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# "If only" counterfactual thoughts about exceptional actions

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**Abstract** People create counterfactual alternatives that change an exceptional action to be like a usual one (e.g., "if he had placed his usual small bet he would have lost less"), as shown in Experiment 1. Experiments 2 and 3 eliminated and reversed this well-known effect: An exceptional action is instead changed to an exceptional alternative when it leads to a better outcome. Experiments 4 and 5 show that the reversal occurs whether or not the exceptional alternative is a justified action. The results indicate that the tendency to change an exceptional action to be like a usual one is guided by the optimality of the counterfactual outcome more than the exceptionality or justifiability of the action. The implications for theories of the counterfactual imagination are discussed.

**Keywords** Creativity · Decision making · Judgment · Social cognition · Reasoning

People often create counterfactual alternatives to reality, and they imagine how a bad outcome could have been different "if only . . ." some aspect of the past was changed. For example, when an individual loses money in a gamble, people can readily create counterfactual thoughts, such as "if only he had placed a different bet" or "if only he had been luckier" (Mandel, Hilton & Catallani, 2005; Markman, Klein & Suhr, 2009; Roese & Olson, 1995a, 1995b). Counterfactual thoughts may help people to prepare for the future, work out causes, learn from mistakes, and experience various emotions, such as regret and relief (Epstude & Roese, 2008; Hoerl, McCormack & Beck, in press; Roese, 1997). People exhibit remarkable regularities in their counterfactual thoughts; for example, they tend to change actions more than inactions (Byrne & McEleney, 2000; Kahneman & Tversky, 1982; see also Feeney & Handley, 2006; Gilovich & Medvec, 1995), controllable events more than uncontrollable ones (Girotto, Legrenzi & Rizzo, 1991; Markman, Gavanski, Sherman & McMullen, 1995; McCloy & Byrne, 2000), first causes in a causal sequence (Segura, Fernandez-Berrocal & Byrne, 2002; Wells, Taylor & Turtle, 1987), and more recent events in a temporal sequence (Byrne, Segura, Culhane, Tasso & Berrocal, 2000; Miller & Gunasegaram, 1990; Walsh & Byrne, 2004). In this article, we examine the tendency to change exceptional actions to be normal (Kahneman & Miller, 1986; Kahneman & Tversky, 1982).

## Exceptional actions

When people are told that Mr. Jones had a car accident on his way home from work, they tend to think,"if only he had left work at his usual time rather than earlier" or "if only he had driven home by his usual route rather than by the scenic route," depending on which action was identified as exceptional in the scenario, the time or the route (Kahneman & Tversky, 1982). Given a negative outcome such as Mr. Jones's death, people imagine a better outcome in which he did not die. However, when they know of a good reason for

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an exceptional action—for example, Mr. Jones took the scenic route because he had to collect medicine for his sick wife—their counterfactual thoughts do not focus on that action (Bonnefon, Zhang & Deng, 2007; see also McCloy & Byrne, 2000). Moreover, people change a usual action to be exceptional when it is within an individual's control—for example, "if only he did not make his usual stop at a bar" (Girotto, Ferrante, Pighin & Gonzalez, 2007; Girotto et al., 1991). And when they think about how an exceptional outcome might have turned out differently, they change exceptional actions that led to it; but when they think about how a usual outcome might have turned out differently, they change both usual and exceptional antecedents (Gavanski & Wells, 1989).

Why do people tend to change an exceptional action to be like a usual one in their counterfactual thoughts? One explanation is that exceptional actions spontaneously bring to mind their normal counterparts, whereas normal actions do not bring to mind exceptional alternatives (Kahneman & Miller, 1986). Another factor is that exceptional actions can appear to be less justified; that is, they have fewer good reasons than usual actions (e.g., Bonnefon et al., 2007). We suggest that another factor is that people change an exceptional action to be like the usual action because they believe that the usual action would have led to a better outcome—for example, "if Mr. Jones had driven home by his regular route, he would not have been in a car accident."

Counterfactual thoughts are guided by the goal of changing the outcome (Byrne, 1997, 2005; Roese, Sanna & Galinsky, 2005). People create more *better world* counterfactuals, e.g., "if he'd driven by his usual route, he would not have had an accident" than *worse world* counterfactuals, e.g., "if he'd been driving faster, other people would have been killed as well" (Markman, Gavanski, Sherman & McMullen, 1993; Roese, 1997). The purpose of an individual also affects the counterfactual outcome he or she creates—for example, to attribute blame, "if he'd worn his seatbelt, his injuries would have been minor" or to console, "even if he'd worn his seatbelt, he still would have been injured" (Davis, Lehman, Wortman, Silver & Thompson, 1995; Roese & Olson, 1995a). People think counterfactually more often after a bad outcome than after a good outcome (Roese, 1994). Of course, they can think counterfactually after good outcomes when they have motives to do so (Sanna, Chang & Meier, 2001; Sanna, Turley-Ames & Meier, 1999), and they can also create 'even if' alternatives that have the same outcome as reality (McCloy & Byrne, 2002; Moreno-Rios, Garcia-Madruga & Byrne, 2008). Nonetheless, the tendency to create counterfactuals that lead to better outcomes may reflect a fundamental principle of human thought to seek positive outcomes in many areas of life (Kahneman, Diener & Schwarz, 1999; Unkelbach, Fiedler, Bayer, Stegmuller & Danner, 2008). We test the idea that the creation of counterfactual alternatives that change an exceptional action to be like a usual one is guided by the optimality of the counterfactual outcome.

Consider a card game in which an actor must choose to place a large bet (€30), a medium bet (€20), or a small bet (€10). The actor plays against three other players: the small-bet player matches only small bets (and so bets only €10), the medium-bet player matches small or medium bets (and so bets €10 or €20), and the large-bet player matches small, medium, or large bets (and so bets €10, €20, or €30). The actor usually chooses to place a small bet. However, in this instance, the actor chooses to place the medium bet. Both the medium-bet and large-bet players match his bet. It turns out that the actor has better cards than the large-bet player but the medium-bet player has the best cards, and so the medium-bet player wins. People may think about the event by envisaging the possibilities corresponding to the action and its outcomes (Byrne, 2005; Byrne & McEleney, 2000), which can be summarized in the following diagram:

Action: Actor places exceptional medium bet.
Outcome: Large- and medium-bet players play.
Actor has better cards than large-bet player.
Medium-bet player has better cards than actor and large-bet player.
Actor loses (medium amount).

Imagine that the actor thinks "things would have been different if. . . ." How do you think he would complete this thought? The counterfactual alternative created by changing the actor's exceptional action (placing the medium bet) to be like his usual action (placing the small bet) would not change the outcome to be better (if he had placed his usual small bet, he still would have lost, because the medium-bet player would have matched his bet and won):

Counterfactual action: Actor places usual small bet.
Counterfactual outcome: Large-, medium-, and small-bet players play.
Actor has better cards than large-bet player.
Medium-bet player has better cards than actor and large-bet player.
Actor loses (small amount).

But the counterfactual created by changing the actor's exceptional action to be like the exceptional alternative (placing the large bet) *would* change the outcome to be better (if he had placed a large bet, he would have won, because the medium-bet player would not have played):

Counterfactual action: Actor places exceptional large bet.
Counterfactual outcome: Large-bet player plays.
Actor has better cards than large-bet player.
Actor wins.

Our aim in the five experiments we report was to pit the optimality of the counterfactual outcome against the exceptionality and justifiability of the action, to examine whether people are guided by their belief that a changed action will lead to a better counterfactual outcome. In Experiments 1–3, the actor does not choose his usual action, the small bet; instead, he chooses the action that participants view as the best bet, the medium bet. The medium bet is a justified action, that is, it is justifiable by good reasons based on the information available to the actor. The exceptional alternative, the large bet, is viewed as unjustified, as is the usual action, the small bet. We show that when the exceptional alternative is not optimal, in that it would not lead to a better outcome, people's counterfactual thoughts focus on the usual action (Experiment 1). But when the outcomes from the exceptional alternative and the usual action are equally optimal, people's counterfactual thoughts focus on the exceptional alternative as often as on the usual action (Experiment 2). And when the exceptional alternative is optimal, their counterfactuals focus on it, despite its being judged a priori by participants as unjustified (Experiment 3). In Experiments 4 and 5, the actor instead chose the action judged by participants as unjustified, the large bet. When the exceptional alternative is judged a priori by participants as justified (the medium bet) but its outcome is not optimal, their counterfactual thoughts focus instead on the usual action (which is judged as unjustified, but its outcome is optimal). When the exceptional alternative is not only judged a priori by participants as justified but is also optimal, they focus on it, rather than on the usual action.

## Experiment 1: An exceptional action is changed to a usual action with a better outcome

Our first experiment demonstrates the standard tendency to change an exceptional action to be like the usual action in the card game scenario, given that the exceptionality effect has been demonstrated in scenarios about everyday events—for example, Mr. Jones's car accident. We gave participants a card game scenario in which an actor chooses to place a large, medium, or small bet (see Appendix 1). Exceptionality was manipulated as in previous exceptionality studies by describing one action as being the actor's *usual* action. The small bet was described as the actor's usual bet, and the other two bets were exceptional. The monetary context of gains and losses allowed an objective measure of the justifiability of the exceptional actions, in that participants could make a decision about which action was best, in advance of knowing the outcome. Of course, it is possible to justify decisions in different ways, even bad decisions or decisions that lead to bad actions or bad outcomes. Nonetheless, of relevance here are actions that are judged a priori as the best decision.The participants robustly considered the large bet to be unjustified a priori and the medium bet to be justified a priori, as shown by our materials tests, reported later. In previous exceptionality scenarios, the usual action was also optimal; it led to a better counterfactual outcome (e.g., Mr. Jones's usual route home would also have been the route on which he would not have had a car accident). The card game scenario allowed us to separate these factors.

Participants were informed that if the actor placed a small bet (€10), all three opposition players would match his bet; if he bet medium (€20), two of the players would match his bet (the medium-bet and large-bet players), and if he bet large (€30), only one player would match his bet (the large-bet player). For all players, a small bet was €10, a medium bet was €20, and a large bet was €30. In the version of the scenario used in this experiment, participants were told that the actor chose to place the medium bet. Both the medium-bet player and the large-bet player matched his bet. In this experiment, participants were told that the large-bet player had better cards than the actor and the medium-bet player, and so the actor lost:

Action: Actor places exceptional medium bet.
Outcome: Large- and medium-bet players play.
Large-bet player has better cards than actor.
Actor loses (medium amount).

A counterfactual can be created by changing the exceptional action to be like the usual action:

Counterfactual action: Actor places usual small bet.
Counterfactual outcome: Large-, medium-, and small-bet players play.
Large-bet player has better cards than actor.
Actor loses (small amount).

Another counterfactual can be created by changing the exceptional action to be like the exceptional alternative:

Counterfactual action: Actor places exceptional large bet.
Counterfactual outcome: Large-bet player plays.
Large-bet player has better cards than actor.
Actor loses (large amount).

We predicted that participants would create counterfactuals that changed the exceptional action to be like the usual action —for example, "if only he had placed his usual small bet, he would have lost less money." Given the outcome (the large-bet player had better cards than the actor), counterfactuals that focus on the other exceptional bet cannot result in a win outcome (if he had placed a large bet, he still would have lost).

The experiment also examined a secondary question about whether prior reasoning about an actor's strategy affects counterfactual thoughts. We asked half of the

participants to explain what the best bet was for the actor and to predict what bet the actor would place before they were told about his decision or the outcome and before they were asked to imagine the actor's counterfactual thoughts. We compared their counterfactual thoughts with those of participants who were not asked to engage in this prior reasoning. We hypothesized that prior reasoning about the reasons for the decision might increase participants' tendency to focus on the reasons, rather than on the decision itself (Bonnefon et al., 2007; Walsh & Byrne, 2007). Prior reasoning may ensure that more information is attended to in the creation of counterfactual thoughts (e.g., Girotto et al., 2007; Pighin, Byrne, Ferrante, Gonzalez & Girotto, 2011).

## Method

### *Participants*

The 60 participants were students from Trinity College Dublin, who took part voluntarily (30 men and 30 women). Their ages ranged from 17 to 69 years (and the average age was 23 years; 1 participant did not provide an age). They were assigned at random to two groups, control and prior reasoning ($n$ = 30 in each).

### *Design and procedure*

The design was a between-participants one, with a prior-reasoning group and a control group. All participants read the scenario described in Appendix 1(i). Participants in the prior-reasoning group then answered two questions *prior* to learning about either the decision made by the actor or the outcome of the game: (1) "Explain what you think is the best decision for Peter" and (2) "What bet do you think Peter places?" Participants in the control group answered only the second of these two questions (and there were no other differences between the two groups). After answering the question(s), participants then read the decision and outcome described in Appendix 1(ii). All participants were then asked to complete a counterfactual sentence stem from the perspective of the player—(3) "Peter thinks to himself after the game, 'things could have been different if . . .'"—*after* they had learned the outcome of the card game scenario. Participants generated these counterfactuals themselves; they were not provided with a selection of counterfactuals from which to choose, nor was any attempt made to guide their thoughts in any direction. The questions were answered in a fixed order, and participants completed them in their own time. The participants were given a booklet that contained general instructions, the scenario, the explanation and prediction questions, the decision and outcome, the counterfactual question, and a debriefing paragraph. They were tested in several large groups.

### *Materials*

Participants were given a version of the card game scenario in which the actor lost, and his decision to place a medium bet was described in the following way (see Appendix 1):

> Peter thought about his choices carefully. He considered betting small, a bet of €10, as he usually does. He then considered a large bet of €30. Then Peter considered the medium bet, he decided to go with the medium bet of €20.
> Peter's medium bet meant that the small-bet player decided not to play with him, so the small-bet player did not place a bet. The medium-bet player and the large-bet player decided to play with Peter by matching Peter's bet of €20.

The outcome was described as follows:

> The large-bet player had better cards than Peter and the medium-bet player, so the large-bet player wins the game and receives €60 (The large-bet player's €20 + the medium-bet player's €20 + Peter's €20 = €60).

We tested whether the participants had judged the exceptional large-bet choice to be unjustified and the exceptional medium-bet choice to be justified by their answers to the questions "Explain what you think is the best decision for Peter?" and "What bet do you think Peter places?" and we report the results of this materials test first.

*Materials test* We expected that participants would consider the large bet to be unjustified and the medium bet to be justified a priori. The actor's usual action (to bet small) and the two exceptional actions (to bet medium or large) differed in the potential loss for the actor (€10, €20, or €30) and, depending on the number of players who would match his bet, the potential gain for the actor (€30 or €40), as summarized in Table 1. We predicted that in the context of the small monetary sums in this card game scenario, participants would make their judgment about which bet was best (in response to the first question) by relying on a *potential gains* computation of how much could be gained (row 4 in Table 1). Although participants were not asked to make judgments about risk, it is informative to note that research on risk judgments shows that people tend to be risk seeking when the monetary amounts are minor (Prelec & Loewenstein, 1991; Weber & Chapman, 2005). Indeed the potential gains computation can be considered to be a risk-seeking computation (see Table 1). On the basis of the number of players who match the bet and the bets they placed, the medium bet allows the maximun gain, €40.

The potential gains hypothesis competes against several alternatives. If participants relied, instead, on a *potential losses* computation of how much could be lost (row 1 of

**Table 1** Potential gains and losses for three bets (small, medium, and large) in the card game scenario and the means for establishing the medium bet as justified a priori and the small and large bets as unjustified a priori

| | Usual | Exceptional | |
|---|---|---|---|
| | Small | Medium | Large |
| 1. Bet (potential loss) | 10 | 20 | 30 |
| 2. No. players match bet | 3 | 2 | 1 |
| 3. Bets placed by others | 10+10+10 | 20+20 | 30 |
| 4. Win (potential gain) | 30 | 40 | 30 |
| 5. Win plus bet | 40 | 60 | 60 |
| Best bet? | | | |
| 6. Risk averse | * | | |
| 7. Risk seeking | | * | |
| 8. Risk amalgamation | | * | * |
| 9. Risk modulation | * | | |

Table 1), they would judge that the small bet was justified a priori, given that it allowed the least loss (€10). This potential losses computation can be viewed as a *risk averse* computation. Risk aversion is common in uncertain choices (Kahneman & Tversky, 1979; Sokolowska, 2006; Weber & Chapman, 2005; see also McCloy, Byrne & Johnson-Laird, 2010). If participants relied on a *gains–losses modulation* calculation of the relation between the potential loss and gain, they would also judge the small bet to be justified a priori, on the basis of a calculation that the small bet allowed the player to quadruple his monies (an input of €10 produced a total output of €40), the medium bet allowed the player to triple his monies, and the large bet only to double them (see Table 1). If they relied on a *gains–losses amalgamation* calculation of the total potential *winnings* returned, including the *unlost* bet placed by the player (row 5 of Table 1), they would conclude that the medium and large bets were both justified a priori.

The results confirm that participants judged the medium bet to be the best bet and that the large bet and small bet were not judged to be the best. Participants in the prior-reasoning group answered the question "Explain what you think is the best decision for Peter" (prior to being told about the actor's decision and the outcome) by judging that the best decision was to place the medium bet, rather than to place the small bet (77% vs. 20%), $\chi^2(1) = 9.97$, $p = .002$, or the large bet (77% vs. 3%), $\chi^2(1) = 2.02$, $p < .001$, as Table 2 shows. This result provides evidence that participants relied on a potential gains calculation in this scenario.

Participants in both the prior-reasoning group and the control group answered the question "What size bet do you think Peter places?" (prior to being told about the actor's decision and the outcome) by judging that Peter would place the medium bet more often than the small bet (control, 67% vs. 17%, $\chi^2(1) = 9.78$, $p = .002$; prior reasoning, 70% vs. 30%, $\chi^2(1) = 4.80$, $p = .028$) and the medium bet more than the large bet (control, 67% vs. 17%, $\chi^2(1) = 9.78$, $p = .002$; prior reasoning, 70% vs. 0%, binomial $n = 21$, $z = 4.36$, $p < .001$), as Table 3 shows. These results further suggest that participants relied on a potential gains calculation.

The results of the materials test confirmed that participants considered the medium bet to be the best bet and the large bet and the small bet not to be the best bets.

**Table 2** Percentages of answers to the materials test question 1, "explain what you think is the best decision to take," that focus on a small, medium, or large bet by the participants in the prior-reasoning groups in the five experiments

| | Small | Medium | Large |
|---|---|---|---|
| Experiment 1: Medium bet (small bet optimal) | 20 | 77 [ab] | 3 |
| Experiment 2: Medium bet (small, large bets optimal) | 17 | 67 [ab] | 17 |
| Experiment 3: Medium bet (large bet optimal) | 40 | 53[b] | 6 |
| Experiment 4: Large bet (small bet optimal) | 20 | 80[ab] | 0 |
| Experiment 5: Large bet (medium bet optimal) | 50 | 44[b] | 6 |

[a] Significantly different from number on left

[b] Significantly different from number on right

**Table 3** Percentages of answers to the materials test question 2, "What size bet do you think Peter places?" that predict that Peter would place a small, medium, or large bet by participants in the prior-reasoning and control groups in the five experiments

| Predicted Bet | | | |
|---|---|---|---|
| | Small | Medium | Large |
| Experiment 1: Medium bet (small bet optimal) | | | |
| Control group | 17 | 67[ab] | 17 |
| Prior-reasoning group | 30 | 70[ab] | 0 |
| Experiment 2: Medium bet (large, small bets optimal) | | | |
| Control group | 17 | 70[ab] | 13 |
| Prior-reasoning group | 30 | 57[b] | 13 |
| Experiment 3: Medium bet (large bet optimal) | | | |
| Control group | 17 | 77[ab] | 7 |
| Prior-reasoning group | 37 | 57[b] | 7 |
| Experiment 4: Large bet (small bet optimal) | | | |
| Control group | 20 | 63[ab] | 17 |
| Prior-reasoning group | 20 | 70[ab] | 10 |
| Experiment 5: Large bet (medium bet optimal) | | | |
| Control group | 22 | 75[ab] | 3 |
| Prior-reasoning group | 39 | 53[b] | 8 |

[a] Significantly different from number on left

[b] Significantly different from number on right

Results and discussion

As we expected, the tendency to change an exceptional action to be like the usual action in counterfactual thoughts was observed: Participants' counterfactual thoughts focused more often on the usual small bet than on the medium bet (control, 43% vs. 10%, $\chi^2(1) = 6.25$, $p = .012$; prior-reasoning, 67% vs. 10% $\chi^2(1) = 12.57$, $p < .001$), as Table 4 shows (and an independent judge who scored the responses of one third of the participants was in agreement on 88% of the trials). The result shows that people change an exceptional action (the medium bet) to be like the usual action (the small bet), rather than like an exceptional alternative (the large bet), when the exceptional alternative does not lead to a better outcome (and in fact, leads to a worse outcome).

Participants' counterfactuals focused on the bets more so than on external factors (e.g., "if only he had more luck . . ."“if only he were a better player . . .") in the prior-reasoning group (80% vs. 20%), $\chi^2(1) = 10.80$, $p = .001$, and not in the control group (57% vs. 43%),$\chi^2(1) = 0.53$, $p = .465$, but there was no difference between the groups in their focus on external factors (43% vs. 20%), $\chi^2(1) = 2.58$, $p = .108$. The sorts of external factors are outlined in Table 5. The result confirms the salience of the bets placed in the scenario.

Participants said "if only he'd placed his usual small bet" equally often in the control group and in the prior-reasoning group (43% vs. 67%), $\chi^2(1) = 1.49$, $p = .223$. There were few differences between the prior-reasoning group and the control group, which suggests that there was little effect of having to make a judgment about what the best decision was.

The experiment demonstrates an exceptionality effect: Participants' counterfactual thoughts tend to change an exceptional action to be like the usual one in this card game scenario just as they do in everyday scenarios (Kahneman & Tversky, 1982). It shows that the effect occurs in situations in which the counterfactual outcome is known (e.g., a card game), as well as situations in which the counterfactual outcome is unknown (e.g., a car accident). In everyday life, counterfactual outcomes can be known with certainty (e.g., "if I had continued to rent, I wouldn't have a large mortgage debt now"), or they can be unknown (e.g., a person cannot know with certainty that "if I had continued my education, I wouldn't be out of work now") (Byrne & McEleney, 2000).

The experiment shows that people change the exceptional action to be like the usual action when the counterfactual outcome from the usual action is optimal and the one from the exceptional alternative is not. In the next experiments, we tested our predictions that this effect can be eliminated when the outcome from the exceptional alternative and the usual action are equally optimal and that it can be reversed when the outcome from the exceptional alternative is optimal and the usual action's is not.

## Experiment 2: An exceptional action is changed to either the usual action or an exceptional alternative with a better outcome

In this experiment, the actor carried out an exceptional justified action (he placed a medium bet), and the other exceptional action was unjustified (the large bet); this scenario represents a particularly strong test of our hypothesis. We

**Table 4** Percentages of counterfactuals constructed in response to the prompt "things could have turned out differently if . . ." that focus on the small, medium, or large bet in the prior-reasoning and control groups in the five experiments

| | Usual Small | Exceptional Medium | Exceptional Large | "Other" Bet | Total Bets[b] |
|---|---|---|---|---|---|
| Experiment 1: Medium bet (small bet optimal) | | | | | |
| Control | 43[a] | – | 10 | 3 | 57 |
| Prior-reason | 67[a] | – | 10 | 3 | 80 |
| Experiment 2: Medium bet (small, large bets optimal) | | | | | |
| Control | 50 | – | 40 | 7 | 97 |
| Prior-reason | 37 | – | 43 | 0 | 80 |
| Experiment 3: Medium bet (large bet optimal) | | | | | |
| Control | 10 | – | 67[a] | 3 | 80 |
| Prior-reason | 17 | – | 57[a] | 10 | 83 |
| Experiment 4: Large bet (small bet optimal) | | | | | |
| Control | 50[a] | 20 | – | 0 | 70 |
| Prior-reason | 20 | 17 | – | 0 | 37 |
| Experiment 5: Large bet (medium bet optimal) | | | | | |
| Control | 19 | 53[a] | – | 6 | 78 |
| Prior-reason | 17 | 33 | – | 14 | 64 |

[a] Significantly greater than other bets

[b] The remainder of responses were external factors

**Table 5** Percentages of seven ad hoc categories of "other" responses to the counterfactual question in the five experiments (including all those responses made by more than 5% of participants in at least one condition in one experiment)

| Categories (see key below) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Experiment 1: Medium bet (small bet optimal) | | | | | | | |
| Prior-reasoning | 7 | 3 | 0 | 7 | 0 | 3 | 0 |
| Control | 17 | 7 | 10 | 0 | 3 | 0 | 7 |
| Experiment 2: Medium bet (small and large bet optimal) | | | | | | | |
| Prior-reasoning | 7 | 7 | 0 | 0 | 3 | 3 | 0 |
| Control | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| Experiment 3: Medium bet (large bet optimal) | | | | | | | |
| Prior-reasoning | 0 | 3 | 3 | 0 | 3 | 3 | 3 |
| Control | 7 | 0 | 0 | 3 | 0 | 7 | 3 |
| Experiment 4: Large bet (small bet optimal) | | | | | | | |
| Prior-reasoning | 20 | 7 | 7 | 20 | 0 | 3 | 0 |
| Control | 13 | 3 | 3 | 0 | 3 | 3 | 0 |
| Experiment 5: Large bet (medium bet optimal) | | | | | | | |
| Prior-reasoning | 0 | 3 | 17 | 0 | 14 | 0 | 0 |
| Control | 0 | 0 | 11 | 0 | 8 | 0 | 0 |

Participants generated counterfactuals of diverse sorts, which have been grouped into the following ad hoc categories:

1. If I had better cards
2. If I hadn't played
3. If opposition had different cards
4. If I was more thoughtful
5. If opposition hadn't played
6. If I had not been so confident
7. If I had been a better/luckier player

predicted that participants would change the exceptional action to be like the exceptional alternative—even though it is considered unjustified a priori—as often as the usual one, because the exceptional alternative also leads to a better outcome.

Participants were told that the actor chose to place the medium bet; the medium-bet player and the large-bet player both matched his bet. This time, they were told that the medium bet player had better cards than the actor and so the actor lost:

> Action: Actor places exceptional medium bet.
> Outcome: Large- and medium-bet players play.
> Medium-bet player has better cards than actor.
> Actor loses (medium amount).

A counterfactual can be created by changing the actor's exceptional action to be like the usual action:

> Counterfactual action: Actor places usual small bet.
> Counterfactual outcome: Large-, medium-, and small-bet players play.
> Medium-bet player has better cards than actor.
> Actor loses (small amount).

Another counterfactual can be created by changing the actor's exceptional action to be like the exceptional alternative:

> Counterfactual action: Actor places exceptional large bet.
> Counterfactual outcome: Large-bet player plays.
> Unknown who has better cards, actor or large-bet player.
> Actor either loses (large amount) or else wins.

No information was provided in this experiment about whether the actor had better or worse cards than the large-bet player. Both the counterfactual possibilities—the choice of the usual small bet or the exceptional large bet—could lead to a better outcome, unlike in the previous experiment, in which one alternative could lead to a better outcome and one could not. The potential for each alternative to lead to a better outcome is captured by the two possibilities (without any need for a calculation of uncertainty or probabilities).

## Method

### *Participants, design, and procedure*

The 60 participants were students from Trinity College Dublin, who took part voluntarily (30 men and 30 women). Their ages ranged from 18 to 53 years (and the average age was 23 years). They were assigned at random to two groups, control and prior reasoning ($n$ = 30 in each). The design and procedure was the same as the previous experiment.

### *Materials*

Participants were given the same scenario as in the previous experiment. However, the outcome was described as follows:

> The medium-bet player had better cards than Peter and the large-bet player, so the medium-bet player wins the game and receives €60 (the large-bet player's €20 + Peter's €20 + the medium-bet player's €20 = €60).

The results of the materials test confirmed that participants judge the medium bet to be the best bet and that the large bet and small bet are not judged to be the best (see Appendix 2).

## Results and discussion

As we expected, the exceptionality effect was eliminated; the tendency to change an exceptional action to be like the usual action was reduced: Participants counterfactual thoughts focused as often on the alternative exceptional bet as on the usual bet (prior reasoning, 43% vs. 37%, $\chi^2(1) = 0.17$, $p$ =

.683; control, 40% vs. 50%, $\chi^2(1) = 0.33$, $p = .564$), as Table 4 shows. The result shows that people change an exceptional action to be like an exceptional alternative as often as they change it to be like the usual action when the exceptional alternative can lead to a better outcome as well. They do so even though the exceptional alternative is considered a priori to be unjustified.

Participants' counterfactuals focused on the bets more so than on external factors in both groups (control, 97% vs. 3%, $\chi^2(1) = 26.13$, $p < .001$; prior reasoning, 80% vs. 20%, $\chi^2(1) = 10.80$, $p = .001$), and there was no difference between the groups in their focus on the bets (97% vs. 80%), $\chi^2(1) = 0.18$, $p = .674$. Participants said "if only he'd placed the large bet" equally often in the control group and in the prior-reasoning group (40% vs. 43%), $\chi^2(1) = 0.04$, $p = .841$, and they said "if only he'd placed the small bet" equally often in both groups (50% vs. 37%), $\chi^2(1) = 0.62$, $p = .43$.

The experiment shows that the tendency to change an exceptional action to be like the usual one in counterfactual thoughts is eliminated when changing it to an exceptional alternative action would also lead to a better outcome.

## Experiment 3: An exceptional action is changed to an exceptional alternative with a better outcome

In this experiment, we tested the hypothesis that participants create counterfactual thoughts that change an exceptional action to be like an exceptional alternative, rather than like the usual action, when only the exceptional alternative leads to a better outcome—even though they judge a priori the exceptional alternative to be unjustified. Participants were told that the actor chose to place the medium bet and the medium-bet and large-bet players both matched his bet; the medium-bet player had better cards than the actor, and so the actor lost. This time, participants were also told that the actor had better cards than the large-bet player:

> Action: Actor places exceptional medium bet.
> Outcome: Large- and medium-bet players play.
> Actor has better cards than large-bet player.
> Medium-bet player has better cards than actor.
> Actor loses (medium amount).

A counterfactual can be created by changing the actor's exceptional action to be like the usual action:

> Counterfactual action: Actor places usual small bet.
> Counterfactual outcome: Large-, medium-, and small-bet players play.
> Actor has better cards than large-bet player.
> Medium-bet player has better cards than actor.
> Actor loses (small amount).

Another counterfactual can be created by changing the actor's exceptional action to be like the exceptional alternative:

> Counterfactual action: Actor places exceptional large bet.
> Counterfactual outcome: Large-bet player plays.
> Actor has better cards than large-bet player.
> Actor wins.

We predicted that participants would *not* create counterfactual alternatives that changed the exceptional action to be like the usual one. Given the outcome of the game (the medium-bet player had better cards than the actor) and the additional information that the actor had better cards than the large-bet player, counterfactuals that changed the exceptional action to be like the other exceptional bet would result in a win outcome, because if the actor had placed a large bet, the medium-bet player would not have played.

### Method

#### *Participants, procedure, and design*

The 60 participants were students from Trinity College Dublin, who took part voluntarily (31 men and 28 women; 1 participant did not submit information on age or gender). Their ages ranged from 18 to 65 years (and the average age was 27 years). They were assigned at random to two groups, control and prior reasoning ($n = 30$ in each). The design and procedure was the same as the previous experiment.

#### *Materials*

Participants were given the same scenario as in the previous experiment, including the description of the same decision to place the medium bet, but the outcome was described as follows (with the additional information in italics):

> *Peter had better cards than the large-bet player,* but the medium-bet player had better cards than Peter and the large-bet player, so Peter and the large-bet player lost the game along with their bets of €20 (the large-bet player's €20 + Peter's €20 + the medium-bet player's €20 − so the medium-bet player wins €60).

The results of the materials test confirmed that participants judged the medium bet to be the best bet and that the large bet and small bet were not judged to be the best (see Appendix 2).

### Results and discussion

As we expected, the tendency to change an exceptional action to be like the usual action in counterfactual thoughts

was reversed: Participants' counterfactual thoughts focused more often on the alternative exceptional bet than on the usual bet (control, 67% vs. 10%, $\chi^2(1) = 12.57$, $p < .001$; prior reasoning, 57% vs. 17%, $\chi^2(1) = 6.55$, $p = .011$), as Table 4 shows. The result shows that people change an exceptional action to be like an exceptional alternative, rather than the usual action, when the exceptional alternative leads to a better outcome.

Participants' counterfactual thoughts focused on the bets more so than on external factors in both groups (control, 80% vs. 20%, $\chi^2(1) = 10.80$, $p < .001$; prior reasoning, 83% vs. 17%, $\chi^2(1) = 13.33$, $p = .001$), and there was no difference between the groups in their focus on the bets (80% vs. 83%), $\chi^2(1) = 0.02$, $p = .89$. Participants said "if only he'd placed the large bet" equally often in the control group and in the prior-reasoning group (67% vs. 57%), $\chi^2(1) = 0.24$, $p = .62$.

The experiment shows that the tendency to change an exceptional action to be like the usual action is reversed when changing it to an exceptional alternative would lead to a better outcome. The result is striking given that participants judge the exceptional action to be unjustified a priori.

The three experiments thus far pit the exceptionality of the action against the optimality of the counterfactual outcome and show that the optimality of the counterfactual outcome takes precedence. We look now at the other side of the coin and examine whether people change an exceptional action to be like an exceptional alternative when they believe the alternative is justified, even if it does not lead to a better outcome. Experiments 4 and 5 pitted not only the exceptionality of the action, but also its justifiability, against the optimality of the counterfactual outcome.

## Experiment 4: An exceptional action is changed to a usual action with a better outcome, not to a justified exceptional alternative

In this experiment, the actor chose an exceptional action that participants judged to be unjustified: He placed a large bet, and there was an exceptional alternative, which was considered a priori to be justified (the medium bet), but it did not lead to a better outcome. Participants were told this time that the actor chose to place the large bet and that the large-bet player matched his bet. They were told that the large-bet player had better cards than the actor, and so the actor lost:

> Action: Actor places exceptional large bet.
> Outcome: Large-bet player plays.
> Large-bet player has better cards than actor.
> Actor loses (large amount).

A counterfactual can be created by changing the actor's exceptional action to be like the usual action:

> Counterfactual action: Actor places usual small bet.
> Counterfactual outcome: Large-, medium-, and small-bet players play.
> Large-bet player has better cards than actor.
> Actor loses (small amount).

Another counterfactual can be created by changing the actor's exceptional action to be like the other exceptional action:

> Counterfactual action: Actor places exceptional medium bet.
> Counterfactual outcome: Large- and medium-bet players play.
> Large-bet player has better cards than actor.
> Actor loses (medium amount).

We predicted that participants would create counterfactuals that focused on the usual action even though the exceptional alternative was considered a priori to be justified. Given the outcome of the game (the large-bet player had better cards than the actor), counterfactual thoughts that focused on the other exceptional bet could not result in a win outcome.

### Method

#### *Participants, design, and procedure*

The 60 participants were students from Trinity College Dublin, who took part voluntarily (34 men and 26 women). Their ages ranged from 17 to 68 years (and the average age was 26 years). They were assigned at random to two groups, control and prior reasoning ($n = 30$ in each). The design and procedure was the same as the previous experiment.

#### *Materials*

Participants were given the same scenario as in the previous experiment. The decision to place a large bet was described as follows:

> Peter thought about his choices carefully. He considered betting small, a bet of €10, as he usually does. He then considered a medium bet of €20. Then Peter considered the large bet, he decided to go with the large bet of €30.
> Peter's large bet meant that the small-bet player and the medium-bet player decided not to play with him, so neither the small-bet player nor the medium-bet player placed a bet. So the large-bet player decided to play with Peter by matching Peter's bet of €30.

The outcome was described as follows:

> The large-bet player had better cards than Peter, so the large-bet player wins the game and receives €60 (the large-bet player's €30 + Peter's €30 = €60).

The results of the materials test confirmed that participants judged the medium bet to be the best bet, and the large bet and small bet were not judged to be the best (see Appendix 2).

### Results and discussion

As we expected, the tendency to change an exceptional action to be like the usual action was observed: Participants' counterfactual thoughts focused more often on the usual small bet than on the medium bet in the control group (50% vs. 20%), $\chi^2(1) = 3.86$, $p = .050$, as Table 4 shows. The result shows that people changed an exceptional action to be like the usual action, rather than like an exceptional alternative, when the exceptional alternative did not lead to a better outcome, even though they judged a priori that the exceptional alternative was the best action to take.

Interestingly, in the prior-reasoning group, participants' counterfactual thoughts did not tend to focus frequently on either the small or the medium bet (20% vs. 17%), $\chi^2(1) = 0.091$, $p = .760$. Participants in the control group said "if only he'd placed his usual small bet" more often than did those in the prior-reasoning group (50% vs. 20%), $\chi^2(1) = 3.86$, $p = .050$, and they focused on the bets more so than on external factors (70% vs. 30%), $\chi^2(1) = 4.80$, $p = .028$. In contrast, participants in the prior-reasoning group focused on external factors more often than did those in the control group (63% vs. 30%), $\chi^2(1) = 3.57$, $p = .059$, and they focused on external factors more so than on the bets (63% vs. 37%), $\chi^2(1) = 2.13$, although the difference was not significant ($p = .144$). These notable differences between the prior-reasoning and control groups occurred when the actor carried out an exceptional action, which participants had judged to be unjustified (placing the large bet). The outcome would not have changed from a loss to a win if he had carried out the justified exceptional action or the usual action. In this situation, prior thinking about the best decision (the medium bet) leads participants to shift their focus to external factors—for example, "if he had had better cards . . . ,""if he had not played . . ." (e.g., Girotto et al., 2007; Markman & Tetlock, 2000).

In the next experiment, we again show that the tendency can be reversed: People create counterfactuals that change an exceptional action to be like the exceptional alternative, instead of the usual action, when the exceptional alternative leads to a better counterfactual outcome.

## Experiment 5: An exceptional action is changed to an exceptional alternative with a better outcome

In the present experiment, the actor again chose an exceptional and unjustified action (the large bet). However, in this version, the actor had better cards than the large-bet player, and so the actor *won*:

> Action: Actor places exceptional large bet.
> Outcome: Large-bet player plays.
> Actor has better cards than large-bet player.
> Actor wins.

A counterfactual can be created by changing the actor's exceptional action to be like the usual action:

> Counterfactual action: Actor places usual small bet.
> Counterfactual outcome: Large-, medium-, and small-bet players play.
> Actor has better cards than large-bet player.
> Unknown whether actor has better cards than medium- or small-bet player.
> Actor either loses (small amount) or wins.

Another counterfactual can be created by changing the actor's exceptional action to be like the exceptional alternative:

> Counterfactual action: Actor places exceptional medium bet.
> Counterfactual outcome: Large- and medium-bet players play.
> Actor has better cards than large-bet player.
> Unknown whether actor has better cards than medium-bet player.
> Actor either loses (medium amount) or wins.

The counterfactual outcome from the exceptional alternative is better than that from the usual action in that, for the exceptional alternative, it is unknown whether the actor has better cards than one other player, whereas for the usual action, it is unknown whether the actor has better cards than two other players. Hence, we predicted that participants would change the exceptional action to be like the exceptional alternative, rather than like the usual action.

In this scenario, the actor wins. People can create counterfactuals after good outcomes, particularly dramatic ones. For example, when a person wins an unexpected prize at their supermarket, they may think, "I wouldn't have won if I hadn't run out of milk this morning," and their feelings of good fortune and luck are elevated (e.g., Byrne, 2005; Roese & Olson, 1995b). The factors that they focus on after a good outcome are similar to those after a bad outcome; for example, people change actions more than inactions (Byrne & McEleney, 2000; Landman, 1987).

## Method

### *Participants, design, and procedure*

The 72 participants were students from Trinity College Dublin, who took part voluntarily (34 men and 38 women). Their ages ranged from 18 to 60 years (and the average age was 27 years). They were assigned at random to two groups, control and prior easoning ($n$ = 36 in each). The design and procedure were the same as the previous experiments.

### *Materials*

Participants were given the same scenario as in the previous experiment. The outcome was described as follows:

> Peter had better cards than the large-bet player, so Peter wins the game and receives €60 (the large-bet player's €30 + Peter's €30 = €60).

The results of the materials test confirmed that participants judged the medium bet to be the best bet and that the large bet and small bet were not judged to be the best (see Appendix 2).

### Results and discussion

As was expected, participants' counterfactual thoughts focused more often on the exceptional alternative bet than on the usual bet (control, 53% vs. 19%, $\chi^2(1) = 5.54$, $p = .019$; prior reasoning, 33% vs. 17%, $\chi^2(1) = 2.00$, although the latter difference was not significant, $p = .157$), as Table 4 shows. The result shows that people change an exceptional action to be like the exceptional alternative, rather than the usual action, when the counterfactual outcome from the exceptional alternative is better than that from the usual action.

Participants imagined a counterfactual alternative in which the player won more money ("if he had placed the medium bet, he could have won €40"). Of the counterfactual thoughts that focused on the medium bet, 78% of them specified that the medium bet could have brought about a better outcome, more than imagined it to bring about a worse outcome (6%), $\chi^2(1) = 1.08$, $p = .001$, and more than did not specify what effect the medium bet would have had (16%), $\chi^2(1) = 1.08$, $p = .001$.

Participants' counterfactual thoughts focused on the bets more so than on external factors in both groups (control,78% vs. 22%, $\chi^2(1) = 11.11$, $p < .001$; prior reasoning, 64% vs. 36%, $\chi^2(1) = 2.78$, although the latter result was marginal, $p = .096$), and there was no difference between the groups in their focus on the bets (78% vs. 64%), $\chi^2(1)$ 0.49, $p = .484$. Participants said "if only he'd placed the medium bet" equally often in the control group and the prior-reasoning group (53% vs. 33%), $\chi^2(1) = 1.58$, $p = .209$.

## General discussion

The experiments show that people create counterfactual thoughts that change an exceptional action to be like an exceptional alternative action, rather than to be like a usual action, when the exceptional alternative would lead to a better outcome. In the novel card game scenario, an exceptionality effect is observed—people create a counterfactual alternative that changes the exceptional action to be like the usual one—when the usual action would lead to a better outcome, as Experiment 1 shows (Kahneman & Tversky, 1982). The effect is eliminated—people create a counterfactual alternative that changes the exceptional action to be like the exceptional alternative as often as to be like the usual action—when either one would lead to a better outcome, as Experiment 2 shows. And the effect is reversed—people create a counterfactual alternative that changes the exceptional action to be like the exceptional alternative—when only the exceptional alternative would lead to a better outcome, as Experiment 3 shows. Their counterfactual thoughts change an exceptional action to be like an exceptional alternative action even though the exceptional alternative is considered a priori to be an unjustified action.

Recall that following a bad outcome, e.g., Mr. Jones is injured in a car accident, individuals do not create counterfactuals that change an exceptional action, e.g., Mr. Jones drove home by the scenic route, to be like the usual action when the exceptional action is justified, e.g., he wanted to collect medicine for his sick wife (Bonnefon et al., 2007). In this context, the demonstration in Experiment 3 that participants create counterfactuals that change the exceptional bet to be like the other exceptional alternative is analogous to individuals creating counterfactuals that change Mr. Jones's exceptional action to be like an exceptional alternative, e.g., Mr. Jones drove home by a shortcut, even though they considered the shortcut to be unjustified a priori, because they have found subsequently that it leads to a better outcome, e.g., he could have collected medicine on this route and would not have been in a car accident. The result is akin to a hindsight shift (Sanna, Schwarz & Stocker, 2002); it could be viewed as a judgment that the counterfactual end justifies the means, in that the exceptional alternative is considered to be unjustified at the outset but becomes the most desirable alternative when it is known, with hindsight, that its outcome would have been better.

And conversely, people change an exceptional action to be like the usual one when the exceptional alternative would not lead to a better outcome, even when the exceptional alternative is judged a priori to be justified, as Experiment 4 showed. They change the exceptional action to be like the exceptional alternative when it would lead to a better outcome, as Experiment 5 showed. The five experiments show that the optimality of the

counterfactual outcome takes precedence over both the normality of the action and its justifiability (Bonnefon et al., 2007; Kahneman & Tversky, 1982).

The demonstration that the usual action is dwelt on in counterfactual thoughts even when it is not considered justified a priori has important consequences for the consideration of the, at times dysfunctional, nature of counterfactual thoughts (Davis et al., 1995). It suggests that people may wish that they had carried out an action even though they know it could not have been considered in advance to be a good decision to do so. The finding that an action is dwelt on in counterfactual thoughts even though it was not considered a priori to be a good action to take is consistent with the view that one of the sources for the tendency to regret actions or inactions is that people forget or fail subsequently to take into account their original reasons for choosing the action or inaction (Gilovich & Medvec, 1995). It suggests, in this case, that people may regret not carrying out a usual action because they fail to take into account that it was not a good decision a priori to choose the usual action.

The exceptionality effect has been demonstrated in scenarios in which the outcome is so bad (e.g., Mr Jones dies) that it is difficult to imagine a worse outcome, and so people naturally create counterfactual alternatives with better outcomes (Kahneman & Tversky, 1982). Our experiments examined the exceptionality effect in scenarios in which it was possible to imagine either a worse outcome (losing more money) or a better outcome (winning or losing less money). The experiments also demonstrated an exceptionality effect for known counterfactual outcomes, as well as unknown ones. However, the experiments suggest that exceptionality plays no separate role in determining counterfactual thoughts when it is varied independently of the optimality of the outcome.

The gambling scenarios used in our experiments differ from scenarios such as the car accident one in several respects and are likely to prompt different sorts of inferences. A notable difference is that the card game scenarios allow the justifiability of the usual and exceptional actions to be controlled objectively. Reasons for actions are important in counterfactual thought (Bonnefon et al., 2007; Quelhas & Byrne, 2003; Walsh & Byrne, 2007), but the goal of creating a better outcome is a strong guide to which aspect of reality is changed when people create a counterfactual alternative to it.

The experiments revealed few differences between participants who were asked to explain what the best bet was for the actor, and so had to think explicitly about the best strategy, and those who were not asked to do so. These participants performed similarly, except in one case: When the actor carried out an exceptional action that participants had judged a priori to be unjustified, participants who had thought about the best strategy tended to focus their counterfactual thoughts on external factors.

In all the experiments, participants judged the medium bet to be the best bet, and they rarely considered the small bet or the large bet to be the best bets. The result indicates that participants relied on a potential gains calculation of how much they could win in this scenario, rather than focusing on how much they might lose or calibrating their potential gains and losses.

The results indicate that people attempt to construct counterfactuals with better outcomes, and they are consistent with the view that counterfactual thinking is goal directed (Byrne, 2002, 2007; Epstude & Roese, 2008; Roese et al., 2005). When the optimality of the counterfactual outcome is weighed against the exceptionality and a priori justifiability of the action, people are guided by their judgments that the changed action will lead to a better counterfactual outcome.

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## Appendix 1

(i) The scenario used in the experiments

Peter is faced with a dilemma when playing a game of cards. The cards given to him give him a great chance of winning the game, and with that, a great chance of winning money. Peter alone knows the values of the cards he holds. However Peter can only win money if the other players in the game decide to play with Peter by matching the bet he makes. If none of the other players decide to play with Peter by betting, all the players will surrender their cards and receive new cards. Peter knows new cards will probably not give him such a great chance of winning.

Peter has good cards. Peter usually places a small bet. However there are actually three choices available to Peter. Peter can bet small, medium, or large. These three values are related to how much money Peter is willing to bet in the game.

Peter is playing with three other players who each use three separate and distinct techniques for playing the game. These techniques have earned them the names of The Mouse, The Lion, and The Jackal. The Mouse only plays small bets, the Lion plays small and medium bets, and the Jackal plays small, medium and large bets. Each of the players' individual techniques means that they will each respond differently to Peter's betting actions.

Peter's cards are very good. However, how much Peter bets has consequences. Betting small, medium or large will

affect the reactions of the three opposition players in different manners, as follows:

If Peter bets small, his bet will be €10. This will result in probably all three opposition players matching his bet. (Peter's €10 matched by Mouse's €10 + Lion's €10 + Jackal's €10)

If Peter bets medium, his bet will be €20. This will result in probably only the Lion and the Jackal matching his bet. (Peter's €20 matched by Lion's €20 + Jackal's €20)

If Peter bets large, his bet will be €30. This will result in probably only the Jackal matching his bet. (Peter's €30 matched by Jackal's €30)

(ii) The decisions and outcomes used in the experiments

Experiment 1: Medium bet (small bet optimal)
*Decision described as follows:*

Peter thought about his choices carefully. He considered betting small, a bet of €10, as he usually does. He then considered a large bet of €30. Then Peter considered the medium bet, he decided to go with the medium bet of €20.
Peter's medium bet meant that the Mouse decided not to play with him, so the Mouse did not place a bet. The Lion and the Jackal decided to play with Peter by matching Peter's bet of €20.

*Outcome described as follows:*

The Jackal had better cards than Peter and the Lion, so the Jackal wins the game and receives €60 (The Jackal €20 + the Lion's €20 + Peter's €20 = €60).

Experiment 2: Medium bet (large, small bets optimal)
*Decision described as above. Outcome described as follows:*

The Lion had better cards than Peter and the Jackal, so the Lion wins the game and receives €60 (The Jackal's €20 + Peter's €20 + the Lion's €20 = €60).

Experiment 3: Medium bet (large bet optimal)
*Decision described as above. Outcome described as follows:*

Peter had better cards than the Jackal, but the Lion had better cards than Peter and the Jackal, so Peter and the Jackal lose the game along with their bets of €20 (The Jackal's €20 + Peter's €20 + Lion's €20 = So Lion wins €60).

Experiment 4: Large bet (small bet optimal)
*Decision described as follows:*

Peter thought about his choices carefully. He considered betting small, a bet of €10, as he usually does. He then considered a medium bet of €20. Then Peter considered the large bet, he decided to go with the large bet of €30. Peter's large bet meant that the Mouse and the Lion decided not to play with him, so neither the Mouse nor the Lion placed a bet. So the Jackal decided to play with Peter by matching Peter's bet of €30.

*Outcome described as follows:*

The Jackal had better cards than Peter, so the Jackal wins the game and receives €60 (The Jackal's €30 + Peter's €30 = €60).

Experiment 5: Large bet wins (medium bet optimal)
*Decision described as above. Outcome described as follows:*

Peter had better cards than the large-bet player, so Peter wins the game and receives €60 (The large-bet player's €30 + Peter's €30 = €60).

## Appendix 2

*Experiment 2 materials test* Participants in the prior-reasoning group answered the question "*explain what you think is the best decision for Peter*" by judging that the best decision was to place the medium bet rather than the small bet (67% vs. 17%), $\chi^2(1) = 9.00$, $p = .003$, or the large bet (67% vs. 17%), $\chi^2(1) = 9.00$, $p = .003$, as Table 2 shows. Participants in both the prior-reasoning group and the control group answered the question "*What size bet do you think Peter places?*" by judging that Peter would place the medium bet more often than the small bet [control, 70% vs. 17%,$\chi^2(1) = 9.85$, $p = .002$; prior reasoning, 57% and 30%, $\chi^2(1) = 2.46$, although the latter difference was not significant, $p = .117$], as Table 3 shows. There were no reliable differences between the judgments of the prior-reasoning group and the control group in predictions that Peter would place a small bet (30% vs. 17%), $\chi^2(1) = 1.14$, $p = .285$, or a medium bet (57% vs. 70%), $\chi^2(1) = 0.42$, $p = .516$. Participants in both groups predicted the medium bet more than the large bet (control, 70% vs. 13%, $\chi^2(1) = 11.56$, $p = .001$; prior reasoning, 57% vs. 13%, $\chi^2(1) = 8.05$, $p = .005$).

*Experiment 3 materials test* Participants in the prior-reasoning group answered the question "*explain what you think is the best decision for Peter*" by judging that the best decision was to place the medium bet, rather than to place the large bet or the small bet [53% vs. 6%, $\chi^2(1) = 10.89$, $p = .001$; 53% vs. 40%, $\chi^2(1) = 0.571$, although the latter difference is not significant, $p = .450$], as Table 2 shows. Participants in both the prior-reasoning group and the control group answered the question "*What size bet do you think Peter places?*" by judging that Peter would place the medium bet

more often than the small bet [control, 77% vs. 17%, $\chi^2(1) = 11.57$, $p = .001$; prior reasoning, 57% vs. 37%, $\chi^2(1) = 1.29$, although the latter difference is not significant, $p = .257$], and the medium bet more than the large bet [prior reasoning, 57% vs. 7%, $\chi^2(1) = 11.84$, $p = .001$; control, 77% vs. 7% $\chi^2(1) = 17.64$, $p < .001$], as Table 3 shows.

*Experiment 4 materials test* Participants in the prior-reasoning group answered the question "*explain what you think is the best decision for Peter*" by judging that the best decision was to place the medium bet, rather than to place the small bet (80% vs. 20%%), $\chi^2(1) = 10.80$, $p = .001$, or the large bet (and in fact, noone judged that the best decision was to place the large bet), as Table 2 shows. Participants in both the prior-reasoning group and the control group answered the question "*What size bet do you think Peter places?*" by judging that Peter would place the medium bet more often than the small bet [control, 63% vs. 20%, $\chi^2(1) = 6.76$, $p = .009$; prior-reasoning, 70% vs. 20%, $\chi^2(1) = 8.33$, $p = .004$], and the medium bet more than the large bet [control, 63% vs. 17%, $\chi^2(1) = 8.20$, $p = .004$; prior-reasoning, 70% vs. 10%, $\chi^2(1) = 13.50$, $p < .001$], as Table 3 shows.

*Experiment 5 materials test* Participants in the prior-reasoning group answered the question "*explain what you think is the best decision for Peter*" by judging that the best decision was to place the medium bet or, equally, the small bet (44% vs. 50%), $\chi^2(1) = 0.12$, $p = .732$; few participants judged the large bet to be best [medium vs. large, 44% vs. 6%, $\chi^2(1) = 1.08$, $p = .001$; small vs. large,50% vs. 6%, $\chi^2(1) = 1.08$, $p = .001$], as Table 2 shows. Participants in both the prior-reasoning group and the control group answered the question "*What size bet do you think Peter places?*" by judging that Peter would place the medium bet more often than the small bet [control, 75% vs. 22%,$\chi^2(1) = 10.31$, $p = .001$; prior-reasoning, 53% vs. 39%, $\chi^2(1) = 0.758$, although this difference is not significant, $p = .380$] and the medium bet more than the large bet [control, 75% vs. 3%, $\chi^2(1) = 24.14$, $p < .001$; prior-reasoning, 53% vs. 8%, $\chi^2(1) = 11.64$, $p = .001$], as Table 3 shows.

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