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Coming to grips with the past: Effect of repeated simulation on the perceived plausibility of episodic counterfactual thoughts

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Abstract

When people revisit previous experiences they often engage in episodic counterfactual thinking: mental simulations of alternative ways in which personal past events could have occurred. The present study employs a novel experimental paradigm to examine the influence of repeated simulation on the perceived plausibility of upward, downward and neutral episodic counterfactual thoughts. Participants were asked to remember negative, positive, and neutral autobiographical memories. One week later, they re-simulated self-generated upward, downward, and neutral counterfactual alternatives to those memories either once or four times. The results indicate that repeated simulation of upward, downward and neutral episodic counterfactual events decreases their perceived plausibility while increasing ratings of ease, detail, and valence. This finding suggests differences between episodic counterfactual thoughts and other kinds of self-referential simulations. Possible implications of this finding for pathological and non-pathological anxiety are discussed.

Introduction

People frequently revisit their past experiences. Often times, such revisions lead to episodic counterfactual thoughts: mental simulations about how specific personal past events might have been (Epstude & Roese, 2008; Kray et al., 2010; De Brigard & Giovanello, 2012;). Considerable research has focused on the affective consequences of revisiting counterfactual simulations. It is well known, for instance, that ruminating about how bad things could have turned out better—upward counterfactuals—tends to elicit feelings of regret and disappointment (Landman, 1993). Conversely, thinking about how good things could have turned out worse—downward counterfactuals—tends to elicit feelings of relief and satisfaction (Markman et al., 1993; Roese, 1994; Roese & Olson, 1995; Mandel et al., 2005). Nonetheless, little is known about how repeated counterfactual simulation affects our beliefs about such imagined alternative events. In particular, little is known as to whether or not revisiting episodic counterfactual thoughts may affect our judgment of how plausible it is that the imagined event could have occurred.

On the one hand, it is possible that repeated simulation of episodic counterfactual events could lead to an increase in their perceived plausibility. A number of studies have demonstrated that repeated simulations of possible future events leads people to believe that those events are more likely to occur (Carroll, 1978; Anderson, 1983; Gregory, Cialdini, & Carpneter, 1982; Sherman, Cialdini, Schwartzman, & Reynolds, 1985; for review, see Koehler, 1991), with this effect being more prevalent for emotional than non-emotional events (Szpunar & Schacter, in press). Moreover, Szpunar and Schacter (in press) have shown that repetition enhances the level of detail and ease of simulation, and that such

increases are associated with a higher degree of perceived plausibility for possible future events. As a result, it may be the case that repeated simulation of counterfactual thoughts, by way of enhancing their level of detail and ease of simulation, could produce a similar increment in perceived plausibility.

On the other hand, unlike simulation of possible future events, generating counterfactual thoughts involves a mental contrast between the event that actually occurred and the alternative imagined possibility (Johnson-Laird & Byrne, 2002). In that sense, counterfactual thinking is constrained by reality in a way that future thinking is not. Repeated simulation may then bring discrepancies between the actual and the possible events more sharply into focus, inviting people to reconsider the amount of modifications that would have been required in order for the imagined event to have occurred. This, in turn, may effect people's assessment of the likelihood of the counterfactual event, leading to a decrease rather than an increase in their perceived plausibility. Indeed, that rumination of episodic counterfactual events may lead to a decrease on their perceived plausibility might constitute a psychologically adaptive strategy, insofar as it would help people to come to grips with the way things were rather than inviting them to focus on how things might have been.

The main purpose of the present study is to try to adjudicate between these two alternative hypotheses by examining the effect of repeated simulation on novel episodic counterfactual thoughts. In addition, the current study examines whether or not the emotional direction of the counterfactual simulation influences the relation between repeated simulation and perceived plausibility. Finally, this study also examines whether or not the perceived plausibility of counterfactual simulations is related to the amount of detail and ease of simulation, as it has been argued for in the case of episodic future thinking (Anderson, 1983).

Method

Thirty-seven undergraduates participated in this study. Due to insufficient number of observations in seven participants (see below), data from thirty participants were analyzed (M age = 20.57, SD = 2.08; 15 females). The study consisted of three sessions. In session 1, participants generated 35 negative, 35 positive and 35 neutral autobiographical memories. For each memory, participants typed a short description, a title, as well as the name of a person (other than themselves) involved in the remembered event, the location where the event took place, and an object featured in the memory. One week later, participants returned to the lab for an episodic counterfactual simulation session. Participants were told that they would be engaging in three kinds of counterfactual simulations: upward, downward and neutral, as indicated by screen headings. When the heading was "Upward", participants were presented with the *person*, *place*, *object*, and *title* components from one of the negative memories collected in session 1. Their task was to imagine an alternative *better* way in which the cued negative memory could have occurred. Participants were allotted 12.5 seconds to simulate this episodic counterfactual event. Participants were then prompted to write a short *new title* for their counterfactual simulation. They were told this new title would help them remember the event they just imagined. Conversely, when the heading was "Downward", participants were presented with the *person*, *place*, *object*, and *title* components from a positive memory, and were asked to imagine an alternative *worse* way in which the cued positive memory could have occurred. Finally, when the heading was "Neutral", participants were presented with the *person*, *place*, *object*, and *title* components from a neutral memory and were asked to simply imagine an alternative way in which the same event could have occurred, so that it would not have altered the emotional value of the actual event at all. Participants simulated 30 Upward, 30 Downward, and 30 Neutral

episodic counterfactuals in random order, plus 3 counterfactuals from each kind during a practice session, to ensure participant's adherence to the instructions (Figure 1).

The third session took place one day later. This session consisted of two parts. In the first part, participants were asked to re-simulate 15 upward, 15 downward and 15 neutral counterfactuals in random order, and three times each. These 45 counterfactuals were randomly selected from the counterfactuals they simulated the day before. Following the parameters in session two, participants were presented with the heading of the counterfactual's direction (i.e., "Upward", "Downward", "Neutral), the person, place and object components, the new title they wrote the day before, and were given 12.5 seconds to re-simulate each event. Participants were explicitly asked to re-simulate the very same counterfactual they generated the day before. After a 10-minute break, during which participants engaged in a distraction task (Sudoku or word puzzle) aimed at preventing them from re-entertaining recently rehearsed simulations, participants re-simulated all 30 upward, 30 downward and 30 neutral counterfactuals. This portion of the experiment was introduced as a recognition test. Participants were told that the main task was to respond whether or not they had simulated each particular counterfactual event earlier that day (i.e., 10 minutes earlier). In addition, they completed five 5-point phenomenological ratings presented randomly: Detail (1 = few details, 5 = many details), Ease (1 = very difficult to imagine, 5 = very easy to imagine), Valence during simulation (1 = very negative, 5 = very positive) and, importantly, *Plausibility* (1 = very implausible, 5 = very plausible) and *Novelty* of the simulation (1 = Not novel, 5 = Novel). For the rating of *Plausibility*, participants were asked to judge how plausible they thought it was that the imagined event could have occurred as they simulated it. Finally, since the purpose of the present study was to examine the effect of repeated simulation in *novel* episodic counterfactual thoughts, a comment on this rating is important. The *Novelty* rating was used to get a sense of which counterfactual simulations participants had previously thought about and which were simulated for the first time during the experiment (the entire scale was: 1 = absolutely sure not novel, 2 = pretty sure not novel, 3 = not sure, 4 = pretty sure novel, and 5 = absolutely sure novel). Post-experimental interviews indicated that the recognition test (Hit Rate = .98) and additional ratings successfully masked the real purpose of the study, i.e., examining the effect of repeated simulation in the subjective plausibility of novel episodic counterfactual thoughts.

Results

Only counterfactuals that participants had not entertained previously (i.e., novelty rating of 3–5) were analyzed. Participants that did not have at least 4 observations of each kind of counterfactual simulation per condition were excluded¹, so data from a total of 30 participants are reported. For simulations repeated 4 times, participants contributed on average 9.967 (SD = 3.03) downward, 7.667 (SD = 2.71) upward, and 10.767 (SD = 3.47) neutral counterfactuals. For simulations repeated only once, participants contributed on average 10.200 (SD = 2.62) downward, 8.600 (SD = 2.74) upward, and 11.033 (SD = 2.89) neutral counterfactuals. Although participants produced on average fewer upward than both downward and neutral counterfactuals, $F(2, 28) = 7.934, p < .01, \eta^2 = .362$, there was no difference between the number of repetitions ($p > .05$).

¹Notably, participants judged the novelty of counterfactual thoughts *after* the repetition manipulation in order to avoid biasing participants away from generating realistic counterfactuals. However, it is possible that participants may have rated fewer counterfactuals as novel following repeated simulation as familiarity associated with those counterfactuals may have increased throughout the experiment, reducing the number of observations we were able to include in our analysis. Nonetheless, a conservative cutoff was adopted to eliminate samples in which participant's produced fewer observations than two SD from the M , as this could artificially skew the variance for the weighted average.

Table 1 presents the mean phenomenological ratings for upward, downward and neutral episodic counterfactual simulations as a function of event repetition. For the *Plausibility* rating, a 3 (Direction: downward, upward, neutral) \times 2 (Repetition: 4 times, 1 time) ANOVA revealed main effects of Direction, $F(2, 28) = 41.895, p < .001, \eta^2 = .750$, and Repetition, $F(1, 29) = 17.023, p < .001, \eta^2 = .370$, with no interaction ($p = .379$). With regard to direction, post-hoc contrasts revealed that neutral episodic counterfactuals were rated as more plausible than both upward, $t(29) = 9.137, p < .001, d = 1.91$, and downward episodic counterfactuals, $t(29) = 7.489, p < .001, d = 1.77$, and that downward episodic counterfactuals were rated as more plausible than upward episodic counterfactuals, $t(29) = 1.959, p < .05, d = .29$. Critically, episodic counterfactual thoughts simulated four times were judged as less plausible than those simulated only once.

Additional 3 (Direction) \times 2 (Repetition) ANOVAS were conducted for the other phenomenological ratings. For the *Detail*, *Ease*, and *Valence* ratings there were main effects of Direction, smallest $F(2, 28) = 4.264, p < .05, \eta^2 = .233$, and Repetition, smallest $F(1, 29) = 4.410, p < .05, \eta^2 = .132$, with no interactions (largest $p = .398$). For *Detail*, upward, $t(29) = 2.485, p < .05, d = 0.43$, and downward, $t(29) = 4.510, p < .001, d = 0.69$, episodic counterfactuals were more detailed than neutral episodic counterfactuals, and there was no difference between downward and upward episodic counterfactuals ($p = .169$). For *Ease*, only downward episodic counterfactuals came to mind more easily than neutral episodic counterfactuals, $t(29) = 2.969, p < .01, d = 0.23$. For *Valence*, downward episodic counterfactuals were more negative than upward, $t(29) = 2.201, p < .01, d = .74$, and neutral, $t(29) = 2.893, p < .01, d = 0.71$, episodic counterfactuals, and there was no difference between upward versus neutral episodic counterfactuals ($p = .274$). With regard to repetition for these three ratings, upward, downward and neutral episodic counterfactuals are simulated with more detail, more easily, and more positively after four repetitions than after just one repetition. Finally, for the ratings of *Novelty* there were no effects.

Discussion

The main purpose of the present study was to examine the effect of repeated simulation of novel episodic counterfactual thoughts on their perceived plausibility. Our results indicate that episodic counterfactual thoughts that were simulated repeatedly were judged as less plausible to have occurred than those that were simulated only once. These results contrast with extant evidence on future thinking, which suggests that the perceived plausibility of imagined possible future events increases as a function of repeated simulations (Anderson, 1983; Carroll, 1978; Gregory et al., 1982; Sherman et al., 1985; Szpunar & Schacter, in press). In addition, the current study examined whether or not the direction of the counterfactual mutation (i.e., upward, downward) influenced the effect of repeated simulation on the perceived plausibility of novel episodic counterfactual thoughts. Our results did not reveal any interaction between the direction of the counterfactual mutation and the effect of repetition. As such, the evidence gathered here suggests that repeated simulation reduces the perceived plausibility of novel episodic counterfactual thoughts independently of the direction of the mutation. Nonetheless, it is important to note that repeated simulation did have an effect on the valence with which the counterfactuals were experienced (i.e., repeated counterfactuals were more positive than non-repeated counterfactuals), and that future research should examine whether valence and perceived plausibility interact in some other fashion.

Our study also examined whether or not the perceived plausibility of counterfactual simulations is related to the amount of detail and ease of simulation. The results indicate that although the perceived plausibility of counterfactual thoughts decreased as a function of repeated simulation, both ratings of detail and ease increased, replicating similar patterns in

future thinking (Lichtenstein et al., 1978). This pattern suggests that an increase in perceived plausibility of possible events is not an inevitable consequence of an increase in detail and ease of simulation.

What accounts for this divergence? One possibility, derived from the mental models view on counterfactual generation (Byrne, 1997; Byrne, 2002; Johnson-Laird & Byrne, 2002), is that when people generate episodic counterfactual thoughts they contrast a mental representation of what is “true” or what is the “norm”—which in the case of episodic counterfactual thoughts would be an autobiographical episodic recollection—with another mental representation that minimally deviates from the first one. This hypothesis explains, for instance, why people tend to mutate close versus temporally distant events (Miller & Gunasegaram, 1990) or actions versus inactions (Kahneman & Tversky, 1982): all such mental mutations involve less divergence from the “normal” or “true” representation. The same may occur for episodic counterfactual thinking: when we first generate a counterfactual simulation the divergence from the actual memory is minimal, so the perceived plausibility is higher. But when more attention can be allocated to further details of the mutation, the divergence from the actual memory increases, thereby rendering it less plausible to the individual. In contrast, in the case of future thinking, there is no “norm” or “true” representation against which to contrast the mental simulation, so there is no divergence that could affect the perceived plausibility of the imagined event. The same line of reasoning can be applied to the finding that repeatedly imagining past events that never occurred increases the subjective likelihood that they did occur (“imagination inflation”; see Garry et al., 1996), because there is no “true” event available for contrast.

That the perceived plausibility of what could have happened reduces as a function of repeated pondering about such ‘what-ifs’ may actually be healthy. Research has shown that increased counterfactual thinking is associated with anxiety and excessive nervousness (Nolen-Hoeksema, 2000; Rachman et al., 2000; Roese et al, 2008). Perhaps, in non-pathological cases, rumination helps bring into focus increasingly divergent details of the counterfactual event in the hopes that, when contrasted with what actually occurred, its perceived plausibility decreases, along with the need for further pondering. Conversely, in pathological cases, there may not be such decrease in perceived plausibility, which may contribute to excessive rumination. Whether or not this is the case remains an open question, and one that merits further research.

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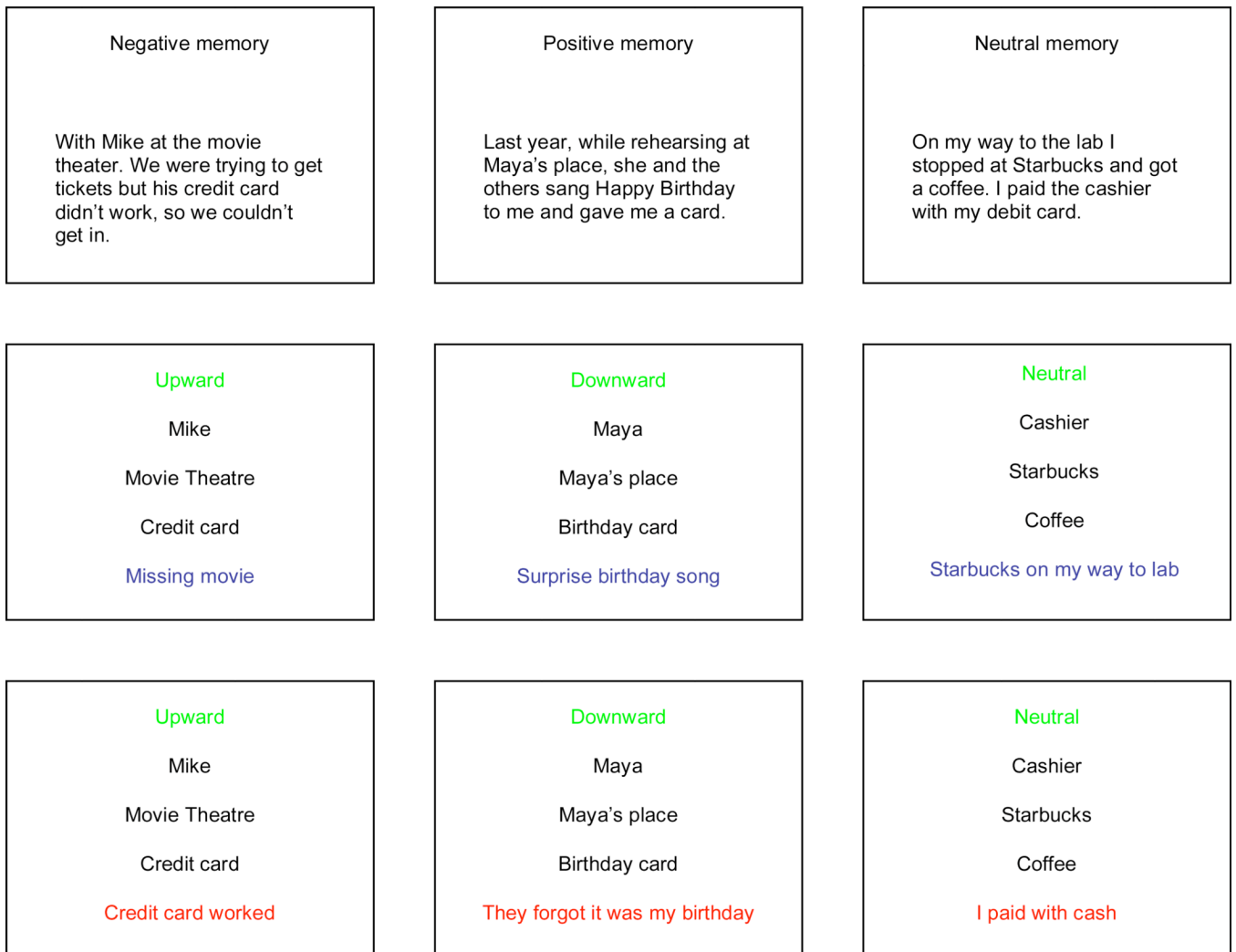


Figure 1. Example of reported autobiographical memories, stimulus displays during counterfactual construction and counterfactual generation. The top row shows examples of negative, positive and neutral memories. The second row shows examples of upward, downward and neutral counterfactual generation. Participants saw the person, place and object of their reported memories plus the title they gave to that memory (shown in blue). The title of the screen (shown in green) indicated the direction of the counterfactual mutation, with upward for negative, downward for positive and neutral for neutral memories. The third row illustrates examples of counterfactuals generated by participants, with the short description of the counterfactual mutation shown in red.

Table 1

Mean phenomenological ratings for upward, downward and neutral episodic counterfactual simulations as a function of event repetition

	Downward	Upward	Neutral
Plausibility			
4 Times	2.857 (.70)	2.587 (.86)	3.856 (.49)
1 Time	3.022 (.66)	2.891 (.84)	3.931 (.45)
Detail			
4 Times	3.687 (.63)	3.613 (.71)	3.213 (.79)
1 Time	3.287 (.65)	3.105 (.78)	2.972 (.67)
Ease			
4 Times	4.078 (.69)	3.957 (.78)	3.847 (.80)
1 Time	3.684 (.67)	3.515 (.89)	3.290 (.73)
Valence			
4 Times	2.593 (.96)	3.229 (.93)	3.080 (.22)
1 Time	2.477 (1.02)	3.164 (.75)	2.991 (.24)
Novelty			
4 Times	4.169 (.41)	4.065 (.46)	4.094 (.62)
1 Times	4.237 (.44)	3.978 (.51)	4.057 (.65)