

Questioning the preparatory function of counterfactual thinking

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Keywords:	Counterfactuals, preparatory hypothesis, prefactuals, advice

Questioning the preparatory function of counterfactual thinking

Abstract

Why do individuals mentally modify reality (e.g., “If it hadn’t rained, we would have won the game”)? According to the dominant view, counterfactuals primarily serve to prepare future performance. In fact, individuals who have just failed a task tend to modify the uncontrollable features of their attempt (e.g., “If the rules of the game were different, I would have won it”), generating counterfactuals that are unlikely to play any preparatory role. By contrast, they generate prefactuals that focus on the controllable features of their ensuing behavior (e.g., “If I concentrate more, I will win the next game”). Here, we test whether this tendency is robust and general. Studies 1a and 1b replicate this tendency and show that it occurs regardless of whether individuals think about their failures or their successes. Study 2 shows that individuals generate relatively few controllable counterfactuals, unless explicitly prompted to do so. These results raise some questions regarding the generality of the dominant view according to which counterfactuals mainly serve a preparatory function.

Keywords: Counterfactuals, preparatory hypothesis, prefactuals, advice.

Questioning the preparatory function of counterfactual thinking

Individuals often mentally modify everyday occurrences (e.g., “If it hadn’t rained, we would have won the game”), historical events (e.g., “If it hadn’t rained during the night of Waterloo, the future of Europe would have been different”), and even fiction (e.g., “If it hadn’t rained the night of the concert, maybe the protagonist of Joyce’s *The mother*” would not have ruined her daughter’s career”). That is, individuals often think *counterfactually* (for a recent review, see Byrne, 2016). Why do they do it?

Although several functions have been suggested for the ability to produce counterfactual thoughts (see Byrne, 2016), the main hypothesis that purports to answer this question has been dubbed the “preparatory theory.” It states that: “the primary function of counterfactual thinking centers on the management and coordination of ongoing behavior. Thinking about what might have been influences performance and facilitates improvement.” Accordingly, “Counterfactual thoughts are typically activated by a failed goal, and they specify what one might have done to have achieved that goal” (Epstude & Roese, 2008, 169-170; see also Epstude & Roese, 2011, Kray, Galinsky & Markman, 2009; Markman, Gavanski, Sherman & McMullen, 1993; Roese, 1997). This prediction of the preparatory hypothesis is intuitively compelling. Indeed, if counterfactuals essentially serve to regulate behavior and improve performance, the typical condition in which they are produced should be a failure, and their typical content should be something that the agent of the failure might have done to avoid it, and will not do again in similar future endeavors. Is this prediction empirically supported?

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As for the conditions that typically elicit counterfactual thoughts, evidence exists that individuals tend to produce more counterfactuals after a failure than after a success (e.g., Roese & Hur, 1997; Roese & Olson, 1995). As for the content of counterfactuals, the evidence is mixed. According to the preparatory hypothesis, individuals who think about their failures should generate relatively more modifications focusing on what they might have done (e.g., “If I had used a different strategy, I would have won the game”) than modifications focusing on how the circumstances might have been different (e.g., “If the rules of the game were different, I would have won it”). In other words, they should produce *controllable* counterfactuals more often than *uncontrollable* ones. Here, we define controllable counterfactuals as counterfactuals that refer to factors that are under the participant’s control, that is, factors that the participant could modify to improve performance in the next iteration of the task. Uncontrollable counterfactuals are defined as counterfactuals that refer to factors that are not under the participant’s control, and thus could not be modified to improve performance in the next iteration of the task.

By this definition, it is clear that only controllable counterfactuals can play a useful preparatory role (e.g., individuals can try using a different strategy in the next attempt, but they cannot change the rules of the game). When individuals read a scenario about a protagonist fails who to reach her goal, they behave as predicted by the preparatory hypothesis: They modify the elements of the scenario that were under the protagonist’s control rather than uncontrollable aspects of reality (e.g., Girotto, Legrenzi, & Rizzo, 1991; McCloy & Byrne, 2000). However, scenario readers do not have the opportunity to think about failures that happened to them. And so their counterfactuals do not obviously serve the primary purpose of improving their own future performance. In fact, if one wants to provide a direct test of the preparatory hypothe-

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3 sis' predictions, one should investigate counterfactual thinking in individuals who
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5 have just experienced an actual failure. Evidence presently reviewed suggests that,
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7 unlike scenario readers, these individuals generate counterfactuals that are not easily
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9 reconciled with the preparatory hypothesis.
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11 In a series of studies, participants were asked to solve a task (e.g., a mathemat-
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13 ical puzzle) and, if they failed to solve it, to think about how things could have been
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15 better for them (Giroto, Ferrante, Pighin, & Gonzalez, 2007; Pighin, Byrne, Ferrante,
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17 Gonzalez, & Giroto, 2011). Contrary to the preparatory hypothesis' prediction, these
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19 participants modified the uncontrollable features that had constrained their failed at-
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21 tempt, including their permanent traits (e.g., "If I had better mathematical abilities ...
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23 ") and the rules of the game (e.g., "If I had been able to use some paper and a pencil
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25 ..."), rather than the features that were under their control, like the strategy they used
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27 (e.g., "If I had started by multiplying the tens") and their attention and concentra-
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29 tion level (e.g., "If I had concentrated better ...").
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34 Studying the hypothetical thoughts of individuals who have recently experi-
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36 enced a failure allows one to test a further prediction of the preparatory hypothesis: If
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38 counterfactual thinking is primarily aimed at improving the future, then when control-
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40 lable alternatives are available, people should tend to use them. Our prefactual condi-
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42 tion provides a good test of the availability of controllable alternatives and therefore if
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44 the preparatory theory is correct, people should focus on controllable events to a simi-
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46 lar extent in the counterfactual and prefactual conditions. This prediction is clearly
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48 made in a recent article defending the preparatory function of counterfactuals:
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51 To the extent that an action fails to yield the desired and expected outcome,
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53 counterfactuals are activated relatively automatically and center on alternative
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55 actions that might well have brought about the desired outcome (Epstude &
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3 Roese, 2011). Action phases situate within a regulatory loop, such that failed
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5 goal pursuit loops from the postactional phase back to a new instantiation of
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7 the predecisional phase. Prefactuals may then become part of the predecisional
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9 phase and feed into the formation of a decision (which goal to pursue) and in-
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11 tention (how to pursue that goal). (Epstude, Scholl, & Roese, 2016, p.49)
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16 In other words, given the same experienced failure, imagining a better past
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18 should not differ from imagining a better future. Ferrante, Giroto, Stragà, and Walsh
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20 (2013) compared the number of thoughts participants generated that focused on con-
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22 trollable features of a task (e.g. how much the participant concentrates on the task)
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24 and uncontrollable features of a task (e.g. the imparted time to complete it). Among
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26 participants who had just failed a task, those who were asked to produce counterfac-
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28 tual thoughts (i.e. “Things would have been better if...”), tended to produce signifi-
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30 cantly fewer controllable thoughts (43%) than those who were asked to produce
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32 prefactual thoughts (i.e. “Things will be better for me in the next game if...”; 78%).
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34 In sum, compared to prefactual thinking, counterfactual thinking seems less likely to
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36 fulfill preparatory goals. Taken together, these and other results (e.g., McCrea, 2008;
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38 Petrocelli & Harris, 2011), which were obtained for different tasks and conditions, se-
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40 riously challenge the preparatory hypothesis, suggesting that the primary function of
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42 counterfactuals may be other than the preparatory one.
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47 The goal of this paper is twofold. The first goal is to provide more evidence
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49 that the relative lack of controllable counterfactual thoughts, compared to prefactual
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51 thoughts, is robust. Studies 1a and 1b aim to replicate and generalize the experiments
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53 documenting that actual failures do not elicit controllable counterfactuals. Whereas
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55 previous studies have investigated only *upward counterfactuals*, that is, hypothetical
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3 thoughts about how things could have been better, Studies 1a and 1b also investigated
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5 *downward counterfactuals*, that is, hypothetical thoughts about how things could have
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7 been worse. According to the preparatory hypothesis, downward counterfactuals may
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9 also serve a preparatory function: In some cases, “downward counterfactual thinking
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11 (“I feel bad when I focus on how I might have done worse”) motivated participants to
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13 try harder on a subsequent [...] task” (Epstude & Roese, 2008, p. 176). It is thus im-
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15 portant to test whether or not individuals also tend to produce uncontrollable down-
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17 ward counterfactuals.
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21 The second goal of this paper is to test an implicit prediction of the preparato-
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23 ry hypothesis. If the main function of counterfactual thinking is to prepare individuals
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25 for better performance, individuals who have experienced a failure should produce
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27 counterfactuals of the controllable sort whether or not they are explicitly prompted to
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29 generate useful thoughts. Contrary to this prediction, we posit that generating counter-
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31 factuals with the explicit aim of improving future performance is close to generating
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33 prefactuals: In both cases, individuals cannot focus on features that could not change
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35 in the future. Accordingly, in both cases individuals should produce controllable al-
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37 ternatives more often than when they receive the standard instruction to generate
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39 counterfactuals. To test these diverging possibilities, we compared the hypothetical
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41 thoughts of participants who had just failed a task and who received the standard ge-
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43 neric request to imagine some modifications with those of participants who received a
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45 specific request to imagine modifications that would be useful for their own or other
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47 individuals’ future performance on a similar task.
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51 52 **Study 1a**

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54 The aim of Studies 1a and 1b was to establish whether individuals tend to
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56 generate relatively more controllable modifications when they create prefactuals than
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3 when they create counterfactuals, regardless of the direction of their thoughts (i.e.,
4 upward vs. downward). In Study 1a, individuals who had just failed or succeeded in
5 solving a task were required to imagine better or worse modifications in an ensuing
6 endeavor or in the past attempt.
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10 11 Method

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14 One hundred twenty-six undergraduate students (71 female; mean age = 24 y)¹
15 from the University IUAV of Venice participated in exchange for raffle tickets to win
16 photocopy cards. After providing informed consent, participants sat in front of a per-
17 sonal computer to complete a computer-based word-search puzzle. It was explained to
18 them that the purpose of the game was to find as many words as possible in an 11-by-
19 11 sized letter grid. Participants were shown a labeled screen shot of an example grid
20 with accompanying instructions. The instructions explained that the hidden words
21 could appear in any direction (vertical, horizontal, or diagonal) and that some letters
22 may belong to more than one word. Participants typed the words into an empty box
23 that appeared below the grid. If an entered word was one of the hidden words in the
24 grid then clicking an “OK” button added the word to a list of discovered words that
25 appeared to the right of the grid. A timer appeared below the list of discovered words
26 showing the time remaining. Further instructions explained the rules of the puzzle
27 game: that all words must be in Italian, contain five or more letters and be common
28 nouns (i.e., not adjectives, verbs, or proper names). Points were awarded according to
29 the orientation of the words in the grid, such that vertical words earned more points
30 than horizontal ones, words with letters in reverse order earned more points than ones
31 in the normal order, and diagonal words earned more points than horizontal and verti-
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55 ¹ One of our aims was to replicate Ferrante *et al.*'s (2013) studies whose group size
56 ranged between about 40 (Experiment 1) and 30 (Experiment 2) respondents. Accord-
57 ingly, we have tested about 30 respondents per group in Study 1a, and about 40 re-
58 spondents per group in Study 1b and Study2.
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3 cal words. Participants were given three minutes to find as many words as possible.
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5 They were informed that their performance on the task would determine whether they
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7 received 20 or 60 raffle tickets to win photocopy cards (value of each card = 1€, about
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9 \$1.10). Independent of their performance, the number of tickets participants received
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11 was determined by whether they had been randomly assigned to a success ($n = 63$;
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13 winning 60 tickets) or failure ($n = 63$; winning 20 tickets) condition.
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17 After the task and following the provision of failure or success feedback (i.e.,
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19 participants were told that their score was below or above the reference score and, as
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21 a consequence, they won 20 or 60 tickets, respectively), participants were informed
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23 that they would shortly complete a similar word-search puzzle, and were first asked to
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25 think about their performance. They were randomly assigned to a counterfactual or a
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27 prefactual condition following their previous failure (counterfactual, $n = 32$; prefactu-
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29 al, $n = 31$) or success (counterfactual, $n = 33$; prefactual, $n = 30$). Those who received
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31 failure feedback were given the following instructions (text in brackets refers to the
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33 prefactual condition): “Things would have been better for me [Things will be better
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35 for me in the next game], if ... Please, write at least one way in which you would
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37 complete this sentence.” Those who received success feedback were given the follow-
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39 ing instructions (text in brackets refers to the prefactual condition): “Things would
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41 have been worse for me [Things will be worse for me in the next game], if ... Please,
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43 write at least one way in which you would complete this sentence.”
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47 Results

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49 Responses to the counterfactual / prefactual sentences included modifications
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51 of the characteristics of the task (e.g., “If I had more time”/ “If the problem is easi-
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53 er”), the participants’ psychophysical status (e.g., “If I had slept more” / none given),
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55 their stable traits (e.g., “If I were good at this sort of game” / “If my verbal intelli-
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gence was trained”), the traits that they could not improve before the following task (e.g., “If I had trained more in this sort of quiz”/ “If I can train”), and contextual factors (e.g., “If I had an exam later”, “If something distracts me”). These responses were coded as *uncontrollable* modifications (see Supplementary Materials for an alternative classification). Other responses included alterations to participants’ strategic approach (e.g., “If I had used a better strategy” / “If I use a different tactic”), and their level of attention and concentration (e.g., “If I had paid more attention”/ “If I concentrate better”). These responses were coded as *controllable* modifications. Two independent judges, unaware of the hypotheses, classified the responses. Their agreement rate was 91%, Cohen’s $k = .83$, $p < .001$. Disagreements were resolved by discussion. We discarded the data of five participants because the response they gave was ambiguous or non-informative (three participants in the success counterfactual, and one in the failure prefactual condition) or because they failed to complete the task (one participant in the failure prefactual condition). The remaining participants were distributed as follows: failure prefactual, $n = 30$; failure counterfactual, $n = 31$; success prefactual, $n = 30$; success counterfactual, $n = 30$.

Participants discovered on average 7.06 words (min = 1, max = 14) in the word-search task. A two-way between-subjects analysis of variance showed that the number of discovered words did not differ in the success ($M = 7.02$, $SD = 2.30$) vs. failure ($M = 7.10$, $SD = 2.58$; $F(1,117) = 0.04$, $p = .85$) conditions, nor in the counterfactual ($M = 7.10$, $SD = 2.51$) vs. prefactual ($M = 7.02$, $SD = 2.38$; $F(1,117) = 0.04$, $p = .85$) conditions.

The four conditions elicited a similar mean number of modifications (see Table 1). In all studies, we report the analyses of the first responses generated on the hypothetical thinking task and of all responses elicited in each condition (i.e., proportion

of controllable modifications on all the modifications generated by each participant). Following failure, respondents generated significantly more controllable thoughts in the prefactual condition than in the counterfactual one, both when we considered the first modifications, (77% vs. 35% respectively), $\chi^2(1, N = 61) = 10.48, p = .001, \phi = .41$, and all the modifications (78% vs. 33% respectively), Mann-Whitney $U = 226.5, p < .001, r = .48$ (see Table 1). Likewise, following success, respondents produced significantly more controllable thoughts in the prefactual condition than in the counterfactual one, both when we considered the first modifications, (60% vs. 20% respectively), $\chi^2(1, N = 60) = 10.0, p = .002, \phi = .41$, and all the modifications (52% vs. 24% respectively), Mann-Whitney $U = 263.5, p = .002, r = .40$.²

Moreover, in each condition, most response patterns were consistent, that is, they contained only uncontrollable or only controllable mutations (failure prefactual: 87%; failure counterfactual: 81%; success prefactual: 77%; success counterfactual: 93%).

These results replicate the results obtained when participants reflected on their failures in Ferrante *et al.* (2013), and extend them to situations in which participants reflect on their successes. In both cases, participants tend to produce more uncontrollable modifications when they generate counterfactuals and more controllable modifications when they generate prefactuals. Only a third of the counterfactuals generated were controllable, a result that would not be predicted if counterfactuals had a preparatory function. Furthermore, individuals knew that they were about to receive another similar task to do and so their motivation to think of how they could improve should

² The minor difference in the framing of the counterfactual and prefactual question could have focused the prefactual question (“things will be better for me in the next game if”) more on the task and the counterfactual question (“things would have been better for me if”) more on the participant’s experience. However, we found that even in the counterfactual condition most thoughts focused on the task. Hence, this potential confound is unlikely to have substantially affected the results.

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3 be strong (see Markman *et al.*, 1993). Yet, participants spontaneously produced few
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5 controllable counterfactuals.
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10 Table 1. Mean number of modifications, and the percentage of first and all modifica-
11 tions that were controllable in the four conditions of Studies 1a and 1b.
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Condition		Study 1a			Study 1b		
		Mean (SD)	First	All	Mean (SD)	First	all
Failure	Prefactual	1.80 (.76)	77	78	1.09 (.34)	61	58
	Counterfactual	1.74 (.63)	35	33	1.29 (.58)	9	8
Success	Prefactual	1.80 (.85)	60	52	1.48 (.57)	45	43
	Counterfactual	1.97 (.85)	20	24	2.07 (.77)	11	16

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Study 1b

In Study 1a, participants received feedback that was unrelated to their actual performance. Thus, for some participants the feedback might have seemed out of touch with their performance. This possibility opens the question of whether the reported difference in the generation of future vs. past modifications might also occur when participants are given accurate feedback on their past performance. To answer this question, in Study 1b participants were required to produce modifications about their own actual performance on a given task. A secondary aim of Study 1b was to generalize the results of Study 1a using a different type of task (a syllogistic task rather than a word-search game) and a different population (on-line survey respondents rather than undergraduates).

Method

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3 Participants were 199 U.S. residents (mean age: 30 y; age range 18-67 y; 71
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5 women) recruited using the Amazon Mechanical Turk platform. They were paid \$1 to
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7 complete a syllogistic task in a limited time. The task asked the participants to order
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9 five individuals by height on the basis of four statements describing the height
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11 relations between pairs of individuals (e.g. “Matt is shorter than Paul”; see
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13 Supplemental Materials for details). An example was provided and the participants
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15 had to complete a simple task to learn how to use the interface to order the
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17 individuals. Once they had completed this trivial task, participants were reminded of
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19 how the actual task would work, and that they would only have 20 seconds to
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21 complete it. After the task, participants were provided with accurate failure or success
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23 feedback (i.e. depending on whether they solved the task in the allotted time) and
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25 were asked to think about their performance. Participants were randomly assigned to a
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27 counterfactual or prefactual condition following their failure (prefactual, $n = 64$;
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29 counterfactual, $n = 68$) or success (prefactual, $n = 36$; counterfactual, $n = 31$). In the
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31 prefactual condition, they were informed that they would shortly complete another
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33 similar syllogistic task. They were given the same instructions as in the corresponding
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35 conditions of Study 1a.
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40 Results

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43 The responses were similar to those obtained in Study 1a, and were coded by
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45 two independent judges, blind to the hypotheses, who used the same coding criterion
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47 as in Study 1a. Their agreement rate was 94%, Cohen’s $k = .87$, $p < .001$. Disagree-
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49 ments were resolved by discussion. We discarded the data of six participants who
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51 failed to complete the task and ten participants who produced only ambiguous re-
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53 sponses. The remaining participants were distributed as follows: failure prefactual, n
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55 = 57, failure counterfactual, $n = 65$, success prefactual, $n = 33$, success counterfactual,
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3 $n = 28$.
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6 Participants generated a significantly higher number of modifications in the
7 success conditions ($M = 1.75$, $SD = 0.72$) than in the failure conditions ($M = 1.20$, SD
8 $= 0.49$), $F(1, 179) = 46.26$, $p < .001$, $\eta^2_p = .21$ (see Table 1). Moreover, in the success
9 conditions, they generated a significantly higher number of counterfactual ($M = 2.07$,
10 $SD = 0.77$) than prefactual modifications ($M = 1.48$, $SD = 0.57$), $F(1, 179) = 4.88$, $p =$
11 $.03$, $\eta^2_p = .03$. We have no plausible explanation for these differences. They did not
12 emerge in the other two studies (see Table 1 and Table 2).
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20 After a failure, the prefactual condition elicited significantly more controlla-
21 ble modifications than did the counterfactual condition, both when we considered the
22 first modifications (61% vs. 9%, respectively), $\chi^2(1, N = 122) = 37.05$, $p < .001$, $\phi =$
23 $.55$, and all modifications (58% vs. 8% respectively), Mann-Whitney $U = 864.0$, $p <$
24 $.001$, $r = .55$ (see Table 1). Likewise, after a success, the prefactual condition elicited
25 significantly more controllable modifications than did the counterfactual condition,
26 both when we considered the first modifications (45% vs. 11% respectively), $\chi^2(1, N$
27 $= 61) = 8.79$, $p = .003$, $\phi = .38$, and all modifications (43% vs. 16%, respectively),
28 Mann-Whitney $U = 287.5$, $p = .003$, $r = .38$. Failure and success feedback elicited a
29 similar rate of controllable counterfactuals, both when we considered the first modifi-
30 cations (9% vs. 11%, respectively), $\chi^2(1, N = 93) = 0.05$, $p = .82$, $\phi = .02$, and all
31 modifications (8% vs. 16%, respectively), Mann-Whitney $U = 850.5$, $p = .39$, $r = .09$.
32 Likewise, the two sorts of feedback elicited a similar rate of controllable prefactuals,
33 both when we considered the first modifications (61% vs. 45% of controllable modi-
34 fications, respectively), $\chi^2(1, N = 90) = 2.15$, $p = .14$, $\phi = .15$, and all modifications
35 (58% vs. 43%, respectively), Mann-Whitney $U = 766.0$, $p = .10$, $r = .17$.
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3 As in Study 1a, most response patterns were consistent both in the failure
4 (prefactual = 98%; counterfactual = 95%) and success (prefactual = 85%; counterfac-
5 tual = 86%) conditions.
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9 Study 1b replicates the findings of Study 1a. Participants generated more con-
10 trollable modifications in the prefactual condition than in the counterfactual condition.
11 They did so both when they had successfully solved the task and when they had failed
12 it. The very low rate of controllable counterfactuals (12% across conditions) clearly
13 conflicts with the predictions of the preparatory hypothesis.
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20 21 **Study 2** 22

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24 Following the preparatory hypothesis, individuals who have experienced a
25 failure should generate controllable counterfactuals regardless of whether they are ex-
26 plicitly prompted to do so. The results reported by Ferrante *et al.* (2013) as well as
27 those obtained in Studies 1a and 1b suggest a different prediction. Individuals who
28 have experienced a failure are not likely to generate controllable counterfactuals.
29 Controllable thoughts, however, are available to these individuals, as proved by their
30 tendency to generate controllable prefactuals. What if these individuals are explicitly
31 required to generate counterfactuals that could be useful for their own or other indi-
32 viduals' future performance on a similar task? Their situation is close to the one of in-
33 dividuals who must generate prefactuals: They cannot focus on the constraints that
34 have governed their past attempt (e.g., the rules of the task) because these features
35 will not change in the following attempt. Hence, they should focus on controllable
36 features (e.g., the strategy they used in their past attempt). In sum, individuals who
37 have to generate counterfactuals that could be useful in an ensuing endeavor should
38 generate controllable thoughts more often than individuals who receive the standard
39 instruction to generate counterfactuals.
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3 In Study 2, we tested these diverging predictions by comparing the hypothet-
4 ical thoughts of participants who had just failed a task and who received four different
5 sorts of instructions. In two conditions, they received the standard instructions to pro-
6 duce counterfactual or prefactual modifications. In two other conditions, they were
7 requested to generate counterfactual modifications that would be useful for their own
8 or other individuals' future performance on a similar task. If the main function of
9 counterfactual thinking were to improve future performance, then participants should
10 produce similar modifications in the four conditions. In particular, they should pro-
11 duce a similar rate of controllable counterfactuals when they are asked to give a piece
12 of advice (to themselves or to other individuals) and when they receive no explicit in-
13 struction to this effect. By contrast, if the main function of counterfactual thinking is
14 not a preparatory one, then participants should produce a higher rate of controllable
15 thoughts in the prefactual and in the advice conditions than in the standard counterfac-
16 tual one.

33 Method

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37 A sample of 181 U.S. residents (mean age: 30 y; age range 18-61 y; 51 wom-
38 en) was recruited using Amazon Mechanical Turk. They were paid \$1 to complete the
39 syllogistic task introduced in Study 2 and to complete a hypothetical sentence. They
40 were randomly assigned to one of four conditions: prefactual, $n = 43$, counterfactual
41 advice-self, $n = 46$, counterfactual advice-other, $n = 43$, and counterfactual, $n = 49$.

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48 The method was similar to that of Study 1b (see Supplemental Materials for
49 details). The participants were asked to solve a syllogistic task. Study 2 differs from
50 Study 1b in the following ways. 1) Participants only had 15s (in contrast with 20s) to
51 complete the task. This change guaranteed that most participants would fail, since we
52 were only interested in modifications following failures. 2) Accordingly, we did not
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3 ask the few participants who succeeded to produce any modifications. 3) In addition
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5 to the prefactual and counterfactual conditions, participants could also be prompted to
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7 produce counterfactual thoughts that would help them improve their performance on a
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9 repetition of the task (counterfactual advice-self condition), or that would help another
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11 participant improve his or her performance on the same task (see Supplemental
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13 Materials for details of the requests).
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16 17 Results

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19 Participants successfully completed the task at similar rates across conditions
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21 (prefactual = 23%; counterfactual self-advice = 15%; counterfactual other-advice =
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23 25%; counterfactual = 18%). The participants who succeeded were not asked to pro-
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25 duce a statement. The statements of those who had failed were coded by two inde-
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27 pendent judges, blind to the hypotheses. Their agreement rate was 93.6%, Cohen's $k =$
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29 $.88, p < .001$. Disagreements were resolved by discussion. We discarded the data of
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31 four respondents in the prefactual condition and one respondent in the other-advice
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33 condition because the only response each one produced was ambiguous. The remain-
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35 ing participants were distributed as follows: prefactual, $n = 29$; counterfactual self-
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37 advice, $n = 39$; counterfactual other-advice, $n = 31$; counterfactual, $n = 40$.
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43 Participants generated a similar mean number of modifications across condi-
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45 tions (see Table 2). The self-advice and other-advice counterfactual conditions elicited
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47 similar rates of controllable modifications both when we considered the first modi-
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49 fications (72% vs. 68%, respectively), $\chi^2(1, N = 70) = 0.14, p = .71, \phi = .04$ and all
50
51 modifications (69% vs. 60% respectively), Mann-Whitney $U = 595.5, p = .90, r = .02$
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53 (see Table 2). Likewise, rates of controllable modifications in the two advice condi-
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55 tions did not differ significantly from prefactual ones: self-advice vs. prefactual first
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57 modifications (72% vs. 79%, respectively), $\chi^2(1, N = 68) = 0.50, p = .48, \phi = .09$, all
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3 modifications (69% vs. 80%, respectively), Mann-Whitney $U = 488.5$, $p = .23$, $r =$
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5 .14); other-advice vs. prefactual first modifications (68% vs. 79%, respectively), $\chi^2(1,$
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7 $N = 60) = 1.03$, $p = .31$, $\phi = .13$, all modifications (60% vs. 80%, respectively), Mann-
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9 Whitney $U = 398.5$, $p = .33$, $r = .13$.

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12 By contrast, the prefactual condition elicited a significantly higher rate of con-
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14 trollable modifications than the counterfactual condition both when we considered the
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16 first modifications (79% vs. 15%, respectively), $\chi^2(1, N = 69) = 28.54$, $p < .001$, $\phi =$
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18 .64, and all modifications (80% vs. 12%, respectively), Mann-Whitney $U = 178.5$, p
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20 $< .001$, $r = .68$. Similarly, both advice conditions elicited a significantly higher rate of
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22 controllable modifications compared to the counterfactual condition: self-advice vs.
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24 counterfactual first modifications (72% vs. 15%, respectively), $\chi^2(1, N = 79) = 25.98$,
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26 $p < .001$, $\phi = .57$, all modifications (69% vs. 12%, respectively), Mann-Whitney $U =$
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28 297.0 , $p < .001$, $r = .60$; other-advice vs. counterfactual first modifications (68% vs.
29
30 15%, respectively), $\chi^2(1, N = 71) = 20.61$, $p < .001$, $\phi = .54$, all modifications (60%
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32 vs. 12%, respectively) Mann-Whitney $U = 248.0$, $p < .001$, $r = .59$. In all conditions,
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34 most response patterns were consistent (prefactual = 97%; counterfactual self-advice
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36 = 87%; counterfactual other-advice = 94%; counterfactual = 98%).³

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39 As predicted, we found that participants generated many more controllable
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41 modifications not only when asked for prefactuals, but also when asked to generate
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43 counterfactuals that could be useful for their future selves or for others. This finding
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45 suggests that the failure of participants to generate such controllable modifications in
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47 the counterfactual condition does not stem from a difficulty in generating controllable
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49 counterfactuals in this task. In sum, contrary to the implicit prediction of the prepara-
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57 ³ Because the design was not fully symmetrical (i.e. there was only one prefactual
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59 condition), we could not perform a log-linear analysis.
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tory hypothesis, participants who were asked to give advice (to themselves or to other individuals) produced a significantly higher rate of controllable counterfactuals than participants who received no explicit instruction to this effect.

Table 2. Mean number of modifications, and the percentages of first and all modifications that were controllable in the four conditions of Study 2

Condition	Mean (SD)	Percentage	
		First	All
Prefactual	1.38 (.68)	79	80
Counterfactual self-advice	1.56 (.88)	72	69
Counterfactual other-advice	1.45 (.81)	68	60
Counterfactual	1.23 (.48)	15	12

General Discussion

In the reported studies, participants who had just completed a task imagined a different outcome to their past attempt (counterfactual condition) or to a following attempt (prefactual condition). Compared to participants who had to think about a different future, those who had to think about a different past were more likely to mentally modify uncontrollable features of their attempt. This tendency occurred both when participants had failed the task (“Things would have been better if the allocated time were longer”) and when they had successfully solved it (“Things would have been worse if the allocated time were shorter”). This difference was observed both when participants received mock (Study 1a) and veridical feedback on their past performance (Study 1b). In Study 2, participants who generated counterfactuals in the

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3 standard way without an explicit purpose produced fewer controllable thoughts than
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5 those who were explicitly prompted to generate counterfactuals that would be useful
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7 either to themselves or to others. In the three studies, the effect sizes for comparisons
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9 between counterfactual conditions and other conditions were medium to large (rang-
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11 ing .38 to .68; see Coolican, 2009).
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14 These results confirm and extend those obtained in earlier studies (e.g., Fer-
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16 rante *et al.*, 2013; Giroto *et al.*, 2007; Pighin *et al.*, 2011), and conflict with the pre-
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18 dictions of the preparatory hypothesis (e.g., Epstude & Roese, 2008, 2011; Markman
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20 *et al.*, 1993, Roese, 1997). If counterfactuals mainly serve to prepare future perfor-
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22 mance, they should be of the controllable sort, they should not differ from prefactuals,
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24 and they should not be affected by external prompts. Contrary to these predictions,
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26 our results show that unless participants are explicitly prompted to generate useful
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28 thoughts they often fail to generate controllable counterfactuals. By contrast, they
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30 spontaneously generate a significantly higher rate of controllable prefactuals.
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34 Recently, Epstude and Roese (2011) have refined the preparatory function hy-
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36 pothesis by distinguishing between a content-neutral pathway and a content-specific
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38 pathway. The content neutral pathway corresponds to a general increase of motivation
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40 after the generation of counterfactual thoughts. It would be very difficult to show that
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42 counterfactuals thoughts, even uncontrollable ones, do not serve such a general func-
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44 tion. By contrast, the content-specific pathway “embodies the transmission of particu-
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46 lar semantic information from the counterfactual to a behavioral intention to an ac-
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48 tion.” (2011, p.21). Our results clearly argue against this content-specific pathway, in
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50 particular since our participants were in the ideal condition to generate controllable
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52 hypothetical thoughts—that is, thoughts that would fit with the definition of the con-
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54 tent-specific pathway. First, participants who think about the outcome of a scenario
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3 may be uncertain about the elements that its characters might or might not control.
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5 Yet, they produce controllable counterfactuals (e.g., Pighin *et al.*, 2011). Our partici-
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7 pants, however, completed the task themselves and thought about their own perfor-
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9 mance. Therefore, they had direct experience of the elements that were and were not
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11 under their control. Second, the participants in our experiments completed a task
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13 whose outcome largely depended on their attention and concentration level, and on
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15 the strategies they employed, instead of luck for instance. Despite these favorable
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17 conditions, our participants generated a very low rate of controllable counterfactuals
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19 (16% across studies), and did so both when they reasoned about a failure or about a
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21 success.
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25 One potential criticism of our studies is that for participants the stakes were
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27 relatively low. Participants stood to earn (or fail to earn) only small rewards. Howev-
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29 er, in Experiment 1a, participants were incentivized by the possibility of winning pho-
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31 tocopy cards. In fact, experiments offered in support of the preparatory hypothesis
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33 have typically used low stakes. Moreover, it is unclear why low stakes would particu-
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35 larly affect the preparatory function and not all potential functions of counterfactuals.
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39 Indeed, several functions other than the preparatory one have been suggested
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41 for counterfactual thoughts: “They explain the past, prepare for the future, modulate
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43 emotional experience, and support moral judgments” (Byrne, 2016, p.136). The list of
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45 counterfactuals reported at the beginning of the paper might be used to illustrate some
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47 of these functions. In the present case, one interpretation of the data is that many of
48
49 the counterfactuals generated by our participants could help them to save face. Fol-
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51 lowing a failure, individuals often explain it away (e.g., Gilovich, 1983; for a review,
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53 see Tavris & Aronson, 2007). Accordingly, the typical counterfactuals produced by
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55 our participants (e.g., “Things would have been better if the allocated time were long-
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3 er”) could be considered as potential excuses of their failure, because they suggest
4 that it was due to factors outside of participants’ control. Such counterfactuals would
5 belong to the family of motivated reasoning: reasoning that does not aim at accuracy,
6 but at defending a pre-established point of view (Kunda, 1990; Mercier & Sperber,
7 2011). In the present case, the participants would be defending their competence in
8 the face of failure.
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16 Following a failure, our participants modified uncontrollable features of their
17 attempt. Uncontrollable counterfactuals, however, are not the only sort of counterfac-
18 tuals that can play a self-defensive role. In our studies, we have used tasks that did not
19 involve any training or practice session. When tasks involve such sessions, individu-
20 als who have experienced a failure generate counterfactuals that do focus on their
21 preparatory effort. For example, McCrea (2008) found that undergraduates who had
22 failed an exam and had reported a lack of study effort tended to produce counterfactu-
23 al thoughts about studying (e.g., “If I had studied more I could have done better”).
24
25 Importantly, these undergraduates experienced an increase in self-esteem as a result
26 of generating such counterfactuals, but a decrease in motivation to adequately prepare
27 for the next exam in the class. This finding shows that, along with uncontrollable
28 counterfactuals, controllable counterfactuals can help save face following negative
29 performance. This finding also shows that counterfactuals, including controllable
30 ones, might have a detrimental effect on learning.
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47 A series of studies by Petrocelli and colleagues (e.g., Petrocelli & Harris,
48 2011; Petrocelli, Seta & Seta, 2013; Petrocelli, Seta, Seta, & Prince, 2012; see also
49 Kruger, Wirtz, & Miller, 2005) confirmed this finding. For example, students who
50 generated counterfactuals about a failed item of a multiple-choice practice exam (e.g.,
51 “If I had read the answer choices more thoroughly...”) were subsequently less likely
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3 to study exam topics related to that item than exam topics related to items for which
4 they had not generated counterfactuals (Petrocelli *et al.*, 2012). In other words, coun-
5 terfactuals, including controllable ones, may provide an erroneous sense of compe-
6 tence (e.g., “I mastered the topic but I did not read the question carefully”) which in
7 turn may hinder efforts toward improvement. Results of this sort corroborate the view
8 that counterfactuals may improve future performance only to the extent that they indi-
9 cate the correct causal antecedent to the negative outcome (e.g., lack of knowledge ra-
10 ther than a simple oversight of an item’s answers), and that individuals have the abil-
11 ity and motivation to change their behavior in the direction prescribed by counterfac-
12 tual modifications (see Petrocelli & Harris, 2011). Along with the strikingly low rate
13 of controllable counterfactuals reported in the present studies, the finding that coun-
14 terfactuals are often dysfunctional are difficult to reconcile with the preparatory func-
15 tion hypothesis.

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32 The reported tendencies indicate that future research should pay more atten-
33 tion to the potential social functions of counterfactual thought. In any case, it is im-
34 portant to bear in mind that testing functional hypotheses takes more than demonstrat-
35 ing that a given cognitive mechanism (here the mechanisms that generate counterfac-
36 tual thoughts) has a given effect (preparing for the future or explaining away the past,
37 say). Any adaptation is bound to have a multitude of effects as by-products, such as
38 the noise our heart produces when beating. Functional hypotheses must be supported
39 instead by evidence of a particularly good match between the hypothesized function
40 of a mechanism and its working (see Williams, 1966, and regarding functionalism in
41 general, Elster, 1989). For instance, more exigent tests of the functional hypothesis
42 might involve showing that engaging in counterfactual thought better prepares indi-
43 viduals for future actions than other cognitive activities would, or that the mecha-
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3 nisms that allow counterfactual thought have features that are explained better by the
4 preparatory function hypothesis than by other functional hypotheses. Obviously, the
5 hypothesis that counterfactuals serve a social function would require the same type of
6 evidence. At the moment, no theory of counterfactual thought seems to have enough
7 arguments to support a functional hypothesis.
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10 11 12 13 **Acknowledgments**

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Supplemental Materials of

Questioning the preparatory function of counterfactual thinking

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1. Study 1a - Materials

Detail of the instructions provided to participants in the success vs. failure conditions.

If participants were assigned to the failure conditions:

Unfortunately, your performance on the word search puzzle game was not a high score.

Your score was slightly below the target, and you did not win the bonus 40 tickets. In any case, the 20 tickets you have earned will be entered into the prize draw.

If participants were assigned to the success conditions:

Well done! Your performance on the word search puzzle game was a high score. Your score was slightly above the target, and you have won the bonus 40 tickets. Thus, the 60 tickets you have earned will be entered into the prize draw.

2. Study 1b - Materials

For the actual task participants were provided with the following four statements:

Matt is shorter than Paul

Frank is shorter than Bob

Frank is taller than Paul

Tom is taller than Bob

After a 20 second time limit, the experiment automatically moved on to the next screen. In the counterfactual condition, if participants provided an incorrect word order or failed to complete the task in the allotted time, they were told:

Sorry, you failed the test. Thinking about what just happened, can you please complete the following sentence:

Things would have been better for me if...

(You can offer several possibilities if you want, putting one per line -- please copy the beginning of the sentence so that you have a complete sentence at every line)

If they succeeded they were told:

You have provided the right answer, congratulations!

Thinking about what just happened, can you please complete the following sentence:

Things would have been worse for me if...

(You can offer several possibilities if you want, putting one per line -- please copy the beginning of the sentence so that you have a complete sentence at every line)

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4 In the prefactual condition, the equivalent requests were:
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8 Sorry, you failed the test. On the next page, you will be given a novel problem that involves
9 ordering 5 individuals according to their height (from tallest to shortest), based on 4 state-
10 ments describing the height relations between pairs of individuals. Again, you will have 20
11 seconds to solve the problem.
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16 Thinking about what WILL happen in this next game, can you please complete the follow-
17 ing sentence:
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20 Things WILL be better for me in the next game if...

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23 (You can offer several possibilities if you want, putting one per line -- please copy the be-
24 ginning of the sentence so that you have a complete sentence at every line)
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30 You have provided the right answer, congratulations! On the next page, you will be given a
31 novel problem that involves ordering 5 individuals according to their height (from tallest to
32 shortest), based on 4 statements describing the height relations between pairs of individuals.
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36 Again, you will have 20 seconds to solve the problem
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38 Thinking about what WILL happen in this next game, can you please complete the follow-
39 ing sentence:
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42 Things WILL be worse for me in the next game if...

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45 (You can offer several possibilities if you want, putting one per line -- please copy the be-
46 ginning of the sentence so that you have a complete sentence at every line)
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3. Study 2 – Materials

Detail of the instructions provided to participants in the counterfactual advice-self and counterfactual advice-other conditions.

Advice-self:

Sorry, you failed the test. You are now given the opportunity to give some advice to another participant who will be confronted with exactly the same task: ranking 5 people, from tallest to shortest, based on 4 statements describing the height relations between pairs of individuals. That person will also have 15 seconds to solve the problem.

Thinking about just happened to you, can you please complete the following sentence, TRY-
ING TO THINK OF ENDINGS THAT COULD HELP YOU IMPROVE YOUR PER-
FORMANCE IN THE NEXT GAME:

Things would have been better for me if...

(You can offer several possibilities if you want, putting one per line -- please copy the beginning of the sentence so that you have a complete sentence at every line)

Advice-other:

Sorry, you failed the test. You are now given the opportunity to give some advice to another participant who will be confronted with exactly the same task: ranking 5 people, from tallest to shortest, based on 4 statements describing the height relations between pairs of individuals. That person will also have 15 seconds to solve the problem.

Thinking about just happened to you, can you please complete the following sentence SO
THAT IT IS USEFUL FOR THE NEXT PARTICIPANT:

Things would have been better for me if...

(You can offer several possibilities if you want, putting one per line -- please copy the beginning of the sentence so that you have a complete sentence at every line)

4 Supplementary coding

In order to provide readers with more information regarding the content of the uncontrollable thoughts generated by participants, one of the authors coded these thoughts mentioning factors that they could change in the future, even if not for the next task (hence their classification as uncontrollable thoughts; i.e., training-related modifications or modifications that referred to ability or behavior that participants can change in general, but not before the following game).

In Study 1a there were: no thoughts of this kind in success-prefactual, five thoughts in success-counterfactual (two in first position), three thoughts in failure-prefactual (one in first position), four thoughts in failure counterfactual (two in first position) conditions. In Study 1b there **was** only one thought of this kind in counterfactual success condition (first modification) and one in prefactual success (second modification). In Study 2, there **were** four thoughts of this kind in advice-self condition (two in first position). All the statistical analyses provide similar results to the ones reported in the article when these thoughts were treated as controllable.

Study 1a

o Success conditions, prefactual vs. counterfactual: 60% vs. 27% of controllable modifications when we considered the first modifications, $\chi^2(1, N = 60) = 6.79, p = .01$, and 52% vs. 32% when we considered all modifications), Mann-Whitney $U = 317.00, p = .03$.

o Failure conditions, prefactual vs. counterfactual: 80% vs. 42% of controllable modifications when we considered the first modifications, $\chi^2(1, N = 61) = 9.26, p = .002$, and 83% vs. 42% of controllable modifications when we considered all modifications, Mann-Whitney $U = 253.00, p = .001$.

Study 1b

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2 o Success conditions, prefactual vs. counterfactual: 45% vs. 14% of controllable modifications
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4 when we considered the first modifications, $\chi^2(1, N = 61) = 6.86, p = .01$, and 45% vs. 17% when
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6 we considered all modifications, Mann-Whitney $U = 285.0, p = .003$.

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8 o Failure conditions, prefactual vs. counterfactual: the coding was the same as reported in the
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10 article.

11 12 Study 2

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14 o Advice-self vs. counterfactual: 77% vs. 15% of controllable modifications when we consid-
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16 ered the first modifications, $\chi^2(1, N = 79) = 30.53, p < .001$, and 75% vs. 12% when we considered
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18 all modifications, Mann-Whitney $U = 252.5, p < .001$

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20 o Advice-self vs. prefactual: 77% vs. 79% of controllable modifications when we considered
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22 the first modifications, $\chi^2(1, N = 68) = 0.05, p = .81$, and 75% vs. 80% when we considered all
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24 modifications, Mann-Whitney $U = 530.5, p = .57$

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26 o Advice-self vs. Advice-other: 77% vs. 68% of controllable modifications when we consid-
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28 ered the first modifications, $\chi^2(1, N = 70) = 0.74, p = .39$, and 75% vs. 60% when we considered all
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30 modifications, Mann-Whitney $U = 569.0, p = .60$
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3 Questioning the preparatory function of counterfactual thinking
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