Memory & Cognition
2000, 28 (2), 264-281

The temporality effect in counterfactual thinking about what might have been

RUTH M. J. BYRNE
University of Dublin, Trinity College, Dublin, Ireland

SUSANA SEGURA
University of Malaga, Malaga, Spain

RONAN CULHANE
University of Dublin, Trinity College, Dublin, Ireland

ALESSANDRA TASSO
University of Padua, Padua, Italy

and

PABLO BERROCAL
University of Malaga, Malaga, Spain

When people think about what might have been, they undo an outcome by changing events in regular ways. Suppose two contestants could win $1,000 if they picked the same color card; the first picks black, the second red, and they lose. The *temporality effect* refers to the tendency to think they would have won if the second player had picked black. Individuals also think that the second player will experience more guilt and be blamed more by the first. We report the results of five experiments that examine the nature of this effect. The first three experiments examine the temporality effect in scenarios in which the game is stopped after the first contestant's card selection because of a technical hitch, and then is restarted. When the first player picks a different card, the temporality effect is eliminated, for scenarios based on implicit and explicit negation and for good outcomes. When the first player picks the same card, the temporality effect occurs in each of these situations. The second two experiments show that it depends on the order of events in the world, not their descriptive order: It occurs for scenarios without preconceptions about normal descriptive order; it occurs whether the second event is mentioned in second place or first. The results are consistent with the idea that the temporality effect arises because the first event is presupposed and so it is immutable; and the elimination of the temporality effect arises because the availability of a counterfactual alternative to the first event creates an opposing tendency to mutate it. We sketch a putative account of these effects based on characteristics of the mental models people construct when they think counterfactually.

Many everyday thoughts rely on imaginative skills, especially when people think about how the past could have been different. These *counterfactual* suppositions can be close to the actual situation, for example,

> If I had taken the side road, I would have avoided the traffic jam. (1)

Or they may be remote, for example,

> If I had studied physics, I would have become a great astronaut. (2)

People generate counterfactuals in response to both dramatic life events and more mundane outcomes commonly encountered in day-to-day living (see, e.g., Hofstadter, 1985; Kahneman & Miller, 1986; Roese, 1997). Our aim in this paper is to report the results of five experiments that examine some of the cognitive mechanisms underlying counterfactual thinking.

A primary cognitive role of counterfactual thinking may be that it helps individuals to learn from mistakes (see, e.g., Kahneman & Miller, 1986; Roese, 1994) by supporting postmortems about how the world might have turned out, or more speculative conjectures (see, e.g., Kahneman & Varey, 1990; Lewis, 1973). Counterfactual thinking can help set up intentions to improve (Markman, Ga-

We thank Vittorio Girotto, Phil Johnson-Laird, Mark Keane, Rachel McCloy, Alice McEleney, John Miyamoto, David O'Brien, and Bobbie Spellman for their comments on aspects of this research. The research was supported in part by a grant from the Ministry of Education, Spain, and by awards from the Dublin University Arts and Social Sciences Benefactions Fund. The results of some of the experiments were presented at the International Workshop on Reasoning and Decision Making at the University of Siena, 1995, and the Seventeenth Annual Conference of the Cognitive Science Society in Pittsburgh, 1995. Correspondence should be addressed to R. M. J. Byrne, Department of Psychology, University of Dublin, Trinity College, Dublin 2, Ireland (e-mail: rmbyrne@tcd.ie).

vanski, Sherman, & McMullen, 1993; Roese, 1994), and it bears a relation to judgments of causality and preventability (see, e.g., Chisholm, 1946; Goodman, 1973; McEleney & Byrne, in press). It has been linked with feelings such as regret and elation (see, e.g., Gilovich & Medvec, 1994; Johnson, 1986; Landman, 1987) and judgments such as blame and equity (see, e.g., Macrae, 1992; D. T. Miller & McFarland, 1986).

Most research on counterfactual thinking has focused on establishing the aspects of the actual situation that people tend to undo in order to construct a counterfactual scenario. For example, when people think about how an outcome might have turned out differently, they tend to undo exceptional aspects, such as actions that are unusual for the specified individual rather than actions that are routine (Kahneman & Tversky, 1982; see also Bouts, Spears, & van der Pligt, 1992; Gavanski & Wells, 1989). They also tend to undo the first cause in a causal sequence rather than subsequent causes (e.g., Wells, Taylor, & Turtle, 1987), and actions of a focal individual rather than actions of an individual in the background (Kahneman & Tversky, 1982). In addition, they tend to undo actions that an individual carried out rather than inactions (e.g., Kahneman & Tversky, 1982; Landman, 1987), at least in the short term (Byrne & McEleney, 1997; Gilovich & Medvec, 1994), and they undo actions under a person's voluntary control rather than those outside his/her control (see, e.g., Girotto, Legrenzi, & Rizzo, 1991). Corresponding to these patterns of undoing is often a pattern of emotional amplification, where the more mutable an individual's actions are judged to be, the more intense emotion the individual is judged to experience, for example, of guilt, regret, or elation (see, e.g., Kahneman & Miller, 1986). These tendencies give hints about the "joints" of reality (Kahneman & Tversky, 1982), where reality is at its most "slippable" (Hofstadter, 1985), and these junctures may correspond to some core categories of mental life (G. Miller & Johnson-Laird, 1976), such as space, time, cause, and intention (Byrne, 1997).

What cognitive mechanisms give rise to this pattern of mutability? Whatever their nature, they satisfy the important constraint that counterfactual scenarios contain *minimal* mutations to reality: To make sense, an imaginary scenario needs to be similar to or accessible from the actual situation (see, e.g., Lewis, 1973; Pollock, 1986; Stalnaker, 1968). Moreover, thinking about what might have been is often directed to the goal of constructing an *effective* alternative scenario, rather than one in which events are mutated but the same outcome still occurs (see, e.g., McCloy & Byrne, in press; Wells & Gavanski, 1989). Most researchers agree that the mutability of an element in a representation depends on how easy it is to think of alternatives to it (e.g., Roese, 1997; Roese & Olson, 1995), which may in turn depend on an availability heuristic—people may base their judgments on the ease with which instances can be brought to mind (Kahneman & Tversky, 1982). Different sorts of changes can be made with differential ease: "Downhill" changes based on the deletion of unlikely events may be easier than "uphill" changes based on the addition of unlikely events (Kahneman & Tversky, 1982; see also Dunning & Parpal, 1989; Roese, 1994). It may be easier to alter elements present in a representation because they can recruit their own alternatives on the basis of their correspondence to the norms of the situation; for example, an exception may retrieve its corresponding norm (Kahneman & Miller, 1986). Alternatively, elements represented explicitly may be focused on because they are in the foreground (see, e.g., Byrne, 1997; Kahneman & Tversky, 1982; Legrenzi, Girotto, & Johnson-Laird, 1993).

The Temporality Effect

The experiments we will report address the *temporality effect*: the tendency to undo mentally the more recent event in a sequence of independent events. Kahneman and Miller (1986) found that when participants were given an ordered sequence of letters (e.g., *xf*) on a computer screen and were asked to quickly replace one, they tended to mutate, that is, to undo mentally, the second letter in the sequence. D. T. Miller and Gunasegaram (1990, p. 1111) reported the following scenario:

> Imagine two individuals (Jones and Cooper) who are offered the following very attractive proposition. Each individual is asked to toss a coin. If the two coins come up the same (both heads or both tails), each individual wins £1,000. However, if the two coins do not come up the same, neither individual wins anything. Jones goes first and tosses a head; Cooper goes next and tosses a tail. Thus, the outcome is that neither individual wins anything. (3)

Almost 90% of their participants considered that it was easier to undo the outcome by the alternative of Cooper tossing a head, rather than Jones tossing a tail. They also judged that Cooper would experience more guilt, and would tend to be blamed more by Jones. Logically, of course, neither party should be considered more mutable, or more likely to experience any more guilt or desire to blame than the other since the event is one of chance. Although people tend to undo the first event in a causal sequence (Wells et al., 1987), they undo the more recent event in an independent sequence of events—that is, a sequence of events that are not causally related (e.g., Jones's toss of heads does not cause Cooper's toss of tails).

D. T. Miller and Gunasegaram (1990) showed that the temporality effect occurs in everyday situations as well—for example, when people consider how a student who failed an examination might have passed. Their participants tended to wish that a different list of examination questions had been set when they believed the questions had been set after they (as students) had prepared for the examination, whereas they wished their preparation had been different when they believed it had been done after the questions were set (i.e., they undid the second event in each case). The temporality effect also occurs for sequences of more than two events; for example, when people think about how a baseball team might have done better in a series of 10 games, they mentally undo the 10th baseball game (which the team lost), regardless of the outcomes of the previous nine games (Sherman & McConnell, 1996). The temporality tendency may play a role in many everyday judgments, such as the tendency for blackjack players to be averse to playing on the last box, for teams to sport their faster runner last in a relay race, and for people to wager more on their predictions than their postdictions (D. T. Miller & Gunasegaram, 1990; Kahneman & Miller, 1986). Our aim in the five experiments we report is to elucidate further the factors that guide the decision to undo the more recent event in an independent sequence of events.

INTERRUPTED TEMPORAL SEQUENCES

We report two series of experiments: In the first series of experiments we show that it is possible to reduce and even eliminate the temporality effect by interrupting the temporal sequence of events (see, e.g., Byrne, Culhane, & Tasso, 1995). We devised a scenario in which two contestants take part in a game show in which there is a technical hitch:

> Imagine two individuals (Jones and Brady) who take part in a television game show, on which they are offered the following very attractive proposition. Each individual is given a shuffled deck of cards, and each one picks a card from his own deck. If the two cards they pick are of the same color (i.e., both from black suits or both from red suits), each individual wins £1,000. However, if the two cards are not the same color, neither individual wins anything.
>
> Jones goes first and picks a black card from his deck. At this point, the game show host has to stop the game because of a technical difficulty. After a few minutes, the technical problem is solved and the game can be restarted. Jones goes first again, and this time the card that he draws is a red card. Brady goes next and the card that he draws is a black card. Thus, the outcome is that neither individual wins anything. (4)

We examine the effects on the temporality effect of this interruption to the temporal sequence in the first series of three experiments.

Experiment 1
Interruptions and the Temporality Effect

The technical hitch device allows us to interrupt the temporal sequence of events with different consequences. In the different-card version of the story, the first player's post-hitch selection was different from his pre-hitch selection: Jones picked black first and then red, Brady picked black, and they lost. We also constructed a same-card story in which the first player's post-hitch selection was the same as his pre-hitch selection: Jones picked black first and then black again; Brady picked red, and they lost.

The temporality effect may arise because the earlier event in the sequence is presupposed or taken for granted more than later events (D. T. Miller & Gunasegaram, 1990). As a result of its being presupposed, the first event is immutable. It should be possible to shake loose this presupposition and render the first event mutable by making explicitly available a counterfactual alternative to the first event. People readily tend to undo events for which there are explicit counterfactual alternatives available (see, e.g., Branscombe, Owen, Garstka, & Coleman, 1996; Wells & Gavanski, 1989). The different-card version of the technical hitch scenario contains the first player's pre-hitch play as an available alternative to the first player's post-hitch play. According to this account, the presupposition of the first event and the availability of a counterfactual alternative to it act as opposing determinants of the mutability of that event, and as a result, the temporality effect should be reduced or eliminated in the different-card version.

An alternative possibility is that the temporality effect arises because the more recent event is "fresh" in working memory, or more available to a backward search through the entries. D. T. Miller and Gunasegaram (1990) briefly considered the possibility that "later events in a temporal sequence may be assigned more causal responsibility because they are more available in memory" (p. 1117), and it is at least a reasonable conjecture that people mutate an event in an independent sequence of events by using a backward search strategy that encounters the most recent entry first (see, e.g., Wells et al., 1987). If the temporality effect arises because the more recent event is more available in working memory, the effect should be observed in both the same-card and the different-card scenario: The second player's play is most recent in either version of the story.

Method

Materials and Design. We constructed two versions of the technical hitch scenario on the basis of the story described earlier. In the same-card version, the first player drew black on both occasions, and the second player drew red (see the Appendix). In the different-card version, the first player drew black on the first occasion, and red on the second occasion, and the second player drew black. The two versions of the story were identical but for the presence of the word *black* or *red* in the description of the post-hitch choice of the first individual, and accordingly, the presence of the word *black* or *red* in the description of the choice of the second player.

The participants' first task was to complete the following sentence: "Jones and Brady could each have won £1,000 if only one of them had picked a different card, for instance if . . ." They were also asked the question, "Who would you predict would experience more guilt—Jones or Brady?" Finally, they were asked the question: "Who will blame the other more—Jones or Brady?" Each participant completed one of the two versions of the story in a between-subjects design. They answered each of the three questions, which were printed in the fixed order presented above, and they wrote their answers in the spaces provided on the sheet of paper.

Participants and Procedure. The 75 participants were undergraduate students from different departments in the University of Dublin, Trinity College, who participated in the experiment voluntarily. They were assigned at random to the same-card condition ($n = 39$) or to the different-card condition ($n = 36$). They were tested in several groups. They were presented with a booklet that contained the instructions, the story, the three questions, and a debrief-

Table 1
Percentages of Mutations of Each Event, and of Judgments of Guilt and Blame in Experiment 1

	Description	
Selections	Black . . . hitch Black . . . Red (same card)	Black . . . hitch Red . . . Black (different card)
Undoing choice		
First event only	8	19
First then second	15	22
Overall first	23	42
Second event only	51	39
Second then first	8	5
Overall second	59	44
Total	82	86
Guilt		
First	10	31
Second	77	44
Neither	8	22
Blame		
First	51	50
Second	13	25
Neither	26	19
n	39	36

Note—The percentages are based on the responses of participants to one scenario each. First event only, participants undid the first event only; first then second, participants undid the first event, and then the second one; second event only, participants undid the second event only; second then first, participants undid the second event, and then the first one.

ing paragraph, each on separate pages. The instructions were as follows: "You are asked to read the scenario on the next page, and then to answer some simple questions. Please answer the questions in the order in which they are asked. Also please do not change an answer to a question once you have written it." The participants worked at their own pace and wrote their answers in the spaces provided on the sheet.

Results and Discussion

"If only . . ." mutations. The results show that for participants whose undoings focused on a single event, in the same-card condition the standard temporality effect was observed in that more participants undid the second event rather than the first (51% vs. 8%, binomial $n = 23$, $k = 3$, $p < .0005$), whereas in the different-card condition the effect was considerably reduced (39% vs. 19%, binomial $n = 21$, $k = 7$, $p < .095$). The 43% difference (between 51% choosing the second event and 8% choosing the first event in the same-card condition) was narrowed by half to just 20% of a difference (between 39% and 19% in the different-card condition, Meddis, 1984, quicktest $z = 1.58$, $n = 44$, $p < .10$).

Table 1 presents the percentages of undoings of the first event or the second overall, and the breakdown of these undoings into those that undid only one event (e.g., "If only Jones had picked a red card") and those that undid one event and posed the other as an alternative (e.g., "If only Jones had picked a red card or Brady had picked a black card"). We combined the two sorts of responses in a second analysis on the basis that the order of mention gives us a clue to the mutability of an event. For undoings focused on the first or second events or both, in the same-card condition the standard temporality effect was observed (59% vs. 23%, binomial $n = 32$, $k = 9$, $p < .01$), whereas in the different-card condition the effect was eliminated (44% vs. 42%, binomial $n = 31$, $k = 15$, $p < .50$); this interaction was reliable ($n = 63$, Meddis quicktest $z = 1.64$, $p < .05$). Order of mention may be vulnerable to other influences, but it is important to note that a similar pattern of results occurs when mutations of a single event or one event followed by another are analyzed.

Overall, most people undid the first, the second, or both events (84% overall), with the majority of the remainder containing simple errors (e.g., the answer "if only Jones had picked a black card" when in fact Jones *had* picked a black card). Few participants mentioned other factors (e.g., "if only the technical hitch had not occurred"), perhaps unsurprisingly given the deliberately constrained nature of the sentence they were asked to complete.

Judgments of guilt and blame. We found a similar pattern of results for the answers to the question about guilt, as Table 1 shows. For the participants who judged that one or other of the individuals would experience more guilt, more participants believed the second player would feel guilt rather than the first in the same-card version (77% vs. 10%, binomial $n = 34$, $k = 4$, $p < .0005$), but not in the different-card version (44% vs. 31%, binomial $n = 27$, $k = 11$, $p < .22$); the interaction was reliable ($n = 61$, Meddis quicktest $z = 2.59$, $p < .005$). Most participants judged that one or other of the players would feel more guilt (81%), with the majority of the remainder indicating that neither would experience more guilt (15%).

For the participants who judged that one or other of the individuals would be blamed more, in the same-card version more participants considered that the first player would blame the other, rather than the other way around (51% vs. 13%, binomial $n = 25$, $k = 5$, $p < .002$); unexpectedly, in the different-card version more participants also seemed to believe that the first player would blame the other (50% vs. 25%), although the effect was weaker (binomial $n = 27$, $k = 9$, $p < .061$); there was no interaction ($n = 52$, Meddis quicktest $z = 1.07$, $p > .10$). Most participants thought that either one or other of the players would blame the other more (70%), with the majority of the remainder indicating that neither would (23%). We will return to the anomalous results for the experience of blame in the next experiment.

The results are consistent with the suggestion that the temporality effect arises because earlier events in an independent sequence are presupposed more than later events. This presupposition can be countered by the availability of a ready-made counterfactual alternative—the pre-hitch play in the different-card scenario. The two opposing tendencies result in the reduction of the temporality effect: Some of the participants' judgments are guided by the presupposed earlier event to focus on the second player and exhibit a temporality effect, and some are guided by the available counterfactual to focus on the first player instead.

Alternative explanations. The results show that the temporality effect is demonstrated most strongly when the first player's post-hitch selection is the same as the pre-hitch selection. The results rule out a number of alternative explanations. They rule out an explanation of the temporality effect in terms of the more recent event being "fresh" in working memory, or more available to a backward search through the entries. If recency accounted for the temporality effect, the effect should continue to be observed even in the different-card scenario. In these technical hitch scenarios, participants are essentially presented with three events, of which only the latter two contribute to the outcome. In the same-card condition, the first two events are identical and participants view the third as more mutable; in the different-card condition, the three events differ and participants view the second and third as similarly mutable. The point to note is that participants do not view as more mutable the more recent event (the third one) in both scenarios.

The results also rule out an explanation based on setting up expectations about how the game can be won. In the different-card version, the pre-hitch choice of the first player of a black card may set up the expectation that to win requires the second player to choose black as well. But the post-hitch choice of the first player of a red card would revise that expectation. If expectations accounted for the temporality effect, it should continue even in the different-card version. Individuals may set up expectations about how the game may be won, and these may be related to their understanding of the context, but the choice of counterfactual alternatives does not depend on precomputed expectations (Kahneman & Miller, 1986).

The results also go against the suggestion that the temporality effect arises because participants perceive the second player to have a greater causal role, following their calculation of the probability of a good outcome after each player's contribution (Spellman, 1997). In D. T. Miller and Gunasegaram's (1990) coin toss scenario, the probability of a good outcome is 50:50 before either play; it remains 50:50 after the first player's selection, but after the second player's selection, the probability of a good outcome changes to either 1 or 0. According to this view, people update their probability estimates after each play, and they consider that the second play has a greater causal role because it determines the probability of the outcome more (Spellman, 1997). But, the technical hitch manipulations do not alter the probabilities: The calculation of probabilities remains the same for both the same-card and the different-card conditions. Hence, the probability explanation predicts that the temporality effect should continue even in the different-card condition, and so it does not predict these results.

Finally, the results rule out the alternative explanation that the temporality effect is reduced in the different-card version because participants believe that the technical hitch is associated in some way with the first player's selection rather than the second player's selection. If this association were responsible for the elimination, the temporality effect should be eliminated in the same-card version as well as in the different-card version. Furthermore, note that the sentence completion task was cast in the past tense, which goes against the suggestion that reasoners believe that if they undo the first player's selection, they would necessarily have to undo both players' selections (on the belief that if the first player picks again, the second player would have to pick again also). In any case, if reasoners had such a mistaken belief, it would have manifested itself in both the same-card and the different-card conditions, resulting in a temporality effect being observed in both conditions. In the next experiment we replicate and extend the elimination of the temporality effect.

Experiment 2
Implicit and Explicit Negation

Our aim in the second experiment is to demonstrate the generalizability of the temporality effect to a different linguistic description and essentially to provide a replication of the reduction of the temporality effect in the technical hitch scenario but with a different, more explicit, description. In the previous scenarios, the differences in events were conveyed implicitly; that is, the implicit negation of black is its opposite (in the binary situation of the game), that is, red. Explicit negation, that is, not black, highlights even more the relationship between the pre- and post-hitch events by the use of the common term (black); for example, Jones picks a black card, the technical hitch occurs, and this time the card Jones picks is not black. We constructed scenarios identical to those of the previous experiment except for the use of explicit negation (not black) instead of implicit negation (red). We expect to replicate the elimination of the temporality effect in the different-card scenario. The experiment also allows us to examine again the anomalous effects of the technical hitch scenario on judgments of blame.

Method

Materials and Design. The materials were based on those in the previous experiment, and the only difference was the use of explicit negation instead of implicit negation; that is, a card was described as "not black" instead of "red." Each participant carried out the same sentence completion task described earlier, and answered the same two questions about guilt and blame, in the same fixed order. Each participant completed one of the two versions of the story in a between-subjects design.

Participants and Procedure. The 79 participants were undergraduate students from different departments in the University of Dublin, Trinity College, who participated in the experiment voluntarily. They were assigned at random to the same-card condition (n = 39) and the different-card condition (n = 40). The procedure and instructions were the same as in the previous experiment.

Results and Discussion

"If only . . ." mutations. The results show that for participants whose undoings focused on a single event, in the same-card condition the standard temporality effect was observed in that more participants tended to undo the second event rather than the first (41% vs. 23%), although the difference was weak (binomial n = 25, k = 9,

Table 2
Percentages of Mutations of Each Event, and of Judgments of Guilt and Blame in Experiment 2

Selections	Description: Black . . . hitch / Black . . . Not black (same card)	Black . . . hitch / Not black . . . Black (different card)
Undoing choice		
First event only	23	35
First then second	8	13
Overall first	31	48
Second event only	41	35
Second then first	13	0
Overall second	54	35
Total	85	83
Guilt		
First	13	45
Second	59	33
Neither	21	18
Blame		
First	54	33
Second	13	35
Neither	18	28
n	39	40

Note—The percentages are based on the responses of participants to one scenario each. First event only, participants undid the first event only; first then second, participants undid the first event, and then the second one; second event only, participants undid the second event only; second then first, participants undid the second event, and then the first one.

$p < .115$); in the different-card condition, the effect was entirely eliminated (35% in each case, binomial $n = 28$, $k = 14$, $p < .57$). The 18% difference (between 41% choosing the second event and 23% choosing the first event in the same-card condition) was narrowed to zero in the different-card condition ($n = 53$, Meddis quicktest $z = 1.02$, $p > .15$).

Table 2 presents the percentages of participants' responses that focused on a single event and those that focused on one event followed by another. A second analysis showed that for participants whose undoings focused on the first, the second, or both events, in the same-card condition more participants tended to undo the second event overall rather than the first (54% vs. 31%, although the difference was again weak (binomial $n = 33$, $k = 12$, $p < .08$), whereas in the different-card condition the temporality effect was eliminated (35% vs. 48%, binomial $n = 33$, $k = 14$, $p < .24$). Although it may seem that participants were undoing the first event more than the second in the different-card condition, the apparent reversal of the standard temporality effect did not approach reliability. The interaction was reliable ($n = 66$, Meddis quicktest $z = 1.71$, $p < .05$), as Table 2 illustrates. Most people undid the first, the second, or both events (84% overall), with the majority of the remainder containing simple errors.

Judgments of guilt and blame. A similar pattern of results was found for the answers to the questions with respect to guilt, as Table 2 shows. For participants who judged that one or other individual would experience more guilt, more participants judged that the second player would feel guilt rather than the first in the same-card version (59% vs. 13%, binomial $n = 28$, $k = 5$, $p < .005$), but not in the different-card version (33% vs. 45%), and once again, although the difference tended toward the opposite direction, it did not do so reliably (binomial $n = 31$, $k = 13$, $p < .24$). Most importantly, the interaction was reliable ($n = 59$, Meddis quicktest $z = 3.14$, $p < .001$). Most participants judged that one or other of the players would feel more guilt (75%), with the majority of the remainder indicating that neither would experience more guilt (20%).

The answers to the question of blame show the same pattern, unlike those of the previous experiment. For participants who judged that one or other individual would experience more blame, more participants considered that the first player would blame the other in the same-card version (54% vs. 13%, binomial $n = 26$, $k = 5$, $p < .001$), and this effect was eliminated in the different-card version (33% vs. 35%, binomial $n = 27$, $k = 13$, $p < .50$); the interaction was reliable ($n = 53$, Meddis quicktest $z = 2.45$, $p < .01$). Most participants thought that either one or other of the players would blame the other more (68%), with the majority of the remainder indicating that neither would experience more blame (23%).

The experiment generalizes the temporality effect and its elimination to another linguistic expression of explicit negation rather than implicit negation. It replicates the crucial findings of the first experiment: The temporality effect occurs for the same-card scenarios and it is eliminated for the different-card scenarios, for "if only" mutations, and for judgments of guilt and blame. The experiment failed to replicate the anomalous findings of the first experiment that blame judgments continue to exhibit a temporality effect even in the different-card version. Instead, in this experiment, blame judgments followed the same pattern of "if only" mutation and guilt judgments. Our third experiment aims to generalize the temporality effect further by examining whether or not it occurs for good outcomes.

Experiment 3
Good Outcomes and the Temporality Effect

Various counterfactual phenomena, such as the tendency to mutate exceptional events rather than normal ones, and to undo actions rather than inactions, occur as readily for good outcomes as for bad ones (see, e.g., Gavanski & Wells, 1989; Johnson, 1986; Landman, 1987). The purpose of counterfactual thinking may be for us to learn not only from our bad outcomes but also from our good ones. When things work out well for us and we feel we have been lucky, it is useful to mull over our narrow escapes or happy chances so that we can learn how to repeat them in the future. Is there a temporality effect for situations with good outcomes? The answer is not known, and our aim in the third experiment is to address this

Table 3
Percentages of Mutations and Judgments of Relief in Experiment 3

	Description	
Selections	Red . . . hitch Red . . . Red (same card)	Black . . . hitch Red . . . Red (different card)
Undoing choice		
First only	17	33
First then second	9	4
Overall first	26	37.5
Second only	50	31
Second then first	9	2
Overall second	59	33
Total	85	70.5
Relief		
First	35	44
Second	59	42
Neither	2	13
n	46	48

Note—The percentages are based on the responses of participants to one scenario each. First only, participants undid the first event only; first then second, participants undid the first event, and then the second one; second only, participants undid the second event only; second then first, participants undid the second event, and then the first one.

issue. We presented participants with scenarios identical to those in the previous experiments but in which the players won. We asked them to consider how things could have been worse for the players, and to judge their relief at having won.

One possible explanation for the results of the previous experiments is that reasoners focus on the "odd-one-out" card *color* to mutate because it stands out as a focal event in the foreground against the background of the other events (see Kahneman & Miller, 1986). In the same-card version of the story used in Experiments 1 and 2, the third event contained a different color card from the previous two; in the different-card version, it was the second event that stood out from the other two because it contained a different color. According to this view, the temporality effect should occur only in situations where there *is* an odd-one-out in the color of selections. As a result, it predicts that there should be no temporality effect for *good* or winning outcomes because, by definition, the individuals choose the same color cards. According to the presupposition account of the temporality effect, the earlier event should be presupposed whether the eventual outcome is good or bad. As a result, it predicts a temporality effect for winning outcomes. The experiment tests these two different views. Our second aim in the experiment is to show that the temporality effect can be eliminated in the manner established in the previous experiments. We gave participants a different-card version of the scenario and we expected that any temporality effect would be eliminated in this situation.

Method

Materials and Design. The materials were based on those in the previous experiments, with the difference that the players won the game (see the Appendix). In the different-card version, the first player picks a black card, and the technical difficulty occurs; the first player then picks a red card, the second player picks a red card, and so each player wins £1,000. In the same-card version, the first player picks red both times. Implicit negation was used in the experiment. The participants first carried out the sentence completion task: "After the draw both Jones and Brady reflected on how lucky they had been. After all, if one of them had picked a different card they might neither have won the £1,000; for instance, if . . . ," and then the question about relief: "Who would you predict would experience more relief at having won—Jones or Brady?" Each participant completed one of the two versions of the story in a between-subjects design.

Participants and Procedure. The 94 participants were undergraduate students from a variety of departments in the University of Dublin, Trinity College, who participated in the experiment voluntarily. The participants were assigned at random to the same-card condition ($n = 46$) and the different-card condition ($n = 48$). The procedure was the same as in the previous experiments.

Results and Discussion

"If only . . ." mutations. The results show that for participants whose undoings focused on a single event, in the same-card condition more participants undid the second event rather than the first (50% vs. 17%, binomial $n = 31$, $k = 8$, $p < .005$), whereas in the different-card condition the effect was eliminated (31% vs. 33%, binomial $n = 36$, $k = 15$, $p < .20$); the interaction was reliable ($n = 67$, Meddis quicktest $z = 2.66$, $p < .01$). If we include also participants whose undoings focused on both events, the same pattern is found: In the same-card condition, more participants undid the second event overall than the first (59% vs. 26%, binomial $n = 39$, $k = 12$, $p < .01$), whereas in the different-card condition, the effect was eliminated (33% vs. 37.5%, binomial $n = 34$, $k = 16$, $p < .43$); this interaction was reliable ($n = 73$, Meddis quicktest $z = 1.9$, $p < .05$).

Table 3 presents the percentages of choices of the first event or the second overall, and also the breakdown of these choices into those that mentioned a single event. Overall, most people undid the first, the second, or both events (83% overall). In addition, 5% of responses overall mentioned "if only the technical hitch had not occurred"; all of these responses fell in the different-card condition, and they were not included in the analysis. The remainder of responses contained simple errors.

Judgments of relief. A similar pattern of results is found for the answer to the question with respect to relief, as Table 3 also shows. For participants who judged that one or the other individual would experience more relief, more participants tended to believe that the second player would feel relief rather than the first in the same-card version (59% vs. 35%, although the difference was somewhat marginal, binomial $n = 43$, $k = 16$, Meddis quicktest $z = 1.52$, $p < .06$); the effect was eliminated in the different-card version (42% vs. 44%, binomial $n = 41$, $k = 20$, $z = 0$, $p < .50$). The 24% difference (between 59% judging more relief experienced by the second player and 35% choosing the first player in the same-card condition) was narrowed to just 2% of a difference (between 42% and 44% in the different-card condition,

$n = 84$, Meddis quicktest $z = 1.29$, $p > .10$). Most participants judged that either one or the other of the players would experience more relief (90%), with the majority of the remainder indicating that neither would experience more relief (8%).

The experiment shows that people exhibit a temporality effect in good outcome situations as well as in bad outcome situations. The experiment also shows that the temporality effect can be eliminated for good outcomes. The results rule out the explanation that reasoners focus solely on the "odd-one-out" card *color* to mutate because it stands out as a focal event in the foreground against the background of the other events. This view predicts that there should be no temporality effect for good outcomes because the individuals choose the same color cards. The results are consistent with the presupposition account of the temporality effect. The results also show that the opposing tendency of an available counterfactual has as big an impact in eliminating the temporality effect for good outcomes as it does for bad outcomes.

THE TEMPORAL ORDER OF EVENTS

The second series of experiments is designed to provide further information on some parameters of the temporality effect. The two experiments provide a test of the influence of the order of events in the world compared with the order in which they are described (see, e.g., Spellman, 1997).

Experiment 4
Heads and Tails, or Tails and Heads

The temporality effect has been observed most strikingly in the coin toss scenario. Eighty-nine percent of participants choose the second alternative given the probe: "There are two ways that Jones and Cooper could have won $1,000. Which of these alternatives comes more readily to mind: (a) Jones tossing a tail; (b) Cooper tossing a head" (D. T. Miller & Gunasegaram, 1990, p. 1112). However, the phrase "heads or tails" has a stereotyped order of mention—the phrase "tails or heads" is unusual in the everyday use of English (as well as other languages, including Spanish, the language of our participants in this experiment). There are many similar conventional orderings, perhaps because physical constraints on the production of different vowels result in a preferred ordering of words, with "fat" vowels first and words with "thin" vowels second (see, e.g., Pinker, 1994). Individuals may believe that many events have usual sequences, such as the sequence in which a teacher sets questions and a student studies for an examination. The strong linguistic convention may lead participants to prefer to alter tails to become heads (regardless of whether it is tossed by the first or second individual); that is, the linguistic convention may provide an available counterfactual alternative that works in opposition to the temporality effect in a similar way to the different-card technical hitch scenario. If so, when the description of the events conflicts with the stereotyped ordering of the phrase, the temporality effect should be eliminated. Our first aim in the experiment was to compare the heads–tails scenario to a tails–heads scenario.

In many situations, people's linguistic preconceptions about the content may be weaker, such as the scenario in the previous experiments in which players must pick the same color card (i.e., black suit or red) in order to win a prize. If the temporality effect is influenced by linguistic conventions, it should be observed more strongly for the heads–tails scenario than for a cards scenario. Of course, the temporality effect is not confined solely to situations governed by linguistic conventions (D. T. Miller & Gunasegaram, 1990; Sherman & McConnell, 1996), but our interest in this experiment is in the relative contribution of linguistic conventions. If the effect is independent of them, it should occur as robustly for the cards scenario as well as for the heads–tails coins scenario. Hence, our second aim is to test whether the temporality effect is as robust for the cards content as the heads–tails coin toss content. Third, the cards scenario order can be a black–red scenario in which the first player picks a black card and the second picks a red card, or a red–black scenario in which the first player picks red and the second black. If the temporality effect is a general phenomenon entirely independent of linguistic convention, it should be observed in the red–black scenario as it is in the black–red scenario.[1]

Method

Materials and Design. We constructed four scenarios. Two were based on the coins content: in the heads–tails version, the first player tossed heads and the second tails; in the tails–heads version, the first player tossed tails and the second heads. Two other scenarios were structurally identical but their content was cards: in the black–red version, the first player picked a black card and the second red; in the red–black version, the first player picked a red card and the second black (see the Appendix). The two individuals were identified as John and Michael, and the stories were presented to the participants in their native Spanish. They were asked to complete the following sentence: "John and Michael could each have won £1,000 if only one of them had picked a different card (tossed a different coin face), for instance if . . ." They were asked: "Who would you predict would experience more guilt?" And "Who would you predict would blame the other more?" We gave each participant one scenario only, and each participant answered the three questions in the fixed order presented here.

Participants and Procedure. The 157 participants were undergraduates from the University of Malaga who participated in the experiment voluntarily. They were assigned to the four conditions: heads–tails ($n = 50$), black–red ($n = 49$), tails–heads ($n = 29$), or red–black ($n = 29$). They were randomly assigned to the first two conditions first, and subsequently to the latter two, and they were tested in groups. They were presented with a booklet with instructions on the first page, the scenario on the next, the three questions on the third, and a debriefing paragraph on the final page. They worked at their own pace and wrote their answers.

Results and Discussion

"If only . . ." mutations. The standard temporality effect occurred for the heads–tails scenario but not for the tails–heads scenario. For participants whose mutations focused on a single event only, the temporality effect occurred for heads–tails (60% vs. 22%, binomial $n = 41$, $k =$

Table 4
Percentages of Mutations and of Judgments of Guilt and Blame in Experiment 4

Selections	Heads–Tails	Tails–Heads	Black–Red	Red–Black
Undoings				
First event only	22	28	25	14
First then second	0	14	6	7
First overall	22	41	31	21
Second event only	60	34	55	52
Second then first	4	7	0	7
Second overall	64	41	55	59
Total	86	81	86	80
Guilt				
First	0	3	2	0
Second	62	79	49	76
Neither	38	17	49	24
Blame				
First	38	69	43	83
Second	2	3	0	0
Neither	60	24	57	14
n	49	29	50	29

Note—The percentages are based on the responses of participants to one scenario each. First event only, participants undid the first event only; first then second, participants undid the first event, then the second one; second event only, participants undid the second event only; second then first, participants undid the second event, and then the first one.

11, $z = 2.81$, $p < .003$), but not for tails–heads (34% vs. 28%, binomial $n = 18$, $k = 8$, $p < .40$). It occurred for black–red (55% vs. 25%, binomial $n = 39$, $k = 12$, $z = 2.24$, $p < .01$) and also for red–black (52% vs. 14%, binomial $n = 19$, $k = 4$, $p < .01$).

Table 4 presents the percentages of undoings of a single event (e.g., "if only John had tossed tails") and of one event followed by another (e.g., "if only John had tossed tails or Michael had tossed heads").[2] Once again, we combined the two sorts of responses on the basis that the order of mention gives us a clue to the mutability of an event. The second analysis showed exactly the same pattern: For participants whose mutations focused on the first or second events overall, the temporality effect occurred for the heads–tails scenario (64% vs. 22% overall, binomial $n = 43$, $k = 11$, $z = 3.05$, $p < .001$), but not for the tails–heads scenario (41% for each). The temporality effect occurred for the black–red scenario (55% vs. 31%, binomial $n = 42$, $k = 15$, $z = 1.697$, $p < .05$) and also for the red–black scenario (59% vs. 21%, binomial $n = 23$, $k = 6$, $p < .02$). The majority of undoings, 75%, focused on a single event, and this total rises to 84% when we include participants who undid one event followed by the other. The majority of the remainder of the responses were either not sufficiently explicit to classify (8%, e.g., "if only they had both picked the same card"), or else they were simple errors (3%, e.g., "if only John had tossed heads," when in fact he *had* tossed heads).

The results show the standard temporality effect; that is, participants' undoings focused on the second event rather than the first, in each of the conditions with the sole exception of the tails–heads condition, where their undoings focused on the two events equally. The temporality effect was observed for events whose description is relatively neutral with respect to linguistic preconceptions about order of mention—that is, the black–red and red–black cards scenarios—and for events whose description follows the existing linguistic preconceptions—that is, the heads–tails coin scenario. The temporality effect was eliminated when the description of the order of the events (tails followed by heads) conflicted with the stereotyped conventional order (heads or tails). The linguistic convention may provide a counterfactual alternative, setting up an opposing tendency to the temporality effect. Nonetheless, as in the previous experiments, the results are consistent with a temporality tendency continuing to operate, since the effect was eliminated rather than reversed.

Judgments of guilt and blame. The responses to the questions of guilt and blame, as Table 4 shows, exhibit an important difference from the mutability responses: The temporality effect occurred for all four conditions, including the tails–heads scenario. For the participants who judged that one or the other of the individuals would experience more guilt, the temporality effect occurred for the heads–tails scenario (62% vs. 0%, binomial $n = 31$, $k = 0$, $p < .001$) and also for the tails–heads scenario (79% vs. 3%, binomial $n = 24$, $k = 1$, $p < .001$). The temporality effect occurred for the black–red scenario (49% vs. 2%, binomial $n = 25$, $k = 1$, $p < .001$) and also for the red–black scenario (76% vs. 0%, binomial $n = 22$, $k = 0$, $p < .001$). The temporality effect for guilt judgments was not as strong in the black–red scenario (49%) as it was in the red–black scenario (76%). Notably, a substantial number of participants (32% over all conditions) judged that neither individual would experience more guilt. This tendency was particularly evident in the black–red scenario, where participants judged that neither individual would experience more guilt as often as they judged that the second individual would experience more guilt (49% in each case). The results show that participants' judgments of guilt focused on the second individual more than the first in each of the four conditions, and in the black–red condition, their judgment that the second individual would feel more guilt was rivaled by their judgment that neither individual would feel more guilt.

Table 4 also shows the percentages of judgments of blame for the two individuals. Once again, the temporality effect occurred for all four conditions. For the participants who judged that one or other of the individuals would experience more blame, the temporality effect occurred for the heads–tails scenario (38% vs. 2%, binomial $n = 20$, $k = 1$, $p < .001$) and also for the tails–heads scenario (69% vs. 3%, binomial $n = 21$, $k = 1$, $p < .001$). The temporality effect occurred for the black–red scenario (43% vs. 0%, binomial $n = 21$, $k = 0$, $p < .001$) and also for the red–black scenario (83% vs. 0%, binomial $n = 24$, $k = 0$, $p < .001$). Once again, the temporality effect for blame judgments was not as strong in the black–red scenario (43%) as it was in the red–black scenario (83%).

Further, a substantial number of participants (39% over all conditions) judged that neither individual would experience more blame. In particular, in the black–red scenario participants judged that neither individual would blame the other more as often as they judged that the first individual would blame the second more (57% vs. 43%, binomial $n = 49$, $k = 21$, $z = 0.857$, $p < .19$); in the heads–tails scenario, they judged that neither individual would blame the other somewhat more often than that the first individual would blame the second (60% vs. 38%, binomial $n = 49$, $k = 19$, $z = 1.42$, $p < .08$). The results show that participants' judgments of blame focused more on the first individual blaming the second rather than the other way around in each of the four conditions. In the heads–tails and the black–red conditions, their judgment that the first individual would blame the second more was rivaled by their judgment that neither individual would be blamed more.

The experiment shows that when individuals generate ways in which an outcome could have been avoided, they show the standard temporality effect when the description of the order of the events corresponds to the linguistic stereotype of the normal order (heads followed by tails) but not when it conflicts with it (tails followed by heads). Nonetheless, they judge that the second individual will feel more guilt and be blamed more by the first individual regardless of the order in which the events are described. Participants show the standard temporality effect for mutations and for judgments of guilt and blame when the description of the order of the events has a relatively weak linguistic stereotype, regardless of the order in which the terms occur—red followed by black or black followed by red. The judgments of guilt and blame show a temporal effect that is somewhat weaker when the weak stereotyped order is violated, in the black–red (*negro–rojo*) condition. We will return to the vagaries between undoings and amplification of emotions and social attributions later. We turn now to an examination of the influence on the temporality effect of the order of the occurrence of the events compared with the order of their mention in the description.

Experiment 5
Event Order and Order of Mention

The aim of the fifth experiment is to test whether the temporality effect depends on the order of mention of the events (individuals tend to undo the second-mentioned event) or whether it depends on the order of occurrence of the events (individuals tend to undo the second event that occurs in the sequence). In the usual sorts of scenarios, such as the coins or cards scenarios, the order of mention and the order of the events in the world corresponds (e.g., Anne drew a blue marble from her sack; after her, Joan drew a white marble from her sack), and people mentally undo the second event. Spellman (1997) separated events into their component play and outcome information. She gave participants the play information in one sequence (e.g., Jones tosses his coin first, and Cooper tosses second), and the outcome information in the reverse sequence (e.g., Cooper's coin was tails, and Jones's coin was heads). She found that the temporality effect depends to a large extent on the outcome information; for example, people undo Jones's play (the first player) more than Cooper's (the second player) when they have been told the outcome of Jones's play second.

Our aim in this experiment is to separate out, not component play and outcome information, but overall event sequence and linguistic order of mention sequence. We examine scenarios in which the second player's play and outcome were described first, and the first player's play and outcome were described second (e.g., Joan drew a white marble from her sack; before her, Anne drew a blue marble from her sack). The experiment tests whether the temporality effect depends on event sequence (greater mutability of the second event that occurred in the world, regardless of its order of mention) or whether it depends on description sequence (greater mutability of the second event that is mentioned in a description, regardless of its order in the event sequence).

Method

Materials and Design. We constructed two sorts of scenarios that were identical but for the description of the players' turns: In the *after* scenario, the turns were described as follows: "Anne had her turn and drew a blue marble from her sack; after her, Joan had her turn and drew a white marble from her sack." In the *before* scenario, the turns were described as follows: "Joan had her turn and drew a white marble from her sack; before her, Anne had her turn and drew a blue marble from her sack" (see the Appendix). The scenarios were based on three sorts of content: the marbles version in the example above; a cards version similar to that used in the previous experiments, in which two individuals identified as John and Michael drew black or red cards from their decks; and a dice version in which two individuals identified as Bill and Joe threw even or odd numbers with their die. Names of the same gender were used in each scenario, they were presented to the participants in their native English, and the turns were described in the past tense. We gave each participant the three contents (marbles, cards, and dice) in a different random order. We gave them one set of scenarios, either the before or the after scenarios, in a between-subjects design.

The participants completed the following sentence: "They could each have won £1,000 if only one of them had picked a different card, for instance if . . ." They also answered the question, "Who would you predict would experience more guilt?" Each participant answered each of the two questions, which were printed in the fixed order presented above, and they wrote their answers in the spaces provided on the sheet of paper.[3] The questions were presented on the same page as the scenario, and we phrased them using "they," following earlier pilot work, to avoid repeating the names of the players, given the predicted sensitivity to order of mention.

Participants and Procedure. The 40 participants were undergraduates from different departments in the University of Dublin, Trinity College who participated in the experiment voluntarily. They were assigned at random to the before condition or the after condition ($n = 20$ in each), and they were tested in groups. Unlike the procedure in the previous experiments, each participant carried out the tasks for three scenarios, so there were 60 observations for each group. They were presented with a booklet that contained the instructions first; each of the three subsequent pages contained a story with two questions printed beneath it, and the final page con-

Table 5
Percentages of Mutations and of Judgments of Guilt in Experiment 5

	Description	
Selections	After Anne had a turn . . . After her, Joan had a turn . . .	Before Joan had a turn . . . Before her, Anne had a turn . . .
Undoing		
First mentioned only	18	30
First then second	18	18
First mentioned overall	37	48
Second mentioned only	35	23
Second then first	15	5
Second mentioned overall	50	28
Total	87	76
Guilt		
First mentioned	5	27
Second mentioned	73	33
Neither	17	30
n	20	20

Note—The percentages are based on the responses of participants to three scenarios each. The first mentioned is, for example, Anne's turn in the after condition and Joan's turn in the before condition. First mentioned only, participants undid the first-mentioned event only; first then second, participants undid the first-mentioned event, then the second; second mentioned only, participants undid the second-mentioned event only; second then first, participants undid the second-mentioned event, then the first.

tained a debriefing paragraph. The instructions were similar to those in previous experiments. The participants worked at their own pace and wrote their answers.

Results and Discussion

"If only . . ." mutations. Individuals undo the second event in a sequence—even when it is mentioned first. As Table 5 shows, in the *after* condition, participants who focused on a single event showed the standard temporality effect; that is, they undid the event that was mentioned second rather than first (e.g., Joan's selection: 35% vs. 18%, binomial $n = 32$, $k = 11$, $p < .04$), whereas participants in the *before* condition tended to undo the event that was mentioned first rather than second (e.g., Joan's selection: 30% vs. 23%), although the difference did not approach reliability (binomial $n = 32$, $k = 14$, $p = .24$). Once again, we combined mutations that focused on a single event and those that undid one followed by the other: In the *after* condition, participants showed some tendency to exhibit the standard temporality effect—that is, to undo the event that was mentioned second rather than first (50% vs. 37% overall, although the effect did not reach significance, binomial $n = 52$, $k = 22$, $z = 0.97$, $p < .17$)—but in the *before* condition they undid the event mentioned first rather than second (48% vs. 28% overall, binomial $n = 46$, $k = 17$, $z = 1.62$, $p < .05$).[4] Participants undid the event that was mentioned second overall more often in the *after* condition than in the *before* condition (50% vs. 28%, Mann–Whitney U, $z = -2.062$, $p < .04$), and they undid the event that was mentioned first equally often in the *before* and *after* conditions (48% vs. 37%, Mann–Whitney U, $z = -0.926$, $p < .35$). Table 5 presents the undoings of a single event and the undoings of one event followed by the other. Overall, 82% of participants responses undid one, the other, or both of the events, and the majority of the remainder of the responses changed both events in a nonspecific manner (7%, e.g., "if only they had picked the same color marble") or made simple errors (5%).

Judgments of guilt. The judgments of guilt display an intriguing asymmetry. As Table 5 shows, in the *after* condition participants judged that the individual who was mentioned second would feel more guilt than the one who was mentioned first (73% vs. 5%, binomial $n = 47$, $k = 3$, $z = 5.8$, $p < .0001$), but in the *before* condition the effect was eliminated: They judged that the individuals would feel equally guilty whether mentioned first or second (27% vs. 33%, binomial $n = 34$, $k = 16$, $p < .43$) or that neither would (30%). Participants judged that the individual who was mentioned second would feel guilt more often in the *after* condition than in the *before* condition (73% vs. 33%, Mann–Whitney U, $z = -2.76$, $p < .006$). They judged that the individual who was mentioned first would feel guilt more often in the *before* condition than in the *after* condition (27% vs. 5%, Mann–Whitney U, $z = -1.98$, $p < .05$). Their judgments that neither individual would experience more guilt were not made reliably more often in the *before* condition than in the *after* condition (30% vs. 17%, Mann–Whitney U, $z = -0.87$, $p < .38$).

The results suggest that the temporality effect is not influenced primarily by the nature of the description: People undo the second event that occurred in the world regardless of whether it was mentioned first or second. The experiment shows that the temporality effect depends on the event sequence—that is, the order in which the events occurred in the world. The temporality effect depends on the event sequence rather than the description sequence, as we have shown, and within the event sequence, it depends largely on the outcome sequence more than the play sequence (Spellman, 1997). Participants judge that the player who is mentioned second will feel more guilt when the order of mention of the events corresponds to their order of occurrence, but they judge guilt equally for the first and second players when the order of mention of the events does not correspond to order of occurrence. Once again the amplification of judgments of guilt is influenced but not wholly determined by the tendencies to mutate one or the other event.

Overall, the two experiments in this second series help to identify the parameters of the temporality effect: It arises from the order of the events in the world, rather than other factors, such as solely from the stereotyped order of the linguistic description or the order of mention of the events in a description. In the experiments, individuals' mutations tended to focus on the nature of the events as they occurred in the world, regardless of the description of them. There was an unexpected dissociation between the counterfactual alternative scenario generated by the participants in their "if only . . ." sentence completions, and their judgments of guilt and blame. The judgments of guilt, for example, show a much simpler pattern than that of the mental undoings—the second player is judged to feel more guilt in every condition in both experiments in this series (or else a judgment is made that neither player feels more guilt). We will return to this dissociation between counterfactual undoing and the judgments of guilt and blame in the general discussion.

GENERAL DISCUSSION

People tend to mentally undo the more recent event in an independent sequence of events when they think "if only . . .". The first experiment shows that the temporality effect is reduced when the first player picks a card, a technical hitch occurs, and the first player picks a different card. The second experiment replicates the elimination of the temporality effect in the technical hitch scenario and shows that the same pattern occurs for "if only" mutations as well as judgments of guilt and blame. The third experiment shows that the temporality effect occurs for good outcomes as well as for bad ones, and that it can be eliminated in these good situations by the technical hitch device, for both "if only" mutations and judgments of relief. These results are consistent with the view that the temporality effect arises primarily because the first event in an independent sequence is presupposed, and so it is immutable relative to subsequent events (D. T. Miller & Gunasegaram, 1990). This presupposition of the first event can be undermined by providing an explicitly available counterfactual alternative. In the different-card technical hitch scenarios, the pre-hitch play provides a ready-made counterfactual alternative, which renders the post-hitch play of the first player mutable. These two opposing tendencies, to presuppose the first event, but to undo an event that has an available counterfactual alternative, lead to the reduction and apparent elimination of the temporality effect.

An available alternative can be provided explicitly, as the technical hitch scenarios demonstrate, or it can be provided implicitly, for example, by the conventions of language. The fourth experiment showed that the more recent event is more mutable for sequences that conform with linguistic stereotypes (i.e., heads–tails), but not for sequences that conflict with the linguistic stereotype (tails–heads). The linguistic stereotype may lead people to focus readily on undoing tails to be heads, and this tendency opposes the presuppositional tendency to result in the elimination of the temporality effect. Of course, the temporality effect is not determined solely by language conventions: It occurs for sequences with relatively neutral linguistic content (including the black–red and red–black cards scenarios). Finally, the fifth experiment showed that the temporality effect depends on the order of the events in the world, not on their order in the description of the world: People undo the second event in a sequence regardless of whether it is mentioned first or second in the description of the events. In each of these two experiments, people focused on the nature of the events as they occurred in the world, regardless of the description.

Disruptions of the Temporality Effect

These experiments demonstrate one robust way in which the temporality effect can be reduced. There are undoubtedly other ways in which the temporal order of an event may be disrupted. We can speculate (with D. T. Miller & Gunasegaram, 1990) that specifying that it is necessary to toss heads to win in the coin toss scenario may eliminate the temporality effect when Jones goes first and tosses tails (see also Spellman, 1997). We suggest that the additional specification sets up the context against which subsequent information is interpreted. Undoubtedly, the effects of context on the temporality effect can generalize to everyday counterfactual thinking. Consider, for example, the finding that participants required to role-play as teachers chose easier questions when their question setting occurred after the students' examination preparation period than when it occurred before—an effect of temporality that highlights the widespread everyday consequences of the increased mutability of the more recent of two independent events in a sequence (D. T. Miller & Gunasegaram, 1990). We suggest that such an effect will be eliminated if the available alternatives are provided to the presupposed first event. For example, setting both target events against the context of previous examinations taken in earlier years, or against an idealized standard of attainment of knowledge within a class, is likely to diminish the temporality effect in this situation.

According to our account of the temporality effect, its basis—the presupposition of the earlier event—can be overridden by other factors, such as the availability of alternatives. This account suggests an explanation for why a causal relation between events in the sequence eliminates the temporality effect (Wells et al., 1987). Causal relations may be understood by explicitly keeping in mind not only the factual situation in which both the cause and the outcome occurred, but also the counterfactual situation in which the cause did not occur (Johnson-Laird & Byrne, 1991, pp. 71–72). Causes may be mentally represented with a readily available counterfactual alternative, and this undermines the immutability of the otherwise presupposed first event in a sequence.

Mutability and Judgments of Blame, Guilt, and Relief

We observed the temporality effect in the mutations that individuals tended to make when they completed an "if only . . ." sentence stem. Of course, a sizable minority of participants in each experiment undid more than one event, and we can infer that immutability is not an absolute property of any event in these scenarios. We also observed the temporality effect in participants' judgments of the guilt, blame, or relief experienced by the players. However, an important point to note is that although the majority of participants in the experiments focused on one or the other event to mutate, far fewer of them believed that one or other of the individuals would experience more guilt, blame, or relief. A second important point is that there were discrepancies between mutability and amplification of the judgments of guilt and blame, particularly in the fourth and fifth experiments, in contrast to earlier findings on the temporality effect (e.g., D. T. Miller and Gunasegaram, 1990; Spellman, 1997). Our mutability task, an "if only" sentence stem completion, was more open-ended than our emotion and social judgments task, a binary choice between the two individuals, which may go some way toward explaining the discrepancies. Alternatively, these two clues may indicate that the relation between the generation of counterfactual alternatives and the experience of guilt, blame, and relief is not a simple one (see also N'gbala & Branscombe, 1997; Shaver, 1985).

Mutability can clearly influence emotional and social judgments such as blame and guilt ascription (see, e.g., Kahneman & Miller, 1986; Wells & Gavanski, 1989), but the relationship may not be straightforward. Instead it seems that people ascribe blame, cause, and preventability differently (e.g., Branscombe, N'gbala, Kobrynowicz, & Wann, 1997; Davis, Lehman, Silver, Wortman, & Ellard, 1996; Mandel & Lehman, 1996). For example, judgments about the mutability, blameworthiness, and preventability of events leading to an accident focus on different aspects, even to the extent that victims of accidents may blame themselves because they perceive that they could have avoided their accident even though they judge that they were not the cause of the accident (e.g., Branscombe et al., 1996; Davis et al., 1996). Counterfactual thoughts and judgments of the preventability of an accident may depend on controllable aspects of the events (e.g., death in a plane crash could have been avoided if the individual had made a different decision about whether to fly or drive to a destination), whereas causal judgments may depend on covariational information (e.g., the cause of the plane crash was engine failure, Mandel & Lehman, 1996). The vagaries indicate that although the generation of counterfactual alternatives may make an important contribution to the experience of guilt or blame, these judgments can be made in the absence of explicitly articulated counterfactual alternatives. Conversely, these judgments may not be made even when explicitly articulated alternatives are available. Counterfactual thinking may be one of the many important interfaces between cognition and emotion, and between cognition and social attribution, but the transformation of cognitive experience into, for example, emotional experience appears to be neither necessary nor sufficient for the judgments of guilt or blame.

The data from our experiments present difficulties for several potential explanations of the temporality effect, including the suggestion that it depends on a backward search through the entries into working memory, that it depends on the identification of an odd-one-out card color, or that it depends on the calculation of probabilities for each player. We have suggested instead that the temporality effect depends on presupposing earlier events (see, e.g., D. T. Miller & Gunasegaram, 1990), and its elimination results from an opposing tendency to focus on available alternatives (see, e.g., Branscombe et al., 1996; Wells & Gavanski, 1989). We turn now to a consideration of the cognitive processes that may underlie these tendencies to presuppose earlier events and to mutate events for which there are available alternatives.

Mental Representations and Counterfactual Thinking

We suggest that when people reason about matters of fact and about matters of possibility or impossibility, including counterfactual matters, they construct mental models—mental representations that are close to the structure of the world rather than to the structure of the language that describes the world (Johnson-Laird, 1983). A conditional, such as

If John picks a red card then he wins £1,000. (5)

is consistent with different situations, and people must keep in mind different models, which we represent in the following diagram:

red	win	
not-red	not-win	
not-red	win	(6)

where "red" stands for "John picks a red card," "win" stands for "he wins £1,000," "not" is a propositional-like tag to indicate negation, and separate models are represented on separate lines (Johnson-Laird & Byrne, 1991). The set of models corresponds to the three alternative situations in which the assertion could be true. The models may contain information about who John is, what kind of game he is competing in, and so on. The set of models is fully explicit; that is, each of the three alternatives is represented, but people may rarely construct explicit models because of working memory constraints. Instead their initial representation of the assertion may represent some information in an implicit way:

red win

. . . (7)

That is, they construct one explicit model that corresponds to the information mentioned in the assertion, and an implicit model, represented in the diagram by the three dots, which captures the possibility that there may be alternatives to the first model (for more technical details, see Johnson-Laird, Byrne, & Schaeken, 1992). The suggestion that reasoners rely on such models to make deductions has been tested experimentally for a range of different sorts of deductions, and modeled computationally (e.g., Johnson-Laird & Byrne, 1991).

Mental Models and the Temporality Effect

Counterfactual thinking may be related to thinking conditionally (e.g., Byrne, Espino, & Santamaria, 1999) and suppositionally (e.g., Byrne & Handley, 1997). Deductions from counterfactual conditionals show predictable similarities to and differences from deductions from factual conditionals (see, e.g., Byrne & Tasso, 1999). We suggest that reasoners construct the following sort of representation of the coin toss scenario:

jones-heads cooper-tails (8)

When they must think of ways in which the outcome could have been different, they may flesh out the counterfactual possibilities to be fully explicit, and they may even annotate their models to indicate what consequences follow from each alternative:

factual:	jones-heads	cooper-tails	*lose*	
counterfactual:	jones-heads	cooper-heads	*win*	
	jones-tails	cooper-tails	*win*	
	jones-tails	cooper-heads	*lose*	(9)

The temporality effect suggests individuals flesh out their counterfactual models for just one of the options:

factual:	jones-heads	cooper-tails	*lose*	
counterfactual:	jones-heads	cooper-heads	*win*	
		. . .		(10)

Why do individuals usually construct the models that correspond to just this particular alternative counterfactual scenario? One factor is that the counterfactual alternative in which the players both lose (the last in the fully fleshed out set in Example 9) is not an *effective* counterfactual alternative in that it does not undo the outcome: The players still lose (Byrne, 1997). Two counterfactual alternatives do succeed in undoing the outcome—depicted on the second and third lines in Example 9—but individuals tend to flesh out only one of them, and we turn now to a possible reason why.

Contextualized Models

We have speculated, along with D. T. Miller and Gunasegaram (1990), that early events are presupposed or taken for granted more than later events, but why would the earlier event be presupposed rather than the later event? We suggest that the presupposition of earlier events emerges from the nature of the cognitive processes that construct and revise mental representations. Our explanation for why the earlier event is presupposed is that it *initializes* the model; that is, it provides the cornerstone of the model's foundation. The game is now "about" heads once the first player has tossed heads—in the sense that a successful outcome requires the same toss from the second player—and this interpretation mediates the interpretation of the subsequent play. Our view is that the first player's choice sets the stage, and subsequent choices are interpreted in the light of this context.

Models need to be initialized because it is necessary to integrate incoming information with existing information to construct a coherent representation. The importance of representational integration is clear in related domains of thinking such as deduction. For example, given premises of the following form (where for simplicity we use A's, B's, and C's):

A is related to B.

B is related to C. (11)

people tend to produce spontaneous conclusions of the form, "A is related to C" rather than of the form, "C is related to A" (Johnson-Laird & Bara, 1984; see also Maybery, Bain, & Halford, 1986). Likewise, people show a robust "figural effect" with categorical syllogisms. In fact, people may refrain from making an inference when it is not apparent how to integrate information into their models. For example, many people given the premises:

If A then B.

not-B. (12)

conclude "nothing follows" rather than "not-A," perhaps because it is not immediately apparent how to integrate the negative information into their initial representation of the conditional (see, e.g., Johnson-Laird et al., 1992; Girotto, Mazzocco, & Tasso, 1997). Many studies have provided further evidence that the integration of information into a single coherent mental representation is crucial (see Evans, Newstead, & Byrne, 1993, for a review). We suggest that it is equally important in other spheres of thinking, and in particular in the domain of counterfactual thinking.

The earlier event plays the initializing role in the absence of knowledge about, say, the norms of the situation, perhaps because of a linear perception of time. Subsequent knowledge is *integrated* into the model against the backdrop provided by the earlier event, and so the initializing event is immutable relative to the other events in the model. In everyday life, individuals' models may be continually changing to deal with new situations, and so the cornerstone of a new situation may help to initialize a new model. What counts as an initializing event may depend on factors such as the event's contribution to an outcome. The idea of an initializing event can be understood by analogy to anchoring in numerical domains—for example, the observation that reasoners asked to estimate quickly the answer to $8 \times 7 \times 6 \times 5 \times 3 \times 2 \times 1$ produce larger estimates than those asked to estimate the answer to $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 \times 8$ (Tversky & Kahneman, 1982).

Our sketch of the putative cognitive processes that underlie the temporality effect focuses on three principles concerning the properties of the mental representations that people construct. First, people construct mental models that correspond to the structure of the world rather than to the structure of the language used to describe the world. Second, people construct an initial set of models that represents as little information as possible explicitly because of the limitations of working memory: They represent the factual situation explicitly but they do not construct all the possible counterfactual models. Third, the first event initializes the set of models, and the initializing event is not as readily available as a candidate for change in the counterfactual models because of its crucial role in integrating subsequent information into the model. These simple principles underlie the representation of the factual situation and the generation of a counterfactual situation based on it.

Models and the Technical Hitch Scenario

In the different-card technical hitch scenario, participants represent the events in the following way:

pre-hitch	jones-black		
post-hitch	jones-red	brady-black	(13)

When they must construct a counterfactual model, there are two possible routes they may take. On the one hand, they can rely on the information already represented in their models, and construct the counterfactual model by fleshing out the earlier pre-hitch event, engaging in a "subjunctive instant replay" (Hofstadter, 1985):

factual:	pre-hitch	jones-black		
	post-hitch	jones-red	brady-black	
counterfactual:	jones-black	brady-black		
		. . .		(14)

In this case, they will undo the first player more than the second. We have proposed that a similar "rewind" to the past factual events accounts for the greater mutability of actions instead of inactions (Byrne & McEleney, 1997). On the other hand, the initialization of the factual model by the first event renders it relatively immutable, and participants who follow this route to constructing a counterfactual alternative exhibit the standard temporality effect. These two opposing tendencies weigh against each other: The contextualization of models is weighed against the explicit representation of a counterfactual alternative.

Conclusions

Our experiments show that the temporality effect can be eliminated when an explicit alternative is available to the otherwise presupposed first event. We have sketched a putative model-based account of the cognitive mechanisms underlying the temporality effect. The perspective we have taken suggests that the human imagination is constrained by what it is possible to change readily in a representation of a factual situation (see, e.g., Byrne, 1997; Kahneman & Miller, 1986). Accordingly, an understanding of the nature of the representation of factual situations may give us a clearer view of the nature of the construction of imaginary alternatives. The account of the temporality effect in terms of mental models suggests that counterfactual thinking, which lies at the heart of the human imagination, may share fundamental properties with logical thought.

REFERENCES

Bouts, P., Spears, R., & van der Pligt, J. (1992). Counterfactual processing and the correspondence between events and outcomes: Normality versus value. *European Journal of Social Psychology*, **22**, 387-396.

Branscombe, N. R., N'gbala, A., Kobrynowicz, D., & Wann, D. L. (1997). Self and group protection concerns influence attributions but they are not determinants of counterfactual mutation focus. *British Journal of Social Psychology*, **36**, 387-404.

Branscombe, N. R., Owen, S., Garstka, T. A., & Coleman, J. (1996). Rape and accident counterfactuals: Who might have done otherwise and would it have changed the outcome? *Journal of Applied Social Psychology*, **26**, 1042-1067.

Byrne, R. M. J. (1997). Cognitive processes in counterfactual thinking about what might have been. In D. L. Medin (Ed.), *The psychology of learning and motivation* (Vol. 37, pp. 105-154). San Diego: Academic Press.

Byrne, R. M. J., Culhane, R., & Tasso, A. (1995). The temporality effect in thinking about what might have been. In J. Moore & J. Lehman (Eds.), *Proceedings of the Seventeenth Annual Conference of the Cognitive Science Society* (pp. 385-390). Hillsdale, NJ: Erlbaum.

Byrne, R. M. J., Espino, O., & Santamaria, C. (1999). Counterexamples and the suppression of inferences. *Journal of Memory & Language*, **40**, 347-373.

Byrne, R. M. J., & Handley, S. J. (1997). Reasoning strategies for suppositional deductions. *Cognition*, **62**, 1-49.

Byrne, R. M. J., & McEleney, A. (1997). Cognitive processes in regret for actions and inactions. In M. Shafto & P. Langley (Eds.), *Proceedings of the Nineteenth Annual Conference of the Cognitive Science Society* (pp. 73-78). Hillsdale, NJ: Erlbaum.

Byrne, R. M. J., & Tasso, A. (1999). Deductive reasoning with factual, possible, and counterfactual conditionals. *Memory & Cognition*, **27**, 726-740.

Chisholm, R. M. (1946). The contrary-to-fact conditional. *Mind*, **55**, 289-307.

Davis, C. G., Lehman, D. R., Silver, R. C., Wortman, C. M., & Ellard, J. H. (1996). Self-blame following a traumatic event: The role of perceived avoidability. *Personality & Social Psychology Bulletin*, **22**, 557-567.

Dunning, D., & Parpal, M. (1989). Mental addition versus subtraction in counterfactual reasoning: On assessing the impact of personal actions and life events. *Journal of Personality & Social Psychology*, **57**, 5-15.

Evans, J. St. B. T., Newstead, S., & Byrne, R. M. J. (1993). *Human reasoning: The psychology of deduction*. Hillsdale, NJ: Erlbaum.

Gavanski, I., & Wells, G. L. (1989). Counterfactual processing of normal and exceptional events. *Journal of Experimental Social Psychology*, **25**, 314-325.

Gilovich, T., & Medvec, V. H. (1994). The temporal pattern to the experience of regret. *Journal of Personality & Social Psychology*, **67**, 357-365.

Girotto, V., Legrenzi, P., & Rizzo, A. (1991). Event controllability in counterfactual thinking. *Acta Psychologica*, **78**, 111-133.

Girotto, V., Mazzocco, A., & Tasso, A. (1997). The effect of premise order in conditional reasoning: A test of the mental model theory. *Cognition*, **63**, 1-28.

Goodman, N. (1973). *Fact, fiction and forecast* (3rd ed.). New York: Bobbs-Merrill.

Hofstadter, D. R. (1985). *Metamagical themas: Questing for the essence of mind and pattern*. London: Penguin.

Johnson, J. (1986). The knowledge of what might have been: Affective and attributional consequences of near outcomes. *Personality & Social Psychology Bulletin*, **12**, 51-62.

Johnson-Laird, P. N. (1983). *Mental models*. Cambridge: Cambridge University Press.

Johnson-Laird, P. N., & Bara, B. G. (1984). Syllogistic inference. *Cognition*, **16**, 1-62.

Johnson-Laird, P. N., & Byrne, R. M. J. (1991). *Deduction*. Hillsdale, NJ: Erlbaum.

Johnson-Laird, P. N., Byrne, R. M. J., & Schaeken, W. (1992). Propositional reasoning by model. *Psychological Review*, **99**, 418-439.

Kahneman, D., & Miller, D. (1986). Norm theory: Comparing reality to its alternatives. *Psychological Review*, **93**, 136-153.

Kahneman, D., & Tversky, A. (1982). The simulation heuristic. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases* (pp. 201-208). New York: Cambridge University Press.

Kahneman, D., & Varey, C. A. (1990). Propensities and counterfactuals: The loser that almost won. *Journal of Personality & Social Psychology*, **59**, 1101-1110.

Landman, J. (1987). Regret and elation following action and inaction: Affective responses to positive versus negative outcomes. *Personality & Social Psychology Bulletin*, **13**, 524-536.

Legrenzi, P., Girotto, V., & Johnson-Laird, P. N. (1993). Focusing in reasoning and decision-making. *Cognition*, **49**, 37-66.

Lewis, D. (1973). *Counterfactuals*. Oxford: Blackwell.

Macrae, C. N. (1992). A tale of two curries: Counterfactual thinking and accident-related judgments. *Personality & Social Psychology Bulletin*, **18**, 84-87.

Mandel, D. R., & Lehman, D. R. (1996). Counterfactual thinking and ascriptions of cause and preventability. *Journal of Personality & Social Psychology*, **71**, 450-463.

Markman, K. D., Gavanski, I., Sherman, S. J., & McMullen, M. N. (1993). The mental simulation of better and worse possible worlds. *Journal of Experimental Social Psychology*, **29**, 87-109.

Maybery, M. T., Bain, J. D., & Halford, G. S. (1986). Information processing demands of transitive inference. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, **12**, 600-613.

McCloy, R., & Byrne, R. M. J. (in press). Counterfactual thinking about controllable actions. *Memory & Cognition*.

McEleney, A., & Byrne, R. M. J. (in press). Spontaneous counterfactual thoughts and explanations. In J. Dunnion, G. O'Hare, S. O'Nuaillain, R. Reilly, & B. Smyth (Eds.), *Proceedings of the AICS '98*.

Meddis, R. (1984). *Statistics using ranks*. Oxford: Basil Blackwell.

Miller, D. T., & Gunasegaram, S. (1990). Temporal order and the perceived mutability of events: Implications for blame assignment. *Journal of Personality & Social Psychology*, **59**, 1111-1118.

Miller, D. T., & McFarland, C. (1986). Counterfactual thinking and victim compensation: A test of norm theory. *Personality & Social Psychology Bulletin*, **12**, 513-519.

Miller, G., & Johnson-Laird, P. N. (1976). *Language and perception*. Cambridge: Cambridge University Press.

N'Gbala, A., & Branscombe, N. R. (1997). When does action elicit more regret than inaction and is counterfactual mutation the mediator of this effect? *Journal of Experimental Social Psychology*, **33**, 324-343.

Pinker, S. (1994). *The language instinct: How the mind creates language*. New York: Academic Press.

Pollock, J. L. (1986). *Subjunctive reasoning*. Dordrecht: Reidel.

Roese, N. J. (1994). The functional basis of counterfactual thinking. *Journal of Personality & Social Psychology*, **66**, 805-818.

Roese, N. J. (1997). Counterfactual thinking. *Psychological Bulletin*, **121**, 133-148.

Roese, N. J., & Olson, J. M. (1995). *Thinking about what might have been: The social psychology of counterfactual thinking*. Hillsdale, NJ: Erlbaum.

Shaver, K. G. (1985). *The attribution of blame: Causality, responsibility and blameworthiness*. New York: Springer-Verlag.

Sherman, S. J., & McConnell, A. R. (1996). The role of counterfactual thinking in reasoning. *Applied Cognitive Psychology*, **10**, 113-124.

Spellman, B. A. (1997). Crediting causality. *Journal of Experimental Psychology: General*, **126**, 323-348.

Stalnaker, R. C. (1968). A theory of conditionals. In N. Rescher (Ed.), *Studies in logical theory* (pp. 98-112). Oxford: Blackwell.

Tversky, A., & Kahneman, D. (1982). Judgment under uncertainty: Heuristics and biases. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases* (pp. 201-208). New York: Cambridge University Press.

Wells, G. L., & Gavanski, I. (1989). Mental simulation of causality. *Journal of Personality & Social Psychology*, **55**, 161-169.

Wells, G. L., Taylor, B. R., & Turtle, J. W. (1987). The undoing of scenarios. *Journal of Personality & Social Psychology*, **53**, 421-430.

NOTES

1. These predictions follow even if there are no preconceptions about the order of black and red, or if there are weak preconceptions that black precedes red (in English) or that red (*rojo*) precedes black (*negro*) in Spanish.

2. Some responses were of the following sort: "If only Juan had tossed heads and Manolo had tossed heads as well," where Juan had tossed heads and Manolo had tossed tails. In all cases, the responses were categorized on the basis of which event was *mutated*—that is, only the second event in the example here.

3. Anticipated time constraints on the availability of participants led us to include only two questions in this experiment.

4. These binomial tests were carried out on the responses of 20 participants to three scenarios; to test our hypotheses about differences between the *before* and *after* conditions more appropriately, we also report the results of Mann–Whitney *U* tests.

(*Continued on next page*)

APPENDIX
Examples of the Scenarios Used in the Five Experiments

Experiment 1

Technical Hitch

Imagine two individuals (Jones and Brady) who take part in a television game show, on which they are offered the following very attractive proposition. Each individual is given a shuffled deck of cards, and each one picks a card from his own deck. If the two cards they pick are of the same color (i.e., both from black suits or both from red suits), each individual wins £1,000. However, if the two cards are not the same color, neither individual wins anything.

Jones goes first and picks a black card from his deck. At this point, the game show host has to stop the game because of a technical difficulty. After a few minutes, the technical problem is solved and the game can be restarted.

Different Context

Jones goes first again, and this time the card that he draws is a red card. Brady goes next and the card that he draws is a black card. Thus, the outcome is that neither individual wins anything.

Same Context

Jones goes first again, and this time the card that he draws is a black card. Brady goes next and the card that he draws is a red card. Thus, the outcome is that neither individual wins anything.

Experiment 2

Explicit Negation (Different Context)

Jones goes first and picks a black card from his deck. At this point, the game show host has to stop the game because of a technical difficulty. After a few minutes, the technical problem is solved and the game can be restarted. Jones goes first again, and this time the card that he draws is not a black card. Brady goes next and the card that he draws is a black card. Thus, the outcome is that neither individual wins anything.

Experiment 3

Good Outcomes

Jones goes first and picks a red card from his deck. At this point, the game show host has to stop the game because of a technical difficulty. After a few minutes, the technical problem is solved and the game can be restarted. Jones goes first again, and this time the card that he draws is a red card. Brady goes next and the card that he draws is a red card. Thus, the outcome is that each individual wins £1,000.

Experiment 4

Coins

Imagine two individuals (John and Michael) who are offered the following very attractive proposition. Each individual is asked to toss a coin. If the two coins come up the same (both heads or both tails), each individual wins £1,000. However, if the two coins do not come up the same, neither individual wins anything.

Heads–Tails

John goes first and tosses a head; Michael goes next and tosses a tail. Thus, the outcome is that neither individual wins anything.

Tails–Heads

John goes first and tosses a tail; Michael goes next and tosses a head. Thus, the outcome is that neither individual wins anything.

Cards

Imagine two individuals (John and Michael) who are offered the following very attractive proposition. Each individual is given a shuffled deck of cards, and each one picks a card from his own deck. If the two cards they pick are of the

APPENDIX (Continued)

same color (i.e., both from black suits or both from red suits), each individual wins £1,000. However, if the two cards are not the same color, neither individual wins anything.

Black–Red

John goes first and picks a black card from his deck. Michael goes next and picks a red card from his deck. Thus, the outcome is that neither individual wins anything.

Red–Black

John goes first and picks a red card from his deck. Michael goes next and picks a black card from his deck. Thus, the outcome is that neither individual wins anything.

Experiment 5

Imagine two individuals who are offered the following proposition. Each individual is given a sack of marbles, and each one draws a marble from her own sack. If the two marbles they draw are of the same color (i.e., both are blue or both are white), each individual wins £1,000. However, if the two marbles are not the same color, neither individual wins anything.

After

Anne had her turn and drew a blue marble from her sack; after her, Joan had her turn and drew a white marble from her sack. Thus, the outcome is that neither individual wins anything.

Before

Joan had her turn and drew a white marble from her sack; before her, Anne had her turn and drew a blue marble from her sack. Thus, the outcome is that neither individual wins anything.

(Manuscript received March 10, 1998;
revision accepted for publication January 25, 1999.)