

An illusion of control modulates the reluctance to tempt fate

Chloe L. Swirsky*

Philip M. Fernbach[†]

Steven A. Sloman[‡]

Abstract

The tempting fate effect is that the probability of a fateful outcome is deemed higher following an action that “tempts” the outcome than in the absence of such an action. In this paper we evaluate the hypothesis that the effect is due to an illusion of control induced by a causal framing of the situation. Causal frames require that the action make a difference to an outcome and that the action precedes the outcome. If an illusion of control modulates the reluctance to tempt fate, then actions that make a difference to well-being and that occur prior to the outcome should tempt fate most strongly. In Experiments 1–3 we varied whether the action makes a difference and the temporal order of action and outcome. In Experiment 4 we tested whether an action can tempt fate if all outcomes are negative. The results of all four experiments supported our hypothesis that the tempting fate effect depends on a causal construal that gives rise to a false sense of control.

Keywords: tempting fate, illusion of control, causal reasoning.

1 Introduction

Risen and Gilovich (2008) have shown that taking an action or making a decision that presupposes a certain state of the world can make the opposite state seem more likely, even when the action or decision has no real causal impact. For example, people judge that leaving one’s umbrella at home increases the probability that it will rain. Risen and Gilovich argue that this *reluctance to tempt fate* occurs because an action that presupposes a good outcome leads to anticipated regret and therefore draws attention disproportionately to the negative outcome. The negative outcome then seems more likely because it is more available. In this paper we elaborate Risen and Gilovich’s hypothesis to specify conditions that exacerbate and attenuate the feeling of tempting fate.

Our claim is that it is not merely the availability of the bad outcome that makes it seem more likely. Rather the reluctance to tempt fate stems from an illusory causal belief that the action will influence the outcome, an *illusion of control* (Langer & Roth, 1975). We further argue that this illusion of control depends on a causal construal of the role of one’s action on the outcome. We understand the illusion of control to be more than a feeling that by taking an action one can bring about a desired outcome, when in fact the outcome is due to chance. We take the term “control” to be more general and to encompass any counterfactual dependency between action and outcome,

including a possible action and a bad outcome. Our use of the term “control” denotes a relation between variables, not states of variables.

An agent will feel control over an outcome only if the agent believes (at some level) that his or her action has a causal relation to the outcome. Causality imposes certain requirements on relations between actions and outcomes. First, for an action to cause an outcome, the action must make a difference to the outcome (see Woodward, 2003). Second, the action must precede the outcome (Hume, 1739/2000). People are highly sensitive to these requirements and therefore we propose that they experience a reluctance to tempt fate when there are cues in the environment suggesting that they should frame their actions causally, specifically that an action has the potential make a difference to the actor’s well-being and that the action precedes the determination of the outcome.

By definition, fate-tempting actions have no real causal impact on the outcome in question; bringing or leaving an umbrella does not influence whether it will rain. However such actions can affect well-being in a way that depends on the uncontrolled outcome. For instance, the decision to leave the umbrella at home and the weather jointly determine whether one gets wet. We argue that actions in which well-being is a joint function of the choice and the uncontrolled outcome are likely to inspire a reluctance to tempt because the causal efficacy of the action leads to a sense of control. In contrast, actions that do not directly influence well-being will not seem to tempt fate. We use the term “make-a-difference” to denote a choice that interacts with the uncontrolled outcome to determine well-being.

Temporal priority is another fundamental property of

*Brown University

[†]University of Colorado

[‡]Corresponding Author: Cognitive, Linguistic, & Psychological Sciences, Brown University, Box 1821, Providence, RI 02912. Email: Steven_Sloman@brown.edu.

causal relations and one that people are highly sensitive to (Lagnado & Sloman, 2006). Girotto and Morris (1998) used this principle to provide evidence that an illusion of control mediated choices in a prisoner's dilemma game. They compared behavior in games where the opponent had already chosen (but what they chose was unknown) to cases where the opponent had not chosen yet. People were more likely to cooperate if their opponent had not chosen yet even though their own choice was unknown to the opponent. This suggests that decision-making was influenced by a belief (at some level) that one's choice could influence the opponent even though it was unknown to him or her (see also Robinson et al., 2011 for more evidence about Prisoner's Dilemma and Rothbart & Snyder, 1970 for a demonstration in the domain of gambles). Similarly we hypothesized that the feeling of tempting fate will be attenuated if the outcome has already been determined, even if one lacks knowledge of the outcome. In sum, our hypothesis predicts that the feeling that one is tempting fate should be strengthened when the choice makes a difference to well-being and the uncontrolled outcome has not yet been determined.

In the first study we manipulated both whether the choice makes a difference and the temporal order of outcome and decision to test this prediction. The second study replicated the first using different wording to rule out an alternative explanation. The third study extended the manipulation to a scenario adapted from Risen and Gilovich (2008). The fourth study examined whether the choice must make a difference that matters. We tested whether a choice can tempt fate in a "lose-lose" situation where all outcomes are negative.

2 Experiment 1

All participants were asked to imagine that they have just finished interviewing for a position at their top choice firm far away from their current home, necessitating a move if they get the position. They were asked to consider whether to sign a contract on a house before finding out whether they have been selected for the position. In the "legally binding" conditions participants were told that once they sign the contract, they are legally bound to buy the home. Thus the uncontrolled outcome (whether they get the job) interacts with the decision to determine well-being. Not getting the job is bad, but not getting the job while having signed a legally binding contract is really bad. In the "non-binding" conditions, the protagonist is not legally bound to purchase the home. Therefore well-being is only a function of the uncontrolled outcome, whether or not he or she gets the job. Temporal order was manipulated by indicating that the decision about whether or not he or she got the job had either already

been made but was yet to be communicated or was not yet made. To determine whether signing the contract was seen as tempting fate, we told participants that the protagonist either did or did not sign the contract and asked them to judge the likelihood of not getting the job. A higher likelihood judgment in the "action taken" condition suggests signing the contract is seen as tempting fate.

2.1 Methods

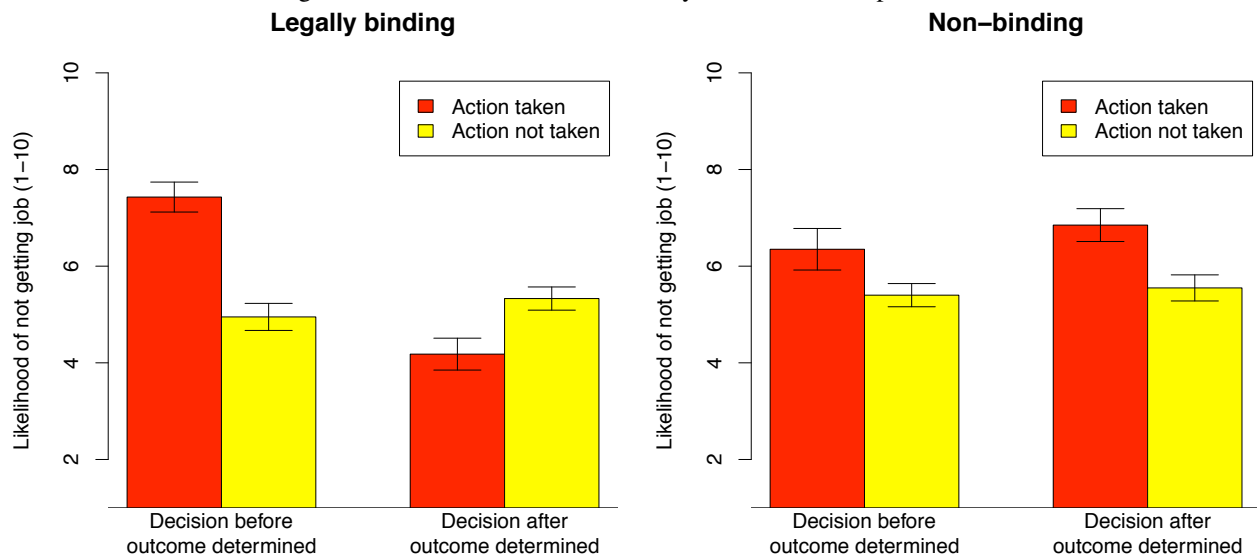
241 people were approached on Brown University's campus or at a supermarket in Providence, RI and participated voluntarily. The *contract type* was manipulated by telling them that the contract is legally binding or not. *Temporal order* was manipulated by stating that the uncontrolled outcome (getting the job) was determined before or after the decision about the contract. The *action taken* variable was manipulated by stating that the protagonist did or did not sign the contract. The vignette is shown below with manipulations in parentheses. The text outside the parentheses represents the legally binding condition in which the decision is made before the outcome is determined and the protagonist takes the action. Italicized sentences are those we manipulated (participants did not see italics) and the text inside the parentheses is labeled with a number to denote the independent variable, 1 for temporal order, 2 for make-a-difference cue relevance and 3 for whether the action is taken:

You have just finished interviewing for a position at your top choice firm. *The management team is meeting in two weeks to make the decision about whether to hire you. So you will not know if you have been hired for two weeks.* (1. *Your interviewer immediately makes his decision about whether he wants to hire you right after the interview is over; but you will not know if you have been hired for two weeks.*) The firm is far away from your current home, so you will have to move if you get the position. After the interview, a realtor offers you a lease on a house in the area 5% below its usual price. If you do not accept the offer now, someone else will take it before you find out whether or not you got the job. But once you sign the lease, *you are legally bound to purchase the house* (2. *you are not legally bound to purchase the house*). After considering all these facts, *you decide to sign the lease for the house.* (3. *you decide not to sign the lease for the house.*)¹

The three-way manipulation yielded 8 conditions, manipulated between participants. Participants received a single piece of paper with the vignette from one of the conditions and were asked to rate the likelihood of *not getting the job offer* by circling a number between 1 (*not*

¹The scenario mistakenly used the word "lease" rather than "contract."

Figure 1: Means and standard errors by condition for Experiment 1.



at all likely) and 10 (*extremely likely*). Thus higher judgments indicate a higher degree of belief in not getting the job.

2.2 Results

Mean likelihood judgments by condition along with standard errors are shown in Figure 1. We subjected the data to a 2 (temporal order) X 2 (non-refundable vs. refundable deposit) X 2 (action taken or not) between-participants analysis of variance. All of the main effects and interactions were significant including the three-way interaction, all F -values $< .05$, except there was no interaction between whether the action was taken and the make-a-difference cue, $F(1, 233) < 1$, ns .

To interpret these findings we conducted separate between-participants ANOVAs on the legally binding and non-binding conditions. Our first critical prediction was that in the legally binding conditions there would be an interaction between judged likelihood when the action was taken versus not taken and the temporal order of the decision and outcome. Confirming this prediction, this interaction was highly significant, $F(1, 157) = 39.0$, $p < 0.001$; participants judged that signing the contract tempted fate only when the decision had not yet been made. This can be seen by comparing the two left-most bars in the chart labeled “Legally Binding” in Figure 1. Unexpectedly, taking the action elicited *lower* judgments when the outcome was determined before the decision, $t(78) = 2.8$, $p < 0.01$ (right-most bars in the same chart). This difference did not emerge in any of the subsequent experiments and we do not discuss it further.

We predicted no interaction in the non-binding condi-

tions and found none, $F < 1$, ns . This can be seen in the chart labeled “Non-Binding” in Figure 1. There was however a main effect of whether the action was taken, $F(1, 76) = 11.7$, $p = 0.001$; participants judged that the action tempted fate regardless of temporal order. This effect is not predicted by our hypothesis and suggests that a reluctance to tempt fate can emerge even when the action does not make a difference, but that this effect does not obey the principle of temporal priority. We discuss this finding at greater length in the General Discussion.

2.3 Discussion

When the action made a difference to well-being participants judged that signing the contract increased the likelihood of not getting the job, but only when the decision had not already been made. This provides evidence for our hypothesis that reluctance to tempt fate is modulated by an illusion of control induced by a causal framing of the decision. The fact that participants had some control over the outcome, i.e., over the possibility that they could be stuck with a legally binding contract on a house they could not use, led them to a false sense that choosing to commit to the home exerted some influence over whether they would get the job.

In this study, temporal order is confounded with whether the outcomes are determined by the interviewer now versus by the team later. This is potentially problematic because it raises the possibility that participants inferred that committing to the home when the outcome has already been determined implied higher confidence in getting the job. In the outcome before decision condition, the outcome may not have been “officially” com-

municated to the candidate, but might have been strongly suggested by the interviewer. This would explain why the likelihood of not getting the job is judged low in that condition: The decision to commit to the home provides diagnostic evidence that the job candidate is confident he or she will get the job.

3 Experiment 2

In Experiment 2 we tested the alternative explanation that the effect of temporal order was due to different levels of confidence in getting the job by rewording the vignette to make it clearer that the candidates did not know whether they got the job. In the presence of a legally binding contract and the action, we compared a condition with the decision before the outcome to one with the decision after the outcome. We expected to replicate Experiment 1's finding of a higher judgment when the decision had not yet been made compared to when it had, even though confidence in getting the job was better controlled across conditions.

3.1 Methods

40 people were approached on Brown University's campus or at a supermarket in Providence, RI, and participated voluntarily. Materials and procedure were identical to Experiment 1 except we varied only temporal order; the contract was always legally binding and the action always taken. Also, the sentence that previously read: "Your interviewer immediately makes his decision about whether he wants to hire you right after the interview is over, but you will not know if you have been hired for two weeks" was changed to read: "The management team has met and they have made their decision about which candidate they will hire. But candidates will not be notified if they have been hired for two weeks. So you will not know if you have been hired for two weeks."

3.2 Results and discussion

Replicating Experiment 1, the action was seen as more fate-tempting when the outcome had not yet been determined, Mean of 6.2 vs. 3.4, $t(38) = 6.8$, $p < 0.01$. This is inconsistent with the alternative explanation that the temporal order effect is due to differing levels of confidence because the wording change equated confidence more closely across conditions.

4 Experiment 3

Experiment 3 extended the manipulation from Experiment 1 to a scenario adapted from Risen and Gilovich

(2008). Participants were asked to imagine that they recently finished applying to graduate school and that Stanford is their top choice. They are looking through their drawers for a shirt to wear and find a Stanford shirt that they had bought when visiting the school. Participants in the "Party" condition read the additional information that they are getting ready to go to a party where a lot of people know they have applied to Stanford. Wearing the sweatshirt publicly could lead to embarrassment if they are rejected from Stanford. Thus the decision to wear the sweatshirt makes a difference as it provides control over the degree of potential embarrassment. We predicted that wearing the sweatshirt would be seen as tempting fate but only when the acceptance decision had not been made yet. We expected no such interaction when there was no party (as in the original vignette).

4.1 Methods

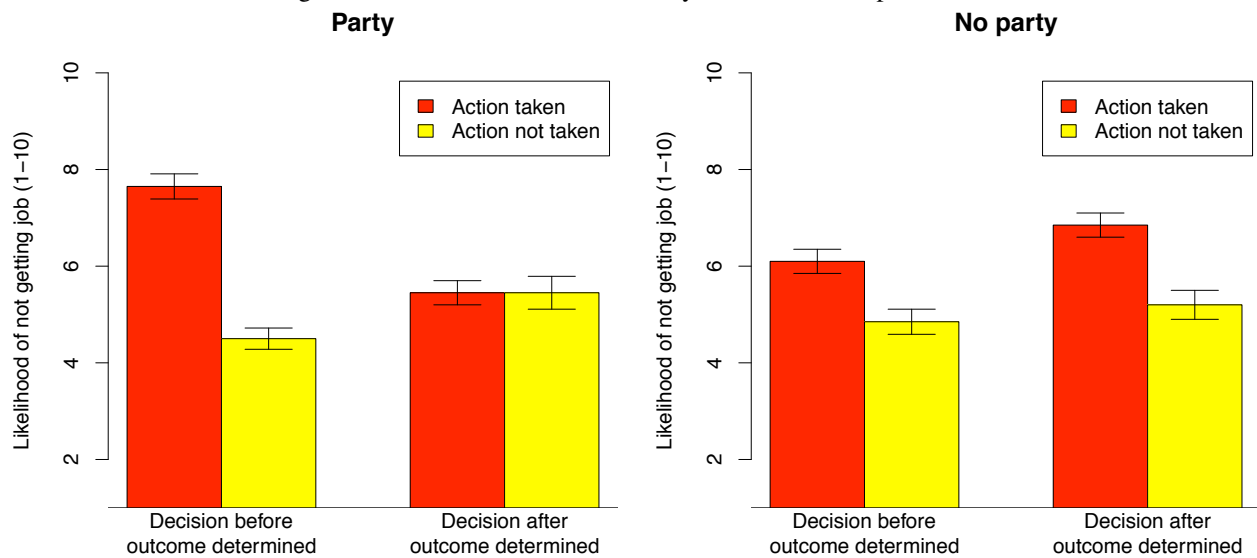
161 participants were obtained as in previous experiments. The design and procedure were identical to Experiment 1. The vignette is shown below with manipulations displayed in the same way as before: The text outside the parentheses represents the condition with the party, with the decision made before the outcome is determined, and with the action taken. Italicized sentences represent the manipulation and parenthesized text is numbered to denote the independent variable: 1 for temporal order, 2 for party vs. no party and 3 for whether the action is taken.

You have applied to Stanford, your first choice graduate school. (1. *A letter from Stanford about your admission status is sitting in your mailbox. But you have not opened it yet so you do not know whether you have been accepted or rejected.*) One day, you are getting ready to go to a party where everybody knows that Stanford is your first choice. (2. *The preceding sentence is omitted in the no party condition.*) You have mostly dirty laundry and are looking for a clean shirt to wear. While looking through your drawers, you find a Stanford shirt that you had bought when visiting the school months before. After considering that you do not know whether or not you have gotten into the school yet and that a lot of people will see you wearing the shirt at the party (2. *The preceding phrase is omitted in the no party condition.*), you decide to wear the shirt. (3. *you decide not to wear the shirt.*)

4.2 Results and discussion

The results are shown in Figure 2. As before we analyzed the data with a 3-way ANOVA which revealed a main effect of whether the action was taken, $F(1, 152) = 62.2$, $p < 0.001$, an interaction between whether the action was taken and the temporal order of the decision

Figure 2: Means and standard errors by condition for Experiment 3.



and outcome, $F(1, 152) = 12.9$, $p < 0.001$, an interaction between temporal order and whether the protagonist attended the party, $F(1, 152) = 13.8$, $p < 0.01$, and a 3-way interaction, $F(1, 152) = 21.4$, $p < 0.001$. To interpret the findings we conducted separate ANOVAs for the party and no party conditions. Corroborating Experiment 1, the predicted interaction was observed only in the party condition, $F(1, 76) = 33.2$, $p < 0.001$, but not in the no party condition, $F < 1$, *ns*. Also replicating Experiment 1, the unpredicted main effect of whether the action was taken was significant in the no party condition, $F(1, 76) = 29.0$, $p < 0.001$.

These results replicate those from Experiments 1 and 2. When the make-a-difference cue was present (the party in Experiment 3 and legally binding contract in Experiments 1 and 2) participants judged that the action increased the likelihood of the bad outcome only when the outcome was not yet decided. Signing a contract and wearing a sweatshirt are quite dissimilar actions, but when the make-a-difference cue is present they both have the potential to exacerbate the loss due to the uncontrolled outcome. The robustness across different scenarios speaks against the possibility that the effect is driven by something idiosyncratic about either vignette. Taken together the experiments provide support for our hypothesis that an illusion of control that depends on a causal frame modulates the reluctance to tempt fate. We also replicated the main effect of tempting fate when no make-a-difference cues were present (the no party condition). Again, this effect is not predicted by our account and is addressed below.

5 Experiment 4

In Experiment 4 we explored the making-a-difference requirement of causality. We hypothesized that the tempting fate effect would be attenuated in cases that involve two bad options. In such cases, the action may still interact to change one of the outcomes, but will not influence overall well-being since the outcome will be bad either way. Participants were asked to imagine that they are college students and that they have a long reading assignment for a large lecture class due the next day. The uncontrolled outcome is whether they are called on in class. In the *win-lose* condition participants were asked to imagine that friends invite them to go out drinking instead of doing the reading. We hypothesized that doing so would tempt fate because doing the reading makes a difference to potential embarrassment in class; getting called on is worse in the case that the reading was not done. In the *lose-lose* condition participants read that they have a ten-page term paper due the following day but they have not started it. The decision was whether to spend more time writing the paper and ignore the reading assignment. In this case, the protagonist has no good option. Despite the fact that doing the reading makes a difference to one outcome (i.e., whether embarrassment ensues if called on in class) it makes little difference to overall well-being, since there is downside either way. We predicted that this would diminish the illusion of control and that the tempting fate effect would therefore be attenuated.

5.1 Methods

171 participants were recruited via Amazon Mechanical Turk and participated online for a small payment. The

design and procedure were similar to the previous experiments except that the make-a-difference cue was always present in the sense that the decision to do the reading interacts with whether one is called on to determine potential embarrassment. Instead we manipulated whether the decision was a *win-lose* or a *lose-lose*. The vignettes for both conditions are shown below. The text outside the parentheses represents the condition where the decision is made before the outcome is determined and the protagonist takes the action. Italicized sentences are those we manipulated (participants did not see italics) and the text inside the parentheses is numbered to denote the independent variable: 1 for temporal order and 2 for whether the action is taken. After reading the vignette participants were asked to judge the likelihood the professor would call on them on a 10-point scale.

Win-Lose

You are a college student and one night you have a long reading assignment for a large lecture class due the next day due. Your friends ask you if you want to go out drinking with them. (1. *Although you are unaware of it, the professor has a particular seat in the classroom in mind and he will ask a question in class the next day about the reading to the person who happens to be sitting in that seat if no one first volunteers to answer.*) You decide not to do the assigned reading for class and instead go out drinking with your friends. (2. *You decide to turn them down and instead spend that time doing the assigned reading for class.*) The next day in the large lecture class, the professor asks the class a question about the assigned reading, but nobody answers. In fact, the class sits in silence for a full two minutes. Then, the professor announces that if nobody can provide an answer he will choose someone randomly.

Lose-Lose

You are a college student and one night you have a ten-page term paper due the following day but you have not started it. You also have a long reading assignment for a large lecture class due the next day. (1. *Although you are unaware of it, the professor has a particular seat in the classroom in mind and he will ask a question in class the next day about the reading to the person who happens to be sitting in that seat if no one first volunteers to answer.*) You decide not to do the assigned reading for class and use the time to work on your paper instead. (2. *You decide to do the assigned reading for class anyway even though it takes up time that you could use to work on your paper instead.*)

The next day in the large lecture class, the professor asks the class a question about the assigned reading, but nobody answers. In fact, the class sits in silence for a full two minutes. Then, the professor announces that if nobody can provide an answer he will choose someone randomly.

5.2 Results and discussion

The results are shown in Figure 3. A three-way ANOVA yielded a main effect of whether the action was taken, $F(1, 163) = 5.2, p < .05$, a main effect of whether the choice had one or two bad outcomes, $F(1, 163) = 9.1, p < 0.01$, and a marginal main effect of temporal order, $F(1, 163) = 3.5, p < 0.1$. The three-way interaction was not significant.

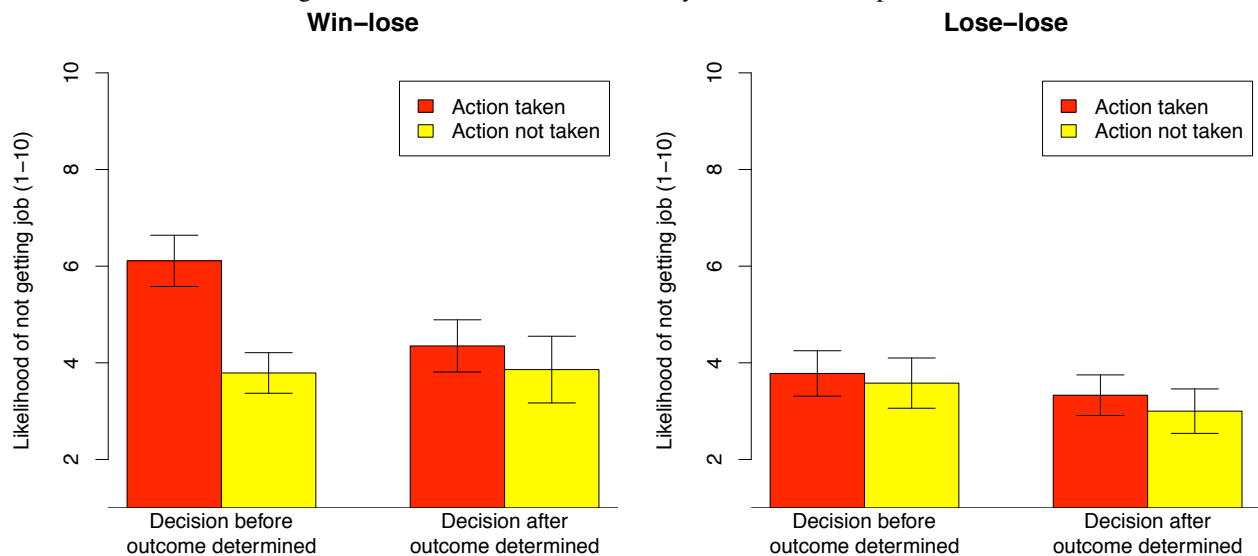
To interpret these results we further analyzed the data with separate ANOVAs for win-lose and lose-lose conditions. In the former, the predicted interaction between temporal order and whether the action was taken was marginally significant $F(1, 88) = 2.9, p < 0.1$. Because the effect was not quite significant we conducted further post hoc comparisons which confirmed that there was a significant difference between taking the action and not taking the action when the outcome was determined after the decision, $t(53) = 3.4, p = 0.001$, but not when it was determined before, $t < 1, ns$. To summarize, going out drinking with friends instead of doing the reading was seen as tempting fate, but only when the uncontrolled outcome was not pre-determined. This corroborates the results of Experiments 1–3.

The unique prediction of no interaction in the lose-lose condition was also confirmed, $F < 1, ns$. Apparently the lack of any good option reduced the sense that not doing the reading tempted fate. This is consistent with the idea that the illusion of control requires a decision that makes a difference to overall well-being. In the absence of a good option, the decision-maker does not really have control over his or her fate. Unlike Experiments 1 and 3, there was no main effect of whether the action was taken, $F < 1, ns$. This may be because all conditions had a make-a-difference cue.

General discussion

The reluctance to tempt fate occurs when the probability of a fateful outcome is deemed higher following an action that “tempts” the outcome than in the absence of such an action. In 4 experiments we tested the hypothesis that the effect is the result of an illusion of control. We did so by varying whether or not the outcome had already occurred (but was unknown) before the tempting action

Figure 3: Means and standard errors by condition for Experiment 4.



was performed. In all 4 experiments, the hypothesis was confirmed: The tempting fate effect was strongest when the action was prior to the outcome. This suggests that tempting fate is at least in part a type of magical causal thinking, belief in the ability to influence events in the absence of a mechanism to do so (e.g., Eckblad & Chapman, 1983; Nemeroff & Rozin, 2000; Woolley, 1997; Zusne & Jones, 1989). Presumably participants would agree and would deny their action would actually influence the fateful outcome.

Experiments 1–3 also tested the hypothesis that the illusion of control requires make-a-difference cues, cues that suggest the agent has control over some outcome even if not the fateful outcome of primary interest. This hypothesis was also confirmed. Make-a-difference cues are likely governed by the same principles that determine other causal attributions (for a review, see Sloman, 2005). For instance, a cue is a good candidate for control if it appears closely prior to the effect, is consistent with the effect, and appears exclusive of alternative causes of the effect (Alloy & Tabachnik, 1984; Einhorn & Hogarth, 1986; Michotte, 1946/1963). Specifically, we expect that an action that occurs just before an outcome can lead one to infer that the agent caused that outcome, even if the outcome is known to be out of the agent's control. Experiment 4 tested the hypothesis that make-a-difference cues will have no effect when all outcomes are negative (the lose-lose conditions) because making a difference to the value of the outcome is a prerequisite for a relation to be causal. This hypothesis was also supported.

Experiments 1 and 3 did produce an unexpected result, a small tempting fate effect in the absence of make-a-difference cues. It may be that there are two indepen-

dent routes to a feeling that an action tempts fate: One arises when there are make-a-difference cues and it respects temporal priority while the other only arises when there are no such cues. The illusion of control appears to be the more powerful contributor however in that the tempting fate effect was always larger in the presence than absence of make-a-difference cues. In fact, we observed no tempting fate effect at all in the lose-lose case of Experiment 4 suggesting the fragility of the effect in the absence of a sense of control.

In conclusion, tempting fate is strongly influenced by an aura of causality. The mere presence of cues suggesting that the agent has control over an event that is not the target event is sufficient to increase the judged probability that the target event will turn out poorly (assuming it is not a lose-lose situation). In this sense, checking the weather report is okay because such an action does not directly influence well-being. In contrast, bringing an umbrella can change one's perspective for provides a sense of control. Unfortunately, the sense of control gets applied to the wrong outcome (whether it will rain as opposed to whether you will get wet). This all holds even though the agent knows that his or her action cannot possibly influence the outcome. In that sense, tempting fate involves a chain of faulty causal inference, from make-a-difference cues that are directed at the wrong outcome to a sense of influence over an event that one knows one cannot influence.

Misguided causal thinking about our actions may arise because one of the ways in which people maintain personal control is to provide reasons for experiences (e.g., Kelley, 1967; Taylor, Lichtman, & Wood, 1984; Weiner, 1985). Engaging in magical causal thinking can support

this effort by allowing a person to believe that his or her thought or action can actually change the situation or provide a solution to a problem (Langer, 1975; Rothbart & Snyder, 1970). Indeed, the more an individual is invested in a situation, the more he or she will search for variables that he or she can control (e.g., Bleak & Frederick, 1998; Friedland, Keinan, & Regev, 1992; Keinan, 1994, 2002; Matute, 1994). The feeling of tempting fate may therefore be the product of a valuable human coping mechanism.

References

- Alloy, L. B. & Tabachnik, N. (1984). Assessment of covariation by humans and animals: The joint influence of prior expectations and current situational information. *Psychological Review*, 91, 112–149.
- Bleak, J. L., & Frederick, C. M. (1998). Superstitious behavior in sport: Levels of effectiveness and determinants of use in three collegiate sports. *Journal of Sport Behavior*, 21, 1–15.
- Eckblad, M., & Chapman, L.J. (1983). Magical ideation as an indicator of schizotypy. *Journal of Consulting and Clinical Psychology*, 51, 215–225.
- Einhorn, H. J. & Hogarth, R. M. (1986). Judging probable cause. *Psychological Bulletin*, 99, 3–19.
- Friedland, N., Keinan, G., & Regev, Y. (1992). Controlling the uncontrollable: Effects of stress on perceptions of controllability. *Journal of Personality and Social Psychology*, 63, 923–931.
- Keinan, G. (1994). Effects of stress and tolerance of ambiguity on magical thinking. *Journal of Personality and Social Psychology*, 67, 48–55.
- Keinan, G. (2002). The effects of stress and desire for control on superstitious behaviour. *Personality and Social Psychology Bulletin*, 28, 102–108.
- Lagnado, D. & Sloman, S.A. (2006). Time as a guide to cause. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 32, 451–460.
- Matute, H. (1994). Learned helplessness and superstitious behavior as opposite effects of uncontrollable reinforcement in humans. *Learning and Motivation*, 25, 216–232.
- Michotte, A. (1963). *The perception of causality* (T. R. Miles & E. Miles, Trans.). New York: Basic Books. (Original work published 1946).
- Morris, W., Sim, H., & Giretto, V. (1998). Distinguishing sources of cooperation in the one-round prisoner's dilemma: evidence for cooperative decisions based on the illusion of control. *Journal of Experimental Social Psychology*, 34, 494–512.
- Hume, D. (2000). *A Treatise of Human Nature*, ed. David Fate Norton and Mary J. Norton. Oxford: Oxford University Press. (Original work published 1739).
- Kelley, H. H. (1967). Attribution theory in social psychology. In D. Levine (Ed.), *Nebraska Symposium on Motivation*. Lincoln: University of Nebraska Press.
- Langer, E. J. (1975). The illusion of control. *Journal of Personality and Social Psychology*, 32, 311–328.
- Langer, E.J., & Roth J. (1975). Heads I win, tails it's chance: The illusion of control as a function of the sequence of outcomes in a purely chance task. *Journal of Personality and Social Psychology*, 32, 951–955.
- Nemeroff, C. & Rozin, P. (2000). The makings of the magical mind. In K.S. Rosengren, C. N. Johnson, & P. L. Harris (Eds.), *Imagining the impossible: Magical, scientific, and religious thinking in children* (pp. 1–34). New York: Cambridge University Press.
- Risen, J. L., & Gilovich, T. (2008). Why People are reluctant to tempt fate. *Journal of Personality and Social Psychology*, 95(2), 293–307.
- Robinson, A. E., Sloman, S. A., Hagmayer, Y., & Hertzog, C. K. (2011). Causality in solving economic problems. *Journal of Problem Solving*, 3, 106–130.
- Rothbart, M. & Snyder, M. (1970). Confidence in the prediction and postdiction of an uncertain event. *Canadian Journal of Behavioral Science*, 2, 38–43.
- Sloman, S. A. (2005). *Causal models: How we think about the world and its alternatives*. New York: Oxford University Press.
- Taylor, S. E., Lichtman, R. R., & Wood, J. Y. (1984). Attributions, beliefs about control, and adjustment to breast cancer. *Journal of Personality and Social Psychology*, 46, 489–502.
- Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review*, 92, 548–573.
- Woodward, J. 2003: *Making Things Happen: A Theory of Causal Explanation*. New York: Oxford University Press.
- Woolley, J. D. (1997). Thinking about fantasy: Are children fundamentally different thinkers and believers from adults? *Child Development*, 68, 991–1011.
- Zusne, L. & Jones, W. H. (1989). *Anomalistic Psychology: a Study of Magical Thinking*. Hillsdale, NJ: L. Erlbaum.

Appendix: Means (standard errors) for Experiments 1, 3 and 4.

Experiment 1		
Legally-binding	Action taken	Action not taken
Decision before outcome determined	7.43 (0.31)	4.95 (0.28)
Decision after outcome determined	4.18 (0.33)	5.33 (0.24)
Non-Binding	Action taken	Action not taken
Decision before outcome determined	6.35 (0.43)	5.40 (0.24)
Decision after outcome determined	6.85 (0.34)	5.55 (0.27)
Experiment 3		
Party	Action taken	Action not taken
Decision before outcome determined	7.65 (0.26)	4.50 (0.22)
Decision after outcome determined	5.45 (0.25)	5.45 (0.34)
No Party	Action taken	Action not taken
Decision before outcome determined	6.10 (0.25)	4.85 (0.26)
Decision after outcome determined	6.85 (0.25)	5.20 (0.30)
Experiment 4		
Win-Lose	Action taken	Action not taken
Decision before outcome determined	6.11 (0.53)	3.79 (0.42)
Decision after outcome determined	4.35 (0.54)	3.86 (0.69)
Lose-Lose	Action taken	Action not taken
Decision before outcome determined	3.78 (0.47)	3.58 (0.52)
Decision after outcome determined	3.33 (0.42)	3.00 (0.46)