparing episodic counterfactuals with memories and future projections. De Brigard and Giovanello (2012) asked their participants to generate emotionally valenced episodic memories. They then asked them to form episodic counterfactuals by changing the emotional contents of the remembered events (i.e., valence changed, temporal direction fixed) and to form future events by generating events similar to memories but which take place in the future (i.e., valence fixed, temporal direction changed). De Brigard and Giovanello showed that past events included more sensory details than episodic counterfactuals and future events. Episodic counterfactuals, however, were less emotionally intense than other event types.

In another study, De Brigard, Szpunar, and Schacter (2013) showed that repeated simulation of episodic counterfactuals decreased their perceived plausibility, although ease of simulation, degree of detail, and valence ratings increased. This was in contrast to the finding that the perceived plausibility of episodic future projections increased with repeated simulation. Thus, although both episodic counterfactuals and episodic future projections are simulations of hypothetical events, temporal direction creates a difference for perceived plausibility of the simulated event. Furthermore, neural evidence is inconclusive, showing that mental simulation of alternatives to past events activates many regions in the default network, and both episodic counterfactuals and episodic future projections activate a common neural network despite differences in hippocampal activity (e.g., Schacter, et al., 2012, 2015; Van Hoeck, et al., 2013; Van Hoeck, Watson, & Barbey, 2015).

One limitation of these studies is that the episodic counterfactuals were constructed through a process that was more constrained by the experimenter than the construction of the other two event types. First, the participants generated an actual memory of a past event in response to a word cue (De Brigard & Giovanello, 2012) or an emotion cue (De Brigard et al., 2013). Next, they transformed this memory into an episodic counterfactual by changing a key feature (e.g., valence; De Brigard & Giovanello, 2012), or by changing details of their memories (e.g., person, location, object, activity; De Brigard et al., 2013) to create upward, downward, and neutral counterfactual alternatives to negative, positive, and neutral memories, respectively. Thus, in both cases, episodic counterfactuals were generated through an experimenter-determined process and through a two-step procedure, which may have affected their characteristics relative to the self-generated episodic memories and/or future projections. We overcome this limitation by using naturalistic episodic counterfactuals that are generated as freely as the episodic memories and future projections.

The present study

The present study addresses three questions left unanswered by previous research: 1) whether and how the phenomenological characteristics of self-generated episodic counterfactuals are similar to, or different from, those of episodic memories and episodic future projections, 2) how temporal distance affects these characteristics, and 3) whether there are differences between these events concerning the semantic influences on their content, more specifically the reliance on CLSs.

To do so, we developed a new method of eliciting episodic counterfactuals. We were interested in naturalistic episodic counterfactuals and therefore adopted methods similar to those used in research on episodic memory. Thus, we restricted our participants as little as possible in their answers, so they provided any type of episodic counterfactual that came to mind in response to a short instruction.

We examined phenomenological characteristics such as sensory detail, emotional valence, emotional intensity, ease of remembering/imagining, and perspective, as has been done in previous studies with experimenter-defined episodic counterfactuals (e.g., De Brigard & Giovanello, 2012; De Brigard, et al., 2013). We also included measures of other phenomenological characteristics of interest that previous studies examined for episodic memories and episodic future projections, but which have not been examined for episodic counterfactuals, such as voluntary and involuntary rehearsal, importance, and centrality to life story and identity.

Based on the literature and our theoretical reasoning, the following predictions were generated: Concerning phenomenological characteristics, we expected episodic memories to be higher on sensory detail than episodic counterfactuals and episodic future projections. We expected episodic future projections to be more positive, more important, and more central to life story and identity than episodic memories and episodic counterfactuals. Lastly, we expected episodic counterfactuals to be less emotionally intense than other events. Concerning temporal distance, we expected sensory detail ratings to decrease, and importance and centrality ratings to increase with increasing temporal distance into the past/future. Finally, we expected temporally distant events to be more schema-based or reliant on CLSs than temporally close events.

Method

Participants

Sixty-nine undergraduate students (40 women and 29 men; mean age: 21.09 years, SD: 2.20, range 18 to 29) from Boğaziçi University participated in the study. The mean years of education was 15.72 (SD: 1.85, range: 12 to 22). Most participants were single (91.3%) and none had children. All participants received course credit for participating.

Materials

The participants were asked to write down “a memory of an important event from your life” (episodic memory), “an important imagined event that could have happened, but did not happen in your life” (episodic counterfactual; see Appendix B for examples), and “an important imagined future event that might happen in your life” (episodic future projection). Further, the participants were instructed to generate events from 1 month ago/into the future, 1 year ago/into the future, and 5 or more years ago/into the future. Hence, participants generated a total of 9 events. The order of events was counterbalanced between participants for a total of 6 possible orders. The order of temporal distance was fixed. Participants reported the most recent event first and the remotest event last. Participants were asked to write a few sentences for each memory/imagined event and give it a brief title.

After recording each event, participants answered questions concerning the phenomenological characteristics of the events. These were adapted from Rubin, Schrauf, and Greenberg (2003), Rubin and Berntsen (2009), Berntsen and Bohn (2010), and Szpunar and Schacter (2013). The following questions measured the extent of people's subjective experience when they recollected and imagined an event (on 7-point-Likert scales): vividness, pre/living, visual imagery, auditory imagery, spatial imagery, emotional valence, emotional intensity, importance, perspective, voluntary rehearsal, involuntary rehearsal, ease of remembering/imagining, and specificity. The participants also dated the events to ensure that they followed instructions to write down events from different temporal distances.

Table 1 shows all phenomenology questions for episodic memories and their corresponding scales. Appendix A shows the modified questions for episodic counterfactuals and episodic future projections. Wording of the questions was modified for the different event types so that all three types of events were clearly distinguishable.

Following the questions related to event phenomenology, participants filled in the 7-item version of the Centrality of Event Scale (CES—Short form, Berntsen & Rubin, 2006) for each event. This scale measures to which extent negative and/or positive life events are evaluated as central to one's life story and identity (e.g., "I feel that this event has become a central part of my life story"; "This event permanently changed my life"). Participants indicated to what degree they agreed or disagreed with each of the statements on a 5-point Likert scale from 1 = "Totally disagree" to 5 = "Totally agree".

For episodic memories, the standard instructions for answering the CES questions were used (Berntsen & Rubin, 2006). For episodic counterfactuals and episodic future projections, the instructions were modified slightly. For episodic counterfactuals, the instructions were: "When answering the following seven questions, think about how you would have felt if the imagined event had actually happened. Please place yourself in the situation that the imagined event had actually taken place and then answer the following questions in an honest and sincere way by choosing a number from 1 to 5." For episodic future projections, the instructions were: "When answering the following seven questions think about how you would feel if the imagined event happens. Please place yourself in the situation that the imagined event has taken place in the future and then answer the following questions in an honest and sincere way by choosing a number from 1 to 5."

Procedure

Participants were tested in groups of 15-20. Testing sessions took approximately an hour. First, each student was asked to read and sign the informed consent form; then each student was given the "memories and imagined events" booklet, which contained the following information and instructions: "Dear participant, this is a study about memories and imagined events. On the following pages you will be asked to remember important memories from your life. You will also be asked to imagine important events which might happen in your future or might have happened in your past, but did not occur. Please read the instructions on each page carefully and write down specific memories/imagined events. This means that memories/imagined events you write should belong to a specific time and a specific place, and their duration should not exceed a full day—24 hours. Please write a few sentences for each memory/imagined event. After you finish writing each memory/imagined event, please provide a brief title and answer a number of questions about it. All of your answers will remain confidential." Participants focused on events at different temporal distances one at a time and answered phenomenology and centrality questions for one before

moving to another. The last page of the booklet consisted of demographic information questions (e.g., gender, years of education, marital status). At the end of testing sessions, participants were thanked and debriefed.

Content Scoring

All events were content coded for CLS events by the first author and an independent coder based on the Turkish CLS (Erdoğan, Baran, Avlar, Taş, & Tekcan, 2008). Interrater agreement was substantial (87%, Cohen's $\kappa = .76$, $p < .001$). Disagreements were resolved by discussion. In order to determine whether participants had understood the instructions and produced actual episodic counterfactuals and not just more randomly imagined events, the first author and an independent coder coded all episodic counterfactuals ($N = 205$). This coding was based on generally accepted theoretical definitions of counterfactuals (e.g., Beck & Riggs, 2014; Byrne, 2007; De Brigard et al., 2013; Epstude & Roese, 2008; Schacter et al., 2015). A key requirement was the explicit description of an alternative outcome of an actual past experience; an outcome, which could have happened but did not take place. The two coders unanimously agreed that 93% of the records were counterfactuals (Cohen's $\kappa = .54$, $p < .001$). The remaining 7% were classified as counterfactuals after discussion, because nothing in the descriptions indicated that they were not counterfactuals, and because the participants had not been instructed to provide sufficiently detailed descriptions to allow objective coding. Some examples of episodic counterfactuals are presented in Appendix B.

Results

We will first present results for our manipulation check for temporal distance. In line with the order of our hypotheses, we then present results for the variables for which episodic memories received higher scores (e.g., sensory-imagery, perspective, ease of remembering/imagining, specificity), the variables for which episodic future projections received higher scores (e.g., emotional valence, importance, voluntary rehearsal, centrality to life story and identity), and the content. Finally, we present results for emotional intensity and involuntary rehearsal.

Manipulation check for temporal distance

To check whether the temporal distance manipulation worked, we converted all answers for temporal distance into weeks and conducted a 3 (event type: episodic memory, episodic counterfactual, episodic future projection) x 3 (time distance: 1 month, 1 year, 5+ years) repeated-

measures ANOVA with temporal distance in weeks as the dependent variable. As expected, there was a significant main effect of temporal distance on temporal distance in weeks; $F(2,126) = 959.29, p < .001, \eta^2_p = 0.93$. Main effect of event type was not significant, but there was a significant interaction; $F(4,252) = 2.78, p = .03, \eta^2_p = 0.04$. Simple effects analyses showed that at all temporal distances, dating of all event types were similar ($ps > .05$). For all event types, events at 5+ years were the remotest and events at 1 month were the most recent. Overall, this ensured that the only difference between temporal distances could be attributed to our experimental manipulation and not to event types. Hence, our temporal distance manipulation worked.

Higher phenomenology ratings for actual past events

Since inter item correlations were high between the sensory detail items of vividness, pre/living, visual imagery and auditory imagery, a composite score entitled “sensory-imagery” was created for each event type before the analyses (Cronbach's α s ranging from .75 to .93; see Berntsen & Bohn, 2010 for a similar procedure). To examine differences in sensory-imagery, specificity, perspective, and ease of remembering/imagining as a function of event type and temporal distance, 3 (event type: episodic memory, episodic counterfactual, episodic future projection) \times 3 (time distance: 1 month, 1 year, 5+ years) repeated-measures ANOVAs were conducted. Figure 1 shows the means for sensory-imagery, spatial imagery, specificity, perspective, and ease of remembering/imagining as a function of event type and temporal distance. In the graphs, episodic memories are referred to as “past” and episodic future projections as “future”. Figure 1 shows that there was a quite consistent pattern with episodic remembering rated higher (for observer perspective lower) on these measures compared to the other event types. At the same time, there was a tendency for these measures to show a decrease across time. Both observations are consistent with our hypotheses. In the following, we offer more detailed analyses.

There was a significant main effect of event type for sensory-imagery; $F(2,128) = 21.85, p < .001, \eta^2_p = 0.25$. Bonferroni-corrected post hoc analyses showed that episodic memories were rated significantly higher than both episodic counterfactuals and episodic future projections (both $ps < .001$), but episodic counterfactuals and episodic future projections were not different from each other ($p > .05$). The main effect of temporal distance on sensory-imagery ratings was also significant, $F(2,128) = 9.42, p < .001, \eta^2_p = 0.13$. Bonferroni-corrected post hoc analyses showed that events at 1 month and 1 year were rated similarly ($p > .05$), but both were rated higher than events at 5+ years ($ps \leq .05$). The interaction was not significant. The main effect of event type on

spatial imagery was significant; $F(2,128) = 39.98, p < .001, \eta^2_p = 0.38$. Bonferroni-corrected post hoc analyses showed that episodic memories were rated higher than other event types (both $ps < .001$). Temporal distance had a significant main effect as well; $F(2,128) = 4.52, p = .01, \eta^2_p = 0.06$. Events at 1 month were higher on spatial imagery than events at 5+ years ($p = .03$). Events at 1 year did not differ from events at 1 month and 5+ years (both $ps > .05$). Event type and temporal distance did not interact.

There was a significant main effect of event type on specificity ($F(2,124) = 36.33, p < .001, \eta^2_p = 0.37$), perspective ($F(2,124) = 4.15, p = .018, \eta^2_p = 0.63$), and ease of remembering/imagining ($F(2,126) = 8.92, p < .001, \eta^2_p = 0.12$). Bonferroni-corrected post hoc analyses showed that episodic memories were significantly more specific than episodic future projections and episodic counterfactuals (both $ps < .001$), which did not differ from each other ($p > .05$). Episodic memories involved significantly more field (first person) perspective than episodic counterfactuals ($p = .05$) and episodic future projections ($p = .03$), which did not differ from each other ($p > .05$). Moreover, remembering episodic memories was considered easier than imagining episodic counterfactuals ($p < .001$) and episodic future projections ($p = .002$). There was a significant main effect of temporal distance both on ease of remembering/imagining ($F(2,126) = 4.87, p = .01, \eta^2_p = 0.07$) and on specificity ($F(2,124) = 4.04, p = .02, \eta^2_p = 0.06$). Bonferroni-corrected post hoc analyses showed that events at 1 month were easier to remember/Imagine than events at 1 year ($p = .006$) and 5+ years ($p = .05$). Ease of remembering/imagining ratings for events at 1 year and 5+ years did not differ ($p > .05$). Similarly, events at 1 month were more specific than events at 5+ years ($p = .05$) but no other comparisons were significant ($ps > .05$). There were no significant interactions.

Higher phenomenology ratings for imagined future events

Figure 2 shows that the mean ratings for emotional valence, importance, voluntary rehearsal, and centrality to life story and identity as a function of event type and temporal distance were generally higher for future projections (e.g., Berntsen & Bohn, 2010). For some of these measures, a systematic increase with increasing temporal distance was seen. Both findings are consistent with our hypotheses. In the following, we offer more detailed analyses.

There was a significant main effect of event type on emotional valence; $F(2,128) = 93.61, p < .001, \eta^2_p = 0.59$. Bonferroni-corrected post hoc analyses showed that episodic future projections were more positive than other event types (both $ps < .001$). Temporal distance did not have a significant main effect, but there was a significant interaction between event type and temporal

distance; $F(4,256) = 3.53, p < .01, \eta^2_p = 0.05$. Simple effects analyses showed that across temporal distances, episodic future projections were consistently rated as more positive than episodic memories and episodic counterfactuals (all $ps < .001$), whereas episodic memories and episodic counterfactuals were not different from each other ($ps > .05$). Moreover, for episodic future projections, ratings at 1 month were lower than ratings at both 1 year ($p = .01$) and 5+ years ($p = .001$). No significant differences were observed between emotional valence at 1 year and 5+ years ($p > .05$). For the other two event types, there were no significant differences in valence ratings across temporal distances ($ps > .05$).

The main effect of event type on importance was significant; $F(2,126) = 13.04, p < .001, \eta^2_p = 0.17$. Bonferroni-corrected post hoc analyses showed that episodic future projections were significantly more important than episodic memories ($p < .001$) and episodic counterfactuals ($p = .006$), which did not differ from each other ($p > .05$). There was also a significant main effect of temporal distance; $F(2,126) = 24.09, p < .001, \eta^2_p = 0.28$. Bonferroni-corrected post hoc analyses showed that events at 1 month were less important than events at 1 year and 5+ years (both $ps < .001$), which did not differ from each other ($p > .05$). The interaction between event type and temporal distance was not significant.

There was a significant main effect of event type on voluntary rehearsal; $F(2,126) = 14.30, p < .001, \eta^2_p = 0.19$. Bonferroni-corrected post hoc analyses showed that episodic future projections were more voluntarily rehearsed than episodic memories ($p = .002$) and episodic counterfactuals ($p < .001$), which did not differ from each other ($p > .05$). Neither main effect of temporal distance, nor interaction was significant. For involuntary rehearsal, the main effect of event type was not significant. Moreover, although the main effect of temporal distance on involuntary rehearsal reached a statistical significance of $p = .05$, Bonferroni-corrected post hoc analyses did not yield any significant differences in ratings between 1 month, 1 year, and 5+ years ($ps > .05$). The interaction between event type and temporal distance was not significant either.

There was a significant main effect of event type on CES ratings; $F(2,124) = 12.04, p < .001, \eta^2_p = 0.16$. Bonferroni-corrected post hoc analyses showed that episodic future projections were significantly more central to life story and identity than other event types (both $ps < .001$). The main effect of temporal distance was significant as well; $F(2,124) = 45.99, p < .001, \eta^2_p = 0.43$. Events at 1 month were less central to life story and identity than events at 1 year and 5+ years (both $ps < .001$). Furthermore, the interaction between event type and temporal distance was significant for CES ratings; $F(4,248) = 4.17, p < .01, \eta^2_p = 0.06$. Simple effects analyses showed

that at 1 month, all event types were equally central to life story and identity ($ps > .05$). At 1 year, episodic future projections were more central than episodic memories ($p = .006$) and episodic counterfactuals ($p = .002$), whereas these did not differ from each other ($p > .05$). Finally, at 5+ years, centrality ratings for episodic future projections were higher than for episodic counterfactuals ($p = .01$) and episodic memories ($p < .001$). Episodic counterfactuals received higher ratings than episodic memories ($p = .04$) as well. For episodic memories, ratings at 1 month were lower than ratings at 1 year ($p = .003$) and 5+ years ($p = .033$). Ratings at 1 year and 5+ years did not differ from each other ($p > .05$). The same pattern was observed for episodic future projections; ratings at 1 month were lower than ratings at 1 year and 5+ years (both $ps < .001$). Ratings at 1 year and 5+ years were, again, not different ($p > .05$). For episodic counterfactuals, however, ratings at 5+ years were higher than ratings at 1 month ($p < .001$) and 1 year ($p = .03$) but ratings at 1 year were also higher than at 1 month ($p < .001$).

Distinct phenomenology of episodic counterfactuals

The bottom of Figure 2 shows the means for emotional intensity as a function of event type and temporal distance. There was a main effect of event type; $F(2,126) = 24.86, p < .001, \eta^2_p = 0.28$. Bonferroni-corrected post hoc analyses showed that episodic counterfactuals were less emotionally intense than the two other event types (both $ps < .001$), which did not differ from each other ($p > .05$). Neither the main effect of temporal distance, nor the interaction was significant.

Reliance on the cultural life script

One of the aims of the present study was to examine whether there were any differences between episodic memories, episodic counterfactuals, and episodic future thoughts regarding their reliance on the CLS. A 3 (event type: episodic memory, episodic counterfactual, episodic future projection) x 3 (time distance: 1 month, 1 year, 5+ years) repeated-measures ANOVA yielded a significant main effect of temporal distance ($F(2,130) = 33.52, p < .001, \eta^2_p = 0.34$) on the percentage of CLS events. Bonferroni-corrected post hoc analyses showed that the percentage of CLS events consistently increased from temporally close (1 month) to temporally distant (5+ years) events (14%, 30%, and 51%, respectively) (all $ps < .01$). Thus, CLS events are on average equally frequently mentioned for episodic memories, episodic counterfactuals, and episodic future projections, and their frequency of mention equally increases across temporal distance from present as shown in Figure 3.

Discussion

We have examined episodic counterfactual thinking in the context of episodic remembering and episodic future projection. We developed a new method to elicit episodic counterfactuals, which allowed participants to freely generate counterfactual thoughts about personal events in the same way as they did for episodic memories and future projections in order to allow systematic comparisons across the three event types. The three event types were compared with regard to their content and phenomenological characteristics, and how these were affected by temporal distance. This study design offered a unique opportunity to disentangle the complexity of episodic counterfactuals, as being both simulations of hypothetical events and past-oriented cognitions. Their special position on the two dimensions crucial for understanding MTT, that is, temporal direction (past vs. future) and reality (real vs. imagined), enabled us to examine whether these dimensions are orthogonal, or whether episodic simulation generally should be seen as more of a future-oriented type of cognition (Szpunar, et al., 2014).

As predicted, episodic memories were recalled with higher levels of sensory and spatial details. They were also more specific, more easily remembered, and experienced more from a field perspective than the other event types. These results agree with findings from previous studies showing that memories contain more perceptual and contextual event details (e.g., D'Argembeau & Van der Linden, 2004; De Brigard & Giovanello, 2012).

Importantly, episodic counterfactuals and future projections followed different patterns than memories and also differed from one another. First, future projections were rated as more positive, more important, more voluntarily rehearsed, and more central to life story and identity. As suggested by previous research, higher subjective ratings of future projections on voluntary rehearsal, positivity, importance and centrality may stem from self-enhancement biases (e.g., Grysman, Prabhakar, Anglin, & Hudson, 2015) or future goals and motivations (e.g., D'Argembeau & Mathy, 2011). Second, when people imagined episodic counterfactuals, they neither produced as many details as they did for episodic memories of actual past events, nor did they consider these alternatives as positive, important, and central to life story and identity as imagined future events.

Overall, our findings suggest an interaction between past versus future temporal direction and real versus imagined events, resulting in different cognitive and motivational processes underlying the unique characteristics of each of the three mental event types. First, in line with the reality and source monitoring framework (e.g., Johnson, Hashtroudi, & Lindsay, 1993; Johnson & Raye, 1981; McGinnis & Roberts, 1996), recall of rich perceptual and contextual details from

actually experienced events helps people differentiate their episodic memories from other constructive cognitive processes, such as imagining counterfactual and future events. Although our memory is error-prone (e.g. Bartlett, 1932; Loftus & Pickrell, 1995; Roediger & McDermott, 1995), we usually are able to distinguish our personal memories from products of our imagination in general (Johnson & Raye, 1981). This is consistent with our finding that episodic memories were more detailed and sensory rich than the two imagined event categories. Second, as predicted, and in line with previous findings (e.g., Berntsen & Bohn, 2010; Grysman, et al., 2013; Kane, et al., 2012; Newby-Clark & Ross, 2003; Rasmussen & Berntsen, 2013; Sharot, Riccardi, Raio, & Phelps, 2007, Van Boven & Ashworth, 2007), future projections were conceived as highly positive and idealized, whereas episodic counterfactuals did not show such positivity bias. This finding supports our hypothesis that episodic counterfactuals and episodic future thoughts have different phenomenological characteristics, even though they are both simulations of hypothetical events.

There might be several potential explanations of the positivity bias for future events. First, healthy individuals tend to see the personal future in a positive light, and lack of this positive view is generally linked to psychopathology (e.g., MacLeod & Byrne, 1996; MacLeod & Conway, 2007; Sharot, et al., 2007; Weinstein, 1980), suggesting that optimism bias has important implications for psychological and physical health (Taylor & Brown, 1988; Taylor, Kemeny, Reed, Bower, & Gruenewald, 2000). Second, previous studies have shown that everyday future-oriented thoughts have important implications for action planning and goal pursuit (e.g., D'Argembeau & Mathy, 2011; D'Argembeau, Renaud, & Van der Linden, 2011). Hence, imagining desired positive outcomes for the future may be beneficial for goal attainment through increased motivation, effective planning, and problem solving (but see Pham & Taylor, 1999; Taylor, Pham, Rivkin, & Armor, 1998). Third, the mere fact that the future is yet to occur in contrast to the past may result in unrealistic optimism and a sense of control over future events (e.g., Heckhausen, 1997; Markus & Nurius, 1986; Taylor & Brown, 1988), and may make it difficult to imagine negative events for the future (e.g., Newby-Clark & Ross, 2003; D'Argembeau & Van der Linden, 2004). Finally, as suggested by the "temporal self-appraisal theory" (Ross & Wilson, 2002; Wilson & Ross, 2000, 2001, 2003), self-enhancement biases, as manifested by people's tendency to conceive their selves as improving over time, are stronger for the future (e.g., Rasmussen & Berntsen, 2013), and the effects of self-enhancement on positivity have been shown to be independent of the increased reference to CLSs for future events (Grysman, et al., 2013, 2015).

In addition to the systematic differences between the three event types, we also found systematic effects of temporal distance across event types. Distance in time was generally accompanied by a reduction of phenomenological qualities of episodic memories (e.g., sensory-imagery and specificity) and by an increase in characteristics associated with future projections (e.g., importance and centrality to life story and identity; higher percentages of CLS events). These findings agree with previous findings (Berntsen & Bohn, 2010) and with the “temporal construal theory” (Trope & Liberman, 2003), according to which events are represented in more abstract terms (high-level construals) as the temporal distance from the present increases. Trope and Liberman suggested that high-level, compared to low-level, construals include more generalized and decontextualized information about event representations. Hence, as people mentally move further away in time from the present, they imagine highly schematic events in broader terms such as culturally normative schemas (as for example, the CLS, Berntsen & Bohn, 2010), for which specific sensory details are lacking or de-emphasized (e.g., D’Argembeau & Van der Linden, 2004; Grysman, et al., 2013).

However, when imagined future events occur naturally in everyday life, they tend to be dated closer to the present than past events (e.g., Berntsen & Jacobsen, 2008; Spreng & Levine, 2006). Yet, in the present study, we kept the temporal distance for future and past events similar by requesting events at fixed time intervals for both temporal directions. We did so to examine how the characteristics of the remembered and imagined events unfold under the same temporal constraints. Previous research using less constrained methods with regard to time course of MTT suggests that the constructions of distant future events rely more on schematic knowledge than the construction of distant past events (e.g., Addis, Wong, & Schacter, 2007; Berntsen & Jacobsen, 2008; Rasmussen & Berntsen, 2013; Szpunar, Watson, & McDermott, 2007).

In the present study, some of the effects of temporal distance were more pronounced for future events, resulting in significant interactions. For example, future projections were more central to life story and identity with increasing time distance, whereas episodic memories and counterfactuals were not. This may suggest that schema-based construction increases as a function of future time distance and, hence, that event representations become more abstract and idealized with an increasingly remote future horizon. Here, the finding that episodic counterfactuals were more central to life story and identity than episodic memories for temporally distant events, may suggest that counterfactual thinking about the past may have greater preparatory functions for future behaviors than just remembering the past (Roese & Olson, 1995). However, people might need

some time to reflect on what might have happened in the past to judge how important and central to the life story and identity this could have been. Thus, when an episodic counterfactual is about a very recent event, people might not have had enough time to evaluate how much this event might have shaped their life story and identity.

The present study has some limitations. First, we used a college student sample, and this may potentially affect the generalizability of the results. The replication of a number of established findings from previous research, however, supports the validity and the reliability of the current findings. Nonetheless, further research may focus on different age groups to better understand the life-span development of the characteristics of episodic memories, episodic counterfactuals, and future projections. For example, the role of episodic counterfactuals in old age may inform the reminiscence literature (Fitzgerald, 1996; Westerhof & Bohlmeijer, 2014; Westerhof, Bohlmeijer, & Webster, 2010). Second, we used one type of cueing (by time intervals and requests for events). Thus, we do not know if our findings generalize to other cueing methods. Previous research (e.g., D'Argembeau & Van der Linden, 2004; Rasmussen & Berntsen, 2013) pointed out that methodological differences in event sampling (e.g., manipulating temporal distance vs. keeping it open-ended) may lead to different results (e.g., increased positivity bias for the future). Thus, future studies may compare different methods to examine temporal effects on phenomenological characteristics of episodic memories, episodic counterfactuals, and future projections.

Conclusion

Taken together, we successfully used a new and relatively open-ended method to systematically compare episodic counterfactuals to episodic memories and future projections. Because they refer to imagined events in the past, episodic counterfactuals can be seen as a cross-over of two important dimensions in the MTT literature, namely past versus future and real versus imagined. Our findings suggest that these two dimensions are best viewed as orthogonal since in general, the characteristics of episodic counterfactuals resembled either episodic memories or future projections. We found that episodic memories of actually experienced events had greater perceptual and contextual details, consistent with the reality and source monitoring framework (e.g., Johnson, et al., 1993; Johnson & Raye, 1981). These perceptual and contextual details may help people to confidently assess their memories as accurate and believable and to differentiate actually experienced events from imagined past and future events. Our findings also suggested that past- vs. future-oriented imaginations clearly differ in that only future projections are associated with

Notice: This is the author's version of a work that was accepted for publication in *Memory & Cognition*.
A definitive version was subsequently published in *Memory & Cognition*, 45, 375-389. DOI:
10.3758/s13421-016-0671-2

uncorrected positive illusions and a more abstract and idealized view of life, consistent with the view that episodic future thinking has important motivational functions in relation to goal pursuit.

Acknowledgements

The authors thank the Danish National Research Foundation (DNRF89) for support. We also thank professor Ali I. Tekcan for his help with the data collection from Boğaziçi University, Istanbul, Turkey, Ecem Bartu, and Irem Ergen for their help with the data coding.

References

- Addis, D. R., Wong, A. T., & Schacter, D. L. (2007). Remembering the past and imagining the future: Common and distinct neural substrates during event construction and elaboration. *Neuropsychologia*, 45(7), 1363-1377. doi:10.1016/j.neuropsychologia.2006.10.016
- Addis, D. R., Wong, A. T., & Schacter, D. L. (2008). Age-related changes in the episodic simulation of future events. *Psychological Science*, 19(1), 33-41. doi:10.1111/j.1467-9280.2008.02043.x
- Atance, C. M., & O'Neill, D. K. (2001). Episodic future thinking. *Trends in Cognitive Sciences*, 5(12), 533-539. doi:10.1016/S1364-6613(00)01804-0
- Bartlett, F. C. (1932). *Remembering: A study in experimental and social psychology*. Cambridge: Cambridge University Press.
- Beck, S. R., & Riggs, K. J. (2014). Developing thoughts about what might have been. *Child Development Perspectives*, 8(3), 175-179. doi: 10.1111/cdep.12082
- Berntsen, D., & Bohn, A. (2010). Remembering and forecasting: The relation between autobiographical memory and episodic future thinking. *Memory & Cognition*, 38(3), 265-278. doi:10.3758/MC.38.3.265
- Berntsen, D., & Jacobsen, A. S. (2008). Involuntary (spontaneous) mental time travel into the past and future. *Consciousness and Cognition*, 17(4), 1093-1104. doi:10.1016/j.concog.2008.03.001
- Berntsen, D., & Rubin, D. C. (2004). Cultural life scripts structure recall from autobiographical memory. *Memory & Cognition*, 32(3), 427-442. doi: 10.3758/BF03195836
- Berntsen, D., & Rubin, D. C. (2006). The centrality of event scale: A measure of integrating a trauma into one's identity and its relation to post-traumatic stress disorder symptoms. *Behaviour Research and Therapy*, 44(2), 219-231. doi:10.1016/j.brat.2005.01.009
- Botzung, A., Denkova, E., & Manning, L. (2008). Experiencing past and future personal events: Functional neuroimaging evidence on the neural bases of mental time travel. *Brain and Cognition*, 66(2), 202-212. doi:10.1016/j.bandc.2007.07.011
- Buckner, R. L., & Carroll, D. C. (2007). Self-projection and the brain. *Trends in Cognitive Sciences*, 11(2), 49-57. doi:10.1016/j.tics.2006.11.004
- Byrne, R. M. (2005). *The rational imagination: How people create counterfactual alternatives to reality*. MIT Press.

- Byrne, R. M. (2007). Precis of the rational imagination: How people create alternatives to reality. *Behavioral and Brain Sciences*, 30, 439-480. doi:
<http://dx.doi.org/10.1017/S0140525X07002579>
- Byrne, R. M. (2016). Counterfactual thought. *Annual Review of Psychology*, 67, 135-157.
doi:10.1146/annurev-psych-122414-033249
- D'Argembeau, A. (2012). Autobiographical memory and future thinking. In D. Berntsen & D. C. Rubin (Eds.), *Understanding Autobiographical Memory: Theories and Approaches* (pp. 311-330). Cambridge: Cambridge University Press.
- D'Argembeau, A., & Mathy, A. (2011). Tracking the construction of episodic future thoughts. *Journal of Experimental Psychology: General*, 140(2), 258-271. doi:10.1037/a0022581
- D'Argembeau, A., Renaud, O., & Van der Linden, M. (2011). Frequency, characteristics and functions of future-oriented thoughts in daily life. *Applied Cognitive Psychology*, 25(1), 96-103. doi: 10.1002/acp.1647
- D'Argembeau, A., & Van der Linden, M. (2004). Phenomenal characteristics associated with projecting oneself back into the past and forward into the future: Influence of valence and temporal distance. *Consciousness and Cognition*, 13(4), 844-858.
doi:10.1016/j.concog.2004.07.007
- D'Argembeau, A., & Van der Linden, M. (2006). Individual differences in the phenomenology of mental time travel: The effect of vivid visual imagery and emotion regulation strategies. *Consciousness and Cognition*, 15(2), 342-350. doi:10.1016/j.concog.2005.09.001
- Davis, C. G., Lehman, D. R., Wortman, C. B., Silver, R. C., & Thompson, S. C. (1995). The undoing of traumatic life events. *Personality and Social Psychology Bulletin*, 21(2), 109-124.
doi: 10.1177/0146167295212002
- De Brigard, F. (2014). Is memory for remembering? Recollection as a form of episodic hypothetical thinking. *Synthese*, 191(2), 155-185. doi: 10.1007/s11229-013-0247-7
- De Brigard, F., & Giovanello, K. S. (2012). Influence of outcome valence in the subjective experience of episodic past, future, and counterfactual thinking. *Consciousness and Cognition*, 21(3), 1085-1096. doi:10.1016/j.concog.2012.06.007
- De Brigard, F., Szpunar, K. K., & Schacter, D. L. (2013). Coming to grips with the past: Effect of repeated simulation on the perceived plausibility of episodic counterfactual thoughts. *Psychological Science*, 24(7), 1329-1334. doi:10.1177/0956797612468163

- Epstude, K., & Peetz, J. (2012). Mental time travel: A conceptual overview of social psychological perspectives on a fundamental human capacity. *European Journal of Social Psychology*, 42(3), 269-275. doi:10.1002/ejsp.1867
- Epstude, K., & Roese, N. J. (2008). The functional theory of counterfactual thinking. *Personality and Social Psychology Review*, 12(2), 168-192. doi: 10.1177/1088868308316091
- Erdoğan, A., Baran, B., Avlar, B., Taş, A. Ç., & Tekcan, A. I. (2008). On the persistence of positive events in life scripts. *Applied Cognitive Psychology*, 22(1), 95-111. doi: 10.1002/acp.1363
- Fitzgerald, J. M. (1996). Intersecting meanings of reminiscence in adult development and aging. In D. C. Rubin (Ed.), *Remembering our past: Studies in autobiographical memory* (pp. 360-383). Cambridge: Cambridge University Press.
- Gryzman, A., Prabhakar, J., Anglin, S. M., & Hudson, J. A. (2013). The time travelling self: Comparing self and other in narratives of past and future events. *Consciousness and Cognition*, 22(3), 742-755. doi:10.1016/j.concog.2013.04.010
- Gryzman, A., Prabhakar, J., Anglin, S. M., & Hudson, J. A. (2015). Self-enhancement and the life script in future thinking across the lifespan. *Memory*, 23(5), 774-785. doi:10.1080/09658211.2014.927505
- Heckhausen, J. (1997). Developmental regulation across adulthood: Primary and secondary control of age-related challenges. *Developmental Psychology*, 33(1), 176. doi:10.1037/0012-1649.33.1.176
- Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin*, 114(1), 3-28. doi:10.1037/0033-2909.114.1.3
- Johnson, M. K., & Raye, C. L. (1981). Reality monitoring. *Psychological Review*, 88(1), 67-85. doi:10.1037/0033-295X.88.1.67
- Kane, J., Van Boven, L., & McGraw, A. P. (2012). Prototypical prospection: Future events are more prototypically represented and simulated than past events. *European Journal of Social Psychology*, 42(3), 354-362. doi:10.1002/ejsp.1866
- Landman, J., & Manis, J. D. (1992). What might have been: Counterfactual thought concerning personal decisions. *British Journal of Psychology*, 83(4), 473-477.
- Loftus, E. F., & Pickrell, J. E. (1995). The formation of false memories. *Psychiatric Annals*, 25(12), 720-725.

- MacLeod, A. K., & Byrne, A. (1996). Anxiety, depression, and the anticipation of future positive and negative experiences. *Journal of Abnormal Psychology, 105*(2), 286-289.
doi:10.1037/0021-843X.105.2.286
- MacLeod, A. K., & Conway, C. (2007). Well-being and positive future thinking for the self versus others. *Cognition and Emotion, 21*(5), 1114-1124. doi:10.1080/02699930601109507
- Markus, H., & Nurius, P. (1986). Possible selves. *American Psychologist, 41*(9), 954-969. doi: 10.1037/0003-066X.41.9.954
- McGinnis, D., & Roberts, P. (1996). Qualitative characteristics of vivid memories attributed to real and imagined experiences. *The American Journal of Psychology, 59*-77.
- Newby-Clark, I. R., & Ross, M. (2003). Conceiving the past and future. *Personality & Social Psychology Bulletin, 29*(7), 807-818. doi:10.1177/0146167203029007001
- Okuda, J., Fujii, T., Ohtake, H., Tsukiura, T., Tanji, K., Suzuki, K., Kawashima, R., Fukuda, H., Itoh, M., & Yamadori, A. (2003). Thinking of the future and past: The roles of the frontal pole and the medial temporal lobes. *Neuroimage, 19*(4), 1369-1380. doi:10.1016/S1053-8119(03)00179-4
- Painter, J. M., & Kring, A. M. (2015). Back to the future: Similarities and differences in emotional memories and prospections. *Applied Cognitive Psychology, 29*(2), 271-279.
doi:10.1002/acp.3105
- Pham, L. B., & Taylor, S. E. (1999). From thought to action: Effects of process-versus outcome-based mental simulations on performance. *Personality and Social Psychology Bulletin, 25*(2), 250-260. doi:10.1177/0146167299025002010
- Rasmussen, A. S., & Berntsen, D. (2013). The reality of the past versus the ideality of the future: Emotional valence and functional differences between past and future mental time travel. *Memory & Cognition, 41*(2), 187-200. doi:10.3758/s13421-012-0260-y
- Roediger, H. L., & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*(4), 803. doi: 10.1037/0278-7393.21.4.803
- Roese, N. J., & Olson, J. M. (1995). Functions of counterfactual thinking. In N. J. Roese & J. M. Olson (Eds.) *What might have been: The Social Psychology of Counterfactual Thinking* (pp. 169-197). New York: Psychology Press.

- Roese, N. J., Sanna, L. J., & Galinsky, A. D. (2005). The mechanics of imagination: Automaticity and control in counterfactual thinking. In R. R. Hassin, J. S. Uleman, & J. A. Bargh (Eds.), *The New Unconscious* (pp. 138-170). Oxford: Oxford University Press.
- Ross, M., & Wilson, A. E. (2002). It feels like yesterday: Self-esteem, valence of personal past experiences, and judgments of subjective distance. *Journal of Personality and Social Psychology*, 82(5), 792-803. doi:10.1037/0022-3514.82.5.792
- Rubin, D. C. (2014). Schema-driven construction of future autobiographical traumatic events: The future is much more troubling than the past. *Journal of Experimental Psychology: General*, 143(2), 612-630. doi:10.1037/a0032638
- Rubin, D. C., & Berntsen, D. (2003). Life scripts help to maintain autobiographical memories of highly positive, but not highly negative, events. *Memory & Cognition*, 31(1), 1-14. doi: 10.3758/BF03196077
- Rubin, D. C., & Berntsen, D. (2009). The frequency of voluntary and involuntary autobiographical memories across the life span. *Memory & Cognition*, 37(5), 679-688. doi: 10.3758/37.5.679
- Rubin, D. C., Schrauf, R. W., & Greenberg, D. L. (2003). Belief and recollection of autobiographical memories. *Memory & Cognition*, 31(6), 887-901. doi: 10.3758/BF03196443
- Schacter, D. L., Addis, D. R., Hassabis, D., Martin, V. C., Spreng, R. N., & Szpunar, K. K. (2012). The future of memory: Remembering, imagining, and the brain. *Neuron*, 76(4), 677-694. doi:10.1016/j.neuron.2012.11.001
- Schacter, D. L., Benoit, R. G., De Brigard, F., & Szpunar, K. K. (2015). Episodic future thinking and episodic counterfactual thinking: Intersections between memory and decisions. *Neurobiology of Learning and Memory*, 117, 14-21. doi:10.1016/j.nlm.2013.12.008
- Sharot, T., Riccardi, A. M., Raio, C. M., & Phelps, E. A. (2007). Neural mechanisms mediating optimism bias. *Nature*, 450(7166), 102-105. doi:10.1038/nature06280
- Spreng, R. N., & Levine, B. (2006). The temporal distribution of past and future autobiographical events across the lifespan. *Memory & Cognition*, 34(8), 1644-1651. doi:10.3758/BF03195927
- Suddendorf, T., & Corballis, M. C. (1997). Mental time travel and the evolution of the human mind. *Genetic, Social, and General Psychology Monographs*, 123(2), 133-167.
- Suddendorf, T., & Corballis, M. C. (2007). The evolution of foresight: What is mental time travel, and is it unique to humans? *Behavioral and Brain Sciences*, 30(03), 299-313. doi:10.1017/S0140525X07001975

- Szpunar, K. K. (2010). Episodic future thought: An emerging concept. *Perspectives on Psychological Science: A Journal of the Association for Psychological Science*, 5(2), 142-162.
doi:10.1177/1745691610362350
- Szpunar, K. K., Addis, D. R., & Schacter, D. L. (2012). Memory for emotional simulations: Remembering a rosy future. *Psychological Science*, 23(1), 24-29.
doi:10.1177/0956797611422237
- Szpunar, K. K., & Schacter, D. L. (2013). Get real: Effects of repeated simulation and emotion on the perceived plausibility of future experiences. *Journal of Experimental Psychology: General*, 142(2), 323-327. doi:10.1037/a0028877
- Szpunar, K. K., Spreng, R. N., & Schacter, D. L. (2014). A taxonomy of prospection: Introducing an organizational framework for future-oriented cognition. *Proceedings of the National Academy of Sciences of the United States of America*, 111(52), 18414-18421.
doi:10.1073/pnas.1417144111
- Szpunar, K. K., Watson, J. M., & McDermott, K. B. (2007). Neural substrates of envisioning the future. *Proceedings of the National Academy of Sciences of the United States of America*, 104(2), 642-647. doi:0610082104
- Taylor, S. E., & Brown, J. D. (1988). Illusion and well-being: A social psychological perspective on mental health. *Psychological Bulletin*, 103(2), 193-210. doi:10.1037/0033-2909.103.2.193
- Taylor, S. E., Kemeny, M. E., Reed, G. M., Bower, J. E., & Gruenewald, T. L. (2000). Psychological resources, positive illusions, and health. *American Psychologist*, 55(1), 99-109.
doi:10.1037/0003-066X.55.1.99
- Taylor, S. E., Pham, L. B., Rivkin, I. D., & Armor, D. A. (1998). Harnessing the imagination: Mental simulation, self-regulation, and coping. *American Psychologist*, 53(4), 429-439.
doi:10.1037/0003-066X.53.4.429
- Teigen, K. H., & Jensen, T. K. (2011). Unlucky victims or lucky survivors? Spontaneous counterfactual thinking by families exposed to the tsunami disaster. *European Psychologist*, 16(1), 48-57. doi:10.1027/1016-9040/a000033
- Trope, Y., & Liberman, N. (2003). Temporal construal. *Psychological Review*, 110(3), 403-421.
doi:10.1037/0033-295X.110.3.403
- Tulving, E. (1983). *Elements of episodic memory*. New York, NY: Oxford University Press.
- Tulving, E. (1985). Memory and consciousness. *Canadian Psychology*, 26, 1-12.
doi:10.1037/h0080017

- Tulving, E. (2002). Chronesthesia: Conscious awareness of subjective time. In D. T. Stuss & R. T. Knight (Eds.), *Principles of frontal lobe function* (pp.311-325). New York, NY: Oxford University Press.
- Van Boven, L., & Ashworth, L. (2007). Looking forward, looking back: Anticipation is more evocative than retrospection. *Journal of Experimental Psychology: General*, 136(2), 289-300. doi:10.1037/0096-3445.136.2.289
- Van Hoeck, N., Ma, N., Ampe, L., Baetens, K., Vandekerckhove, M., & Van Overwalle, F. (2013). Counterfactual thinking: An fMRI study on changing the past for a better future. *Social Cognitive and Affective Neuroscience*, 8(5), 556-564. doi:10.1093/scan/nss031
- Van Hoeck, N., Watson, P. D., & Barbey, A. K. (2015). Cognitive neuroscience of human counterfactual reasoning. *Frontiers in Human Neuroscience*, 9(420), doi: 10.3389/fnhum.2015.00420
- Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology*, 39(5), 806-820. doi:10.1037/0022-3514.39.5.806
- Westerhof, G. J., & Bohlmeijer, E. T. (2014). Celebrating fifty years of research and applications in reminiscence and life review: State of the art and new directions. *Journal of Aging Studies*, 29, 107-114. doi:10.1016/j.jaging.2014.02.003
- Westerhof, G. J., Bohlmeijer, E., & Webster, J. D. (2010). Reminiscence and mental health: A review of recent progress in theory, research and interventions. *Ageing and Society*, 30(04), 697-721. doi:10.1017/S0144686X09990328
- Williams, J. M. G., Ellis, N. C., Tyers, C., Healy, H., Rose, G., & MacLeod, A. K. (1996). The specificity of autobiographical memory and imageability of the future. *Memory & Cognition*, 24(1), 116-125. doi: 10.3758/BF03197278
- Wilson, A. E., & Ross, M. (2000). The frequency of temporal-self and social comparisons in people's personal appraisals. *Journal of Personality and Social Psychology*, 78(5), 928-942. doi:10.1037/0022-3514.78.5.928
- Wilson, A. E., & Ross, M. (2001). From chump to champ: People's appraisals of their earlier and present selves. *Journal of Personality and Social Psychology*, 80(4), 572-584. doi:10.1037/0022-3514.80.4.572
- Wilson, A., & Ross, M. (2003). The identity function of autobiographical memory: Time is on our side. *Memory*, 11(2), 137-149. doi:10.1080/741938210

Table 1

Phenomenology Questions Answered for Episodic Memories

1. (Vividness) This memory is vivid. (1 = *not at all*, 7 = *to a very high degree*).
 2. (Reliving) As I remember the memory, I feel as though I am reliving the original event. (1 = *not at all*, 7 = *as clearly as if it were happening now*).
 3. (Visual imagery) As I remember the memory, I can see it in my mind. (1 = *not at all*, 7 = *as clearly as if it were happening now*).
 4. (Auditory imagery) As I remember the memory, I can hear it in my mind. (1 = *not at all*, 7 = *as clearly as if it were happening now*).
 5. (Spatial imagery) As I remember the memory, I know the location of people/objects in the place where it occurred—spatial layout (1 = *not at all*, 7 = *as clearly as if it were happening now*).
 6. (Emotional valence) The emotions I have when I recall the memory are (-3 = *very negative*, +3 = *very positive*).
 7. (Emotional intensity) The emotions I have when I recall the memory are intense. (1 = *not at all*, 7 = *to a very high degree*).
 8. (Importance) The memory is important to my life. (1 = *not at all*, 7 = *to a very high degree*).
 9. (Perspective) When I recall the memory, I primarily see what happened from a perspective as seen through (1 = *my own eyes*, 7 = *an observer's eyes*).
 10. (Voluntary rehearsal) Since it happened, I have willfully thought back to this event in my mind and thought about it or talked about it. (1 = *not at all*, 7 = *very often*).
 11. (Involuntary rehearsal) Has the memory of the event suddenly popped up in your thoughts by itself—that is, without your having attempted to remember it? (1 = *not at all*, 7 = *very often*).
 12. (Ease of remembering) Remembering this memory was (1 = *very easy*, 7 = *very difficult*).
 13. (Specificity) This memory was specific in the sense that it happened at a specific time and place, and its duration did not exceed a full day—24 hours. (1 = *not at all*, 7 = *very specific*).
 14. (Date) How long ago did this event occur? (weeks/months/years ago).
-

Figure 1. Mean ratings of sensory-imagery, spatial imagery, specificity, ease, and perspective as a function of event type and temporal distance. Error bars represent the standard errors of the means.

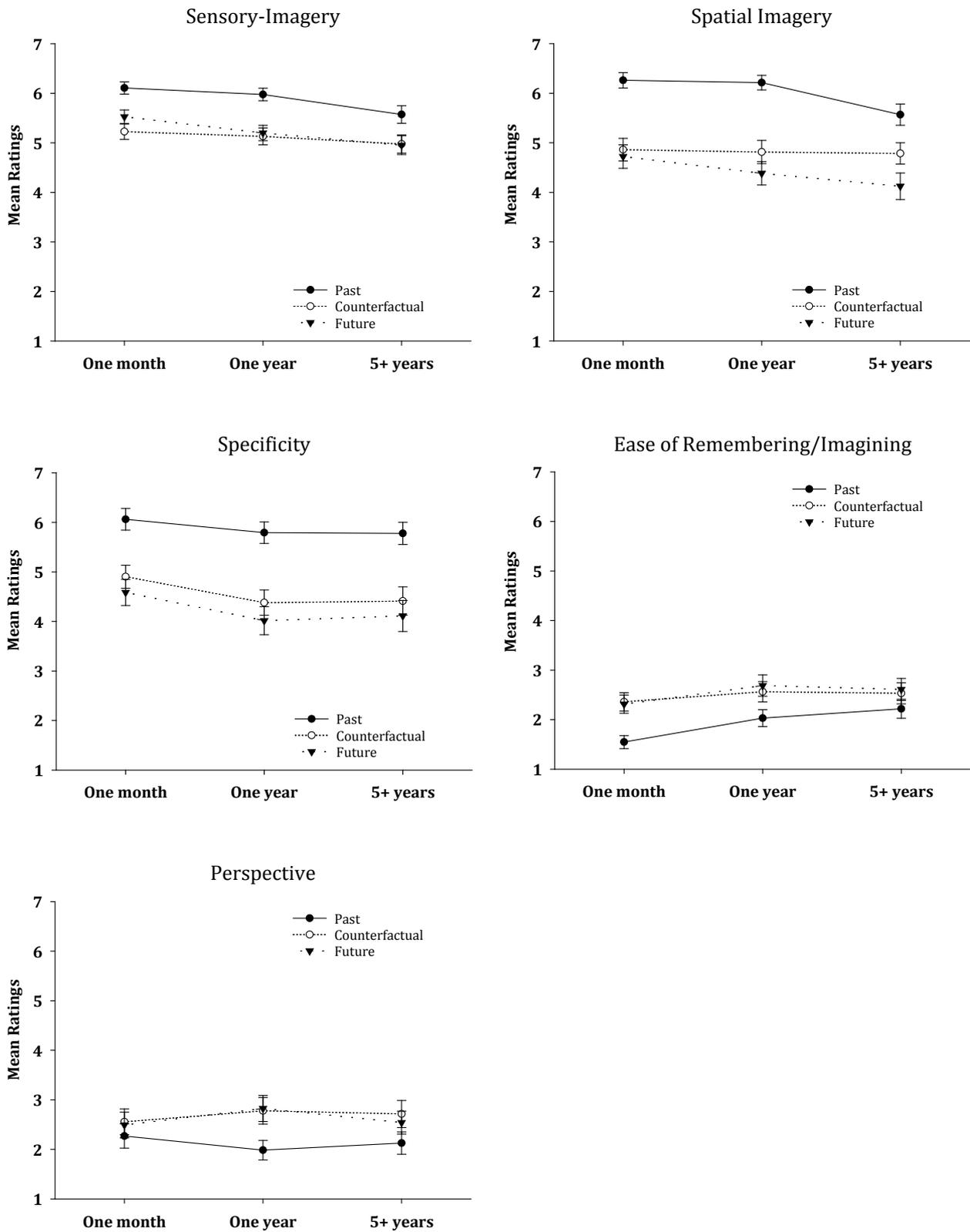


Figure 2. Mean ratings of emotional valence, importance, voluntary rehearsal, centrality, emotional intensity, and involuntary rehearsal as a function of event type and temporal distance. Error bars represent the standard errors of the means.

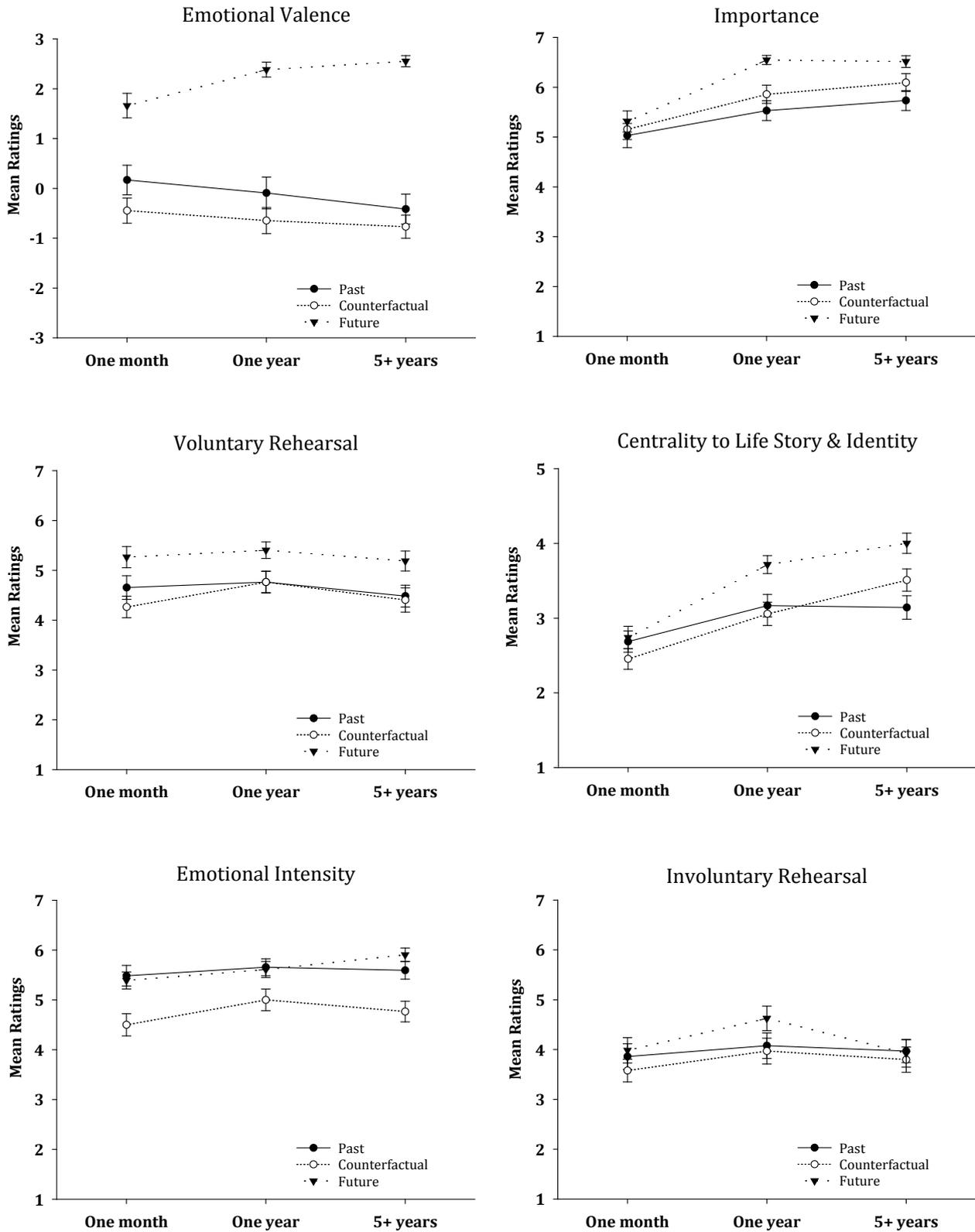
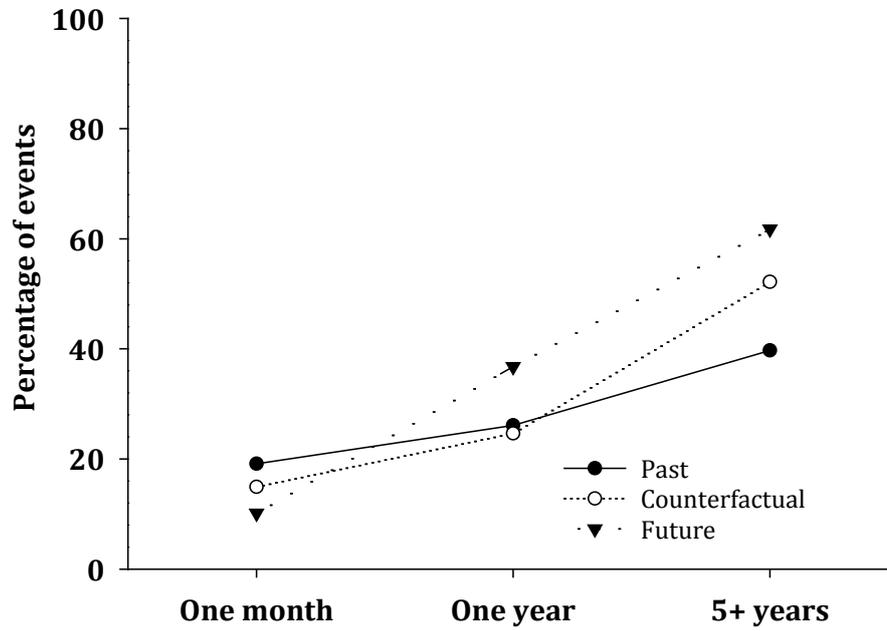


Figure 3. Reference to cultural life script events in percentage as a function of event type and temporal distance



APPENDIX A

Phenomenology Questions Answered for Episodic Counterfactuals

1. (Vividness) This imagined event is vivid. (1 = *not at all*, 7 = *to a very high degree*).
 2. (Reliving) As I imagine the event, I feel as though I am experiencing the event now. (1 = *not at all*, 7 = *as clearly as if it were happening now*).
 3. (Visual imagery) As I imagine the event, I can see it in my mind. (1 = *not at all*, 7 = *as clearly as if it were happening now*).
 4. (Auditory imagery) As I imagine the event, I can hear it in my mind. (1 = *not at all*, 7 = *as clearly as if it were happening now*).
 5. (Spatial imagery) As I imagine the event, I know the location of people/objects in the place where it could have occurred—spatial layout (1 = *not at all*, 7 = *as clearly as if it were happening now*).
 6. (Emotional valence) The emotions I have when I imagine the event are (-3 = *very negative*, +3 = *very positive*).
 7. (Emotional intensity) The emotions I have when I imagine the event are intense. (1 = *not at all*, 7 = *to a very high degree*).
 8. (Importance) If it had happened, the imagined event would have been important to my life. (1 = *not at all*, 7 = *to a very high degree*).
 9. (Perspective) When I imagine the event, I primarily see what could have happened from a perspective as seen through (1 = *my own eyes*, 7 = *an observer's eyes*).
 10. (Voluntary rehearsal) Since the time it could have happened, I have willfully thought back to this event in my mind and thought about it or talked about it. (1 = *not at all*, 7 = *very often*).
 11. (Involuntary rehearsal) Has the imagined event suddenly popped up in your thoughts by itself—that is, without your attempting to imagine it? (1 = *not at all*, 7 = *very often*).
 12. (Ease of remembering) Imagining this event was (1 = *very easy*, 7 = *very difficult*).
 13. (Specificity) This imagined event was specific in the sense that it could have happened at a specific time and place, and its duration would not have exceeded a full day—24 hours. (1 = *not at all*, 7 = *very specific*).
 14. (Date) If this event had happened, how long ago would it have happened? (weeks/months/years ago).
-

Phenomenology Questions Answered for Episodic Future Projections

1. (Vividness) This imagined event is vivid. (1 = *not at all*, 7 = *to a very high degree*).
 2. (Reliving) As I imagine the event, I feel as though I am preliving the event. (1 = *not at all*, 7 = *as clearly as if it were happening now*).
 3. (Visual imagery) As I imagine the event, I can see it in my mind. (1 = *not at all*, 7 = *as clearly as if it were happening now*).
 4. (Auditory imagery) As I imagine the event, I can hear it in my mind. (1 = *not at all*, 7 = *as clearly as if it were happening now*).
 5. (Spatial imagery) As I imagine the event, I know the location of people/objects in the place where it might occur—spatial layout (1 = *not at all*, 7 = *as clearly as if it were happening now*).
 6. (Emotional valence) The emotions I have when I imagine the event are (-3 = *very negative*, +3 = *very positive*).
 7. (Emotional intensity) The emotions I have when I imagine the event are intense. (1 = *not at all*, 7 = *to a very high degree*).
 8. (Importance) The imagined event will be important to my life. (1 = *not at all*, 7 = *to a very high degree*).
 9. (Perspective) When I imagine the event, I primarily see what might happen from a perspective as seen through (1 = *my own eyes*, 7 = *an observer's eyes*).
 10. (Voluntary rehearsal) I have willfully imagined the event in my mind and thought about it or talked about it. (1 = *not at all*, 7 = *very often*).
 11. (Involuntary rehearsal) Has the imagined event suddenly popped up in your thoughts by itself—that is, without your attempting to imagine it? (1 = *not at all*, 7 = *very often*).
 12. (Ease of remembering) Imagining this event was (1 = *very easy*, 7 = *very difficult*).
 13. (Specificity) This imagined event was specific in the sense that it might happen at a specific time and place, and its duration will not exceed a full day—24 hours. (1 = *not at all*, 7 = *very specific*).
 14. (Date) How long from now might this imagined event happen? (weeks/months/years from now).
-

APPENDIX B

Examples of episodic counterfactual thoughts

Time distance – 1 month

Example (Woman, 20 years)

I did not study for one of my departmental courses because I thought the teacher asks very difficult questions at the exam and the course is so complicated that even if I study, I cannot understand anyways. Yet, the exam was really easy. If I had studied a bit, I would have gotten all questions correct, but I did not; I failed the departmental course. Since this course was a prerequisite, it really affected my schedule. Everything would have been much easier, if I had studied.

Time distance – 1 year

Example (Man, 23 years)

Little more than a year ago, I had a terrible experience with drugs. It kept going worse; I experienced blackouts and loss of consciousness. If the circumstances had been just slightly different during that time, it could have definitely led to my death.

Time distance – 5+ years

Example (Woman, 21 years)

When I took the high school entrance exam almost 7 years ago, I got lower scores than I had expected. Therefore, I attended a high school of a lower degree. However, if I had waited for the 2nd round of placement after the exam, I could have attended a high school of a higher degree and I could have gotten a better education.
