

Counterfactuals, Causal Attributions, and the Hindsight Bias: A Conceptual Integration

NEAL J. ROESE

Northwestern University

AND

JAMES M. OLSON

University of Western Ontario, London, Ontario, Canada

Received: July 6, 1994; revised: March 22, 1995; accepted: November 8, 1995

Although past theory and research have suggested that counterfactual thoughts (representations of alternatives to past outcomes) weaken the hindsight bias (after-the-fact exaggeration of an outcome's a priori likelihood), the present research shows the opposite (i.e., positive) relation. Experiment 1 demonstrated that counterfactual thinking can heighten the hindsight bias, and that the effect of counterfactuals on causal inferences can account for this relation. Experiment 2 indicated that postoutcome elaboration of the causal linkage between an antecedent and outcome is essential for the hindsight bias, and that this bias may be redefined to include postoutcome certainty regarding "what should have been" as well as what was. Experiment 3 provided more direct evidence that causal inferences mediate the facilitative effect of counterfactual thinking on the hindsight bias. © 1996 Academic Press, Inc.

I just knew I should have picked door number two. *Let's Make a Deal* contestant

The above comment exemplifies a perception familiar perhaps not only to game show contestants, but to many of us. An unfortunate set of circumstances befalls us and we recognize instantly—alas, too late—that we might have

This research was supported by a postdoctoral fellowship awarded to Neal Roese and a research grant awarded to James Olson, both from the Social Sciences and Humanities Research Council of Canada. We thank Dave Hamilton, Dale Miller, Mike Ross, Richard Sorrentino, Yaacov Trope, and two anonymous reviewers for providing valuable comments on various versions of the manuscript. We are also grateful to Eileen da Pena for her assistance in running the first experiment. Correspondence and reprint requests should be addressed to Neal Roese, Department of Psychology, Northwestern University, Evanston, IL 60208-2710. e-mail: roese@nwu.edu. Counterfactual research news is posted at the web site, <http://www.psych.nwu.edu/people/roese>.

done something to avoid it. This perception embraces three inferences: A counterfactual (i.e., that the outcome in question could have occurred differently than it did), a causal attribution (i.e., a specification of the outcome's cause, such as a critical decision), and a bias of hindsight (i.e., a postoutcome exaggeration of the a priori predictability of the outcome, such that one believes that one "knew it all along"). The goal of this article is to synthesize these three elements into a coherent model. Three experiments are described that provide evidence for three key assertions. First, consideration of a counterfactual conditional (specifying an "if-then" alternative to the obtained outcome) increases the magnitude of the hindsight bias. Second, the mechanism underlying this effect is based on a causal attribution process: counterfactual conditionals yield causal information, the clarity and explanatory value of which may then increase hindsight certainty. Third, the hindsight bias may be expanded to embrace a postoutcome enhancement of certainty directed not only to what was, but also to what might have been. Our introduction elaborates on each of these ideas.

The Hindsight Bias

People commonly perceive past outcomes to be clear and understandable relative to the uncertainty of future possibilities. This "knew-it-all-along" effect, or hindsight bias, has become an enduring and robust psychological finding (see Christensen-Szalanski & Willham, 1991; Hawkins & Hastie, 1990, for reviews). The hindsight bias represents more than simple learning from past experience; it describes an inability to retrieve one's pre-outcome explanatory perspective. It is, therefore, "a projection of new knowledge into the past accompanied by a denial that the outcome information has influenced judgments" (Wasserman, Lempert, & Hastie, 1991, p. 30).

The effect seems to be rooted primarily in the purely cognitive process labeled "rejudgment" by Hawkins and Hastie (1990). People "make sense" of the past by superimposing structure and simplicity on their recollections of it. Outcome information is rapidly, effortlessly assimilated into a schematic representation of the past and, unbeknownst to the perceiver, powerfully affects perceptions of the causal structure of past outcomes (Fischhoff, 1975). Selective recall of information congruent with the outcome, cued by the outcome itself, contributes to causal inferences linking specific, promotive antecedents to the outcome (Schkade & Kilbourne, 1991; Wasserman *et al.*, 1991; see also Read, 1987). The result is a modification of the perceiver's "generic model of causal relations in the domain under consideration" (Hawkins & Hastie, 1990, p. 322), and the exaggerated after-the-fact belief that the outcome was quite predictable before the fact.

Fischhoff (1975) coined the term "creeping determinism" for his interpretation that the hindsight bias represents a post hoc perception of inevitability, one that has "crept up" on the individual after a preoutcome view that was much less certain. In support of this view, Fischhoff quoted historian Georges Florovsky:

In retrospect, we seem to perceive the logic of the events which unfold themselves in a regular or linear fashion according to a recognizable pattern with an alleged inner necessity. So that we get the impression that it really could not have happened otherwise (cited in Fischhoff, 1975, p. 288; also cited in Fischhoff, 1982).

But exactly what *sort* of determinism is creeping here? The above quotation clearly asserts that the hindsight bias precludes, or is incompatible with, propositions of what might have been (i.e., counterfactuals), an assumption that has been pervasive in this literature. However, a useful distinction between two kinds of hindsight judgment (and hence two kinds of determinism) must be stressed. The above description refers to a retrospective likelihood judgment that is unconditional; that is, it is not contingent upon any antecedent conditions. This corresponds to what some philosophers have called *actualism*; i.e., the belief that what happened in the past had to have happened *no matter what* (Ayer, 1968; Berofsky, 1966; Dennett, 1984). This type of hindsight would certainly be inversely related to counterfactual musings (i.e., the belief that what happened was the only, predestined way in which things could have unfolded certainly precludes admission of an alternative outcome). Actualism, however, is not only unworkable philosophically (Dennett, 1984), at odds with the very practice of science (Bunge, 1970), but likely does not characterize lay perceptions either.

In contrast, a likelihood judgment of a past outcome that is conditional—in other words, that is contingent upon the preoccurrence of some causally potent, generative antecedent condition—is more often equated with the determinism typically assumed by scientists (Bunge, 1970). According to this view, a past outcome is viewed to have been certain (i.e., “determined”) only to the extent that its cause preceded it. In this case, one can very easily point to the counterfactual inference that had its causal antecedent not been present, the outcome would not have occurred. This form of determinism is the one most often assumed by present-day philosophers and scientists (Bunge, 1970) and very likely also forms the basis of the hindsight bias. More specifically, the core assertions of this article are (a) that the hindsight bias is largely limited to conditional (or contingent) likelihood judgments, and (b) that given this conditionality, counterfactual thinking is not only compatible with the hindsight bias, it may also increase it. We examine this causal relation in greater detail in the next section.

Counterfactual Thinking

The actualist, unconditional likelihood interpretation of the hindsight bias (as represented by the Florovsky quotation) as a denial of outcome alternatives seems at odds with a growing literature detailing the ubiquity of counterfactual thoughts—thoughts that explicitly specify outcome alternatives. Counterfactual thinking refers to the consideration of alternatives to

past outcomes, to "what might have been" (e.g., Kahneman & Miller, 1986; Kahneman & Tversky, 1982; Miller, Turnbull, & McFarland, 1990; Roese & Olson, 1993a, 1995a). "If only" prefixes exemplify such thoughts (e.g., "If only she had studied, she would have passed") and they are frequently conceptualized as conditional propositions, embracing both an antecedent (e.g., studying) and a consequent (e.g., passing). As in the above example, counterfactuals often focus prescriptively on what "should have been" (Gilovich, Medvec, & Chen, 1995; Miller & Taylor, 1995; Miller & Turnbull, 1990); that is, on what decisions or actions might have led directly to a more desired outcome and thus "ought" to have been implemented. Recent research has focused on the beneficial effect of generating such counterfactuals, in that they may often elucidate plans and behavior that lead to future betterment (Johnson & Sherman, 1990; Markman, Gavanski, Sherman, & McMullen, 1993; Roese, 1994; Roese & Olson, 1995b; but see also Sherman & McConnell, 1995).

As argued previously, several theorists have embraced the actualist definition of hindsight bias, focusing on how an unconditional likelihood judgment of outcome certainty should preclude thoughts of what might have been. For example, Kahneman and Varey (1990) noted the "intriguing tension" between counterfactuals and the hindsight bias, noting that "X is neither necessary nor inevitable if it can properly be said that Y almost happened instead of [X]" (p. 1103). This assumption has been echoed by several authors: "To the extent that counterfactuals are easily and spontaneously generated, the past seems less inevitable: Other outcomes were clearly possible" (Sherman, 1991, p. 182). Indeed, there is some experimental evidence to suggest that the elicitation of counterfactual thoughts reduces the hindsight bias. For example, the more alternatives to a stated outcome that subjects consider, the lower the median likelihoods ascribed to these outcomes (Fischhoff, 1976, Experiment 2). Also, subjects requested to consider how a published experimental outcome might have turned out otherwise reduced their expectations that the experiment could be replicated (Slovic & Fischhoff, 1977, Experiment 2).

In contrast, when we define the hindsight bias in terms of scientific determinism, that is, in terms of conditional likelihood judgments, it becomes clear that counterfactuals may be positively, rather than negatively, related to the hindsight bias. This relation rests on the idea that causal assertions explain an outcome. And explanations breed certainty (Anderson, Lepper & Ross, 1980; Anderson & Sechler, 1986). To the extent that the generating conditions for a given outcome are explained and understood, the outcome should appear more certain in retrospect, at least insofar as those generating conditions continue to hold. Thus, counterfactuals that explain an outcome by influencing a causal inference should increase estimates of conditional likelihood. This positive relation of counterfactuals and hindsight bias rests on the effect of counterfactuals on causal attributions, to which we turn next.

Causal Attributions

Counterfactual conditionals are essentially causal statements (Mackie, 1974; Roese & Olson, 1995a). If a student believes that “if only she had bought the study guide, she would have passed her exam,” she has articulated the causal contingency between study guides and grades: buying a study guide causes better grades. Counterfactual conditionals embody the “manipulability” criterion of causality embraced by modern scientists (White, 1990). Thus, asserting that the addition or deletion of antecedent X “undoes” outcome Y leads to the causal attribution that X caused Y. Wells and Gavanski (1989) described two experiments demonstrating this relation. These authors manipulated whether the deletion of a salient antecedent action undid an outcome. Greater attributions of responsibility resulted when the counterfactual so generated undid the outcome (e.g., “If X were different, the outcome would have been avoided”) than when the counterfactual could not undo the outcome (e.g., “Even if X were different, the outcome would have been the same”).

The hindsight bias, according to current consensus, resides in an elaborative restructuring of the outcome’s mental representation upon receipt of outcome information (Fischhoff, 1975; Hawkins & Hastie, 1990). That is, people perceive the occurrence of an outcome and are compelled to make sense of it. They erect a conceptual superstructure that binds the outcome to their implicit assumptions regarding the workings of the world. At the heart of this processing is attributional, or causal reasoning. By elaborating the causal structure enmeshing an outcome and, hence, articulating those causal antecedents that brought it about, the outcome becomes more predictable, more inevitable. Recent evidence confirms the relation of causal judgments to the hindsight bias. Wasserman *et al.* (1991) demonstrated that when subjects could make clear, “deterministic” attributions regarding an outcome, the hindsight bias was increased relative to cases where more random factors seemed at play. The clearer the attribution of the outcome to a specific antecedent, the greater the magnitude of the hindsight bias (see Nario & Branscombe, 1995). In another vein, expectancy-disconfirmation, previously shown to trigger attributional thinking (e.g., Hastie, 1984; Weiner, 1985), has been similarly shown to heighten the hindsight bias. In research by Schkade and Kilbourne (1991), outcome knowledge created greater certainty regarding the outcome’s likelihood (relative to no-outcome conditions), but this hindsight effect was greater when the outcome was inconsistent rather than consistent with past performance. Thus, previous evidence converges to suggest the facilitating impact of causal attributions on the hindsight bias.

This relation between counterfactuals and attributions, and between attributions and the hindsight bias, leads very naturally to the prediction that generating a counterfactual conditional targeting a specific outcome should increase the hindsight bias associated with that outcome. Counterfactual

conditionals illuminate the causal contingency between a given antecedent and outcome, which in turn heightens the explanatory clarity, and hence certainty, directed toward the outcome. In Experiments 1 and 3, we document the effect of counterfactual thinking on causal attributions and on the hindsight bias, showing that causal attributions mediate the positive impact of counterfactuals on the hindsight bias.

This reasoning also invokes important limiting conditions on the positive effect of counterfactuals on the hindsight bias. First, for the effect to occur, individuals must recognize the causal implications of the counterfactual they have generated. Second, the counterfactual must be a conditional, and it must undo the outcome, in order for it to result in the type of causal attribution that can increase the certainty directed toward an outcome (Kahneman, 1995). If the counterfactual is not a conditional (i.e., a “close counterfactual” that specifies only some narrowly missed outcome but no antecedent condition), or if it fails to undo the outcome (which would suggest that the considered antecedent is not causally potent), then no compelling explanation for “why” the outcome occurred can be advanced, and hindsight certainty will not increase.

An intriguing implication of this line of reasoning is that the hindsight bias may represent more than an enhanced after-the-fact certainty regarding the occurrence of an outcome. The hindsight bias involves a shift in the individual’s causal model of the domain under consideration; based on the above argument, counterfactual inferences are an integral component of such models. Thus, by extension, the hindsight bias may also represent an enhanced post hoc certainty that another outcome could have, or perhaps should have, occurred. This extension of hindsight “certainty” to counterfactual alternatives may form the basis for the “armchair quarterback.” When sports fans watch their favorite team lose, they may demonstrate the classic hindsight bias in noting that the loss was predictable and inevitable, given, for example, certain foolish decisions made by the coach. But note that this same post hoc certainty may also apply to decisions the coach *should have* made and that would have resulted in victory. That is, fans may believe that the team certainly would have won if only the coach had made different decisions. Both types of certainty, one directed to what was and the other to what should have been, reflect the output of active attempts to “make sense” of the past, and both are rooted in post hoc attributions. In Experiment 2, we show that the hindsight bias reflects the effect of outcome knowledge on both perceptions of the obtained outcome (as has traditionally been shown) and also perceptions of what should have been.

EXPERIMENT 1

The first experiment was designed to show that a manipulation of counterfactual availability can influence both causal and hindsight judgments. Specifically, if a counterfactual conditional “undoes” the target outcome (i.e., the

mental alteration of some antecedent results in the mental elimination of the outcome), then judgment of the causal contingency between the antecedent and outcome, and therefore of the predictability of the outcome (i.e., the hindsight bias), should be heightened, relative to the case where the counterfactual fails to undo the outcome.

In this experiment, subjects read a scenario depicting a student's preparations for an important exam. She engages in several preexam undertakings (the target causal antecedents), some facilitative and others inhibitory of success on the exam. To examine the role of undoing, we manipulated covariation information regarding one of these antecedent actions. The action was either consistently or inconsistently successful in the past. However, in the present circumstance, the action was *dormant*: The protagonist failed to make use of it. Thus, the only way that subjects could see any relevance of this antecedent to the present situation was to elaborate it counterfactually (i.e., to consider whether it *would have* had an effect *if it had been* employed in present case). To be more specific, the protagonist in the scenario suffers panic attacks, for which she has been prescribed pills. These pills were described as either frequently or rarely effective in the past (i.e., a manipulation of consistency information). On the day of her exam, she forgets to take her pill. Hence, subjects could generate the respective counterfactuals that "if she had taken her pill, she may have performed better" (the undoing condition) or "even if she had taken her pill, her performance would have been the same" (the no-undoing condition). We predicted that undoing (vs no-undoing) would heighten perceptions of the causal potency of forgetting to take the pill, but would have no effect on causal perceptions regarding the other antecedent actions. Further, we predicted that undoing (vs no-undoing) would magnify the hindsight bias.

In order to shed some light on the motivational underpinnings for our model, we also manipulated outcome.¹ The rationale for this manipulation derives from three related lines of research. First, counterfactual thinking may be triggered by negative and unexpected outcomes (Kahneman & Miller, 1986; Olson, Roese, & Deibert, 1996; Roese & Olson, 1995a). Second, several studies have shown that attributional thinking also becomes more vigorous following negative and unexpected outcomes (Hastie, 1984; Weiner, 1985). Because counterfactual inferences underlie many attributional judgments (Lipe, 1991; Wells & Gavanski, 1989), the impact of outcome on counterfactuals may account for the effect of outcome on attributions. Third, the hindsight bias is also heightened by negative and unexpected outcomes (Schkade & Kilbourne, 1991). Because negative and unexpected events are

¹ Our use of the term "motivation" focuses on the basic impulsion to avoid aversive outcomes and approach gratifying outcomes. Hence, negative outcomes may be said to motivate avoidance behavior and also to mobilize cognitive activity designed to minimize damage and facilitate future avoidance behavior (Taylor, 1991). By contrast, previous research on the hindsight bias has used the term motivation to refer to impression management goals (Leary, 1982), individual differences in need for closure (Campbell & Tesser, 1983), and monetary goals (Hell et al., 1988).

those most likely to motivate “sense making” cognitive activity (an inherently functional and survival-oriented response), these sorts of outcomes should elicit counterfactual and attributional judgments, thereby increasing the hindsight bias. In this experiment, we used three levels of outcome, with valence and expectancy deliberately confounded.² We predicted an interaction between undoing and outcome, such that the undoing effect would be stronger on both attributions and the hindsight bias in the negative outcome conditions, relative to the neutral outcome condition.

Method

Subjects. Subjects were 100 students (54 women, 46 men) enrolled in introductory psychology classes at the University of California at Santa Barbara, participating for course credit. Subjects were randomly assigned to the 6 conditions of a 2 (undoing) \times 3 (outcome) factorial design.

Materials and procedure. Subjects were seated individually in small rooms containing IBM-compatible computers. They completed the study privately and anonymously. After a brief introduction, the computer program displayed the scenario 2 sentences at a time; subjects pressed ENTER when they wished to move on to the next sentences. The scenario described Sarah, an undergraduate student preparing for an important exam (adapted from Roese & Olson, 1993b). Four antecedents focusing on Sarah’s preparation were detailed. Two were success-facilitative (extra reference material, saw last year’s exam) and 2 were success-inhibitory (went out with friends, forgot to take pill). The undoing manipulation, as noted previously, was based on whether the counterfactual antecedent, “if Sarah had remembered to take her pill,” undoes the outcome. In the undoing condition, the description of the pill’s past effectiveness suggests the counterfactual that “Sarah would’ve done better,” but in the no-undoing condition, the description of the pill’s ineffectiveness suggests the counterfactual that “Sarah wouldn’t have done any better.” Further, the outcome was described as being neutral (Sarah receives a grade of 70%), mildly negative (55%), or extremely negative (40%). The scenario read as follows:

Sarah is a freshman student in university. She is a typical student in most respects, getting grades that average around 70% in her first quarter. Sarah has an important midterm exam coming up in her psychology class. She begins to prepare about a week before the exam date, intent on getting at least her customary grade (70%). As she always did before an important exam, Sarah went to the library to look over some extra reference material. Three nights before the exam, Sarah was invited out by old friends from high school. Because she hadn’t seen them for several months, she decided to go, even though she had planned to study that night. Two days before the exam, Sarah happened to run into an old friend, Lynn, who had taken the same psychology course the

² The point of this manipulation was to operationalize the situational impulsion for “sensemaking.” Both negative and unexpected outcomes have been conceptualized in precisely these motivational terms. Nevertheless, it should be noted that these are distinct constructs, and controversy has centered on which might account for the other in terms of their attributional effects (e.g., Bohner, Bless, Schwarz, & Strack, 1989; Kanazawa, 1992; Olson, Roese, & Zanna, 1996). Complicating matters is the fact that the two constructs covary naturally: Negative outcomes are frequently unexpected. However, this controversy does not bear directly on the present research, as separate assertions regarding one or the other construct are never made. For the sake of clarity, we label levels of the manipulated variable in terms of valence (neutral, mildly negative, extremely negative), but of course, these levels also represent levels of expectancy (expected, mildly unexpected, extremely unexpected).

year before and had copies of last year's exams. Sarah studied some of these exams closely to get an idea of the kinds of questions that might be on her exam. Just before sitting down to take exams, Sarah usually swallows a pill prescribed by her doctor for the panic attacks she often suffers. Sarah almost always takes a pill before exams, and it often seems to make her feel better [even though it rarely seems to make her feel better]. On the day of her psychology exam, however, she forgets to take her pill. Sarah does her best on the exam. A week later, she learns that her grade on the exam is 70% [55%, 40%].

Several 9-point rating scales then appeared onscreen one at a time, and subjects were requested to press a number between 1 and 9 for each. Appearing first were two items assessing the hindsight bias: "How predictable in advance was Sarah's grade on the exam?"; "How inevitable was Sarah's grade on the exam?" These ratings were anchored, respectively, by "not at all predictable" and "extremely predictable," and by "not at all inevitable" and "extremely inevitable." Subjects then rated the causal potency of the four antecedents. The antecedent was first described by a single sentence (e.g., "Sarah forgot to take her pill"), followed by the question, "How big of an effect did this have on her grade?" Nine-point ratings were anchored by "very small effect" versus "very large effect." Two ratings followed that assessed global perceptions of Sarah's actions. The first focused on controllability: "How much control did Sarah have over her grade?" The second was a rating of global internal attribution for the outcome: "Overall, how large an effect did Sarah's actions have on the grade she received?" These ratings were anchored, respectively, by "not at all under her control" and "completely under her control," and by "very small effect" and "very large effect."

Finally, manipulation checks were completed. The valence and expectancy disconfirmation components of the outcome manipulation were assessed by the questions, "How upsetting do you think Sarah found her grade on the exam?" and "How surprising do you think Sarah found her grade on the exam?" These ratings were anchored, respectively, by "not at all upsetting" and "extremely upsetting," and by "not at all surprising" and "extremely surprising."

Results and Discussion

Manipulation check. Ratings of "upsetting" and "surprising" were assessed using 2 (undoing) \times 3 (outcome) ANOVAs as checks on the outcome manipulation. Both revealed only the expected main effect of outcome, $F_s(2, 94) = 231.79, 78.92, ps < .001$. As the outcome became more negative, subjects rated it as more upsetting ($M_s = 2.06, 7.00, 7.33$) and more surprising ($M_s = 1.97, 6.34, 6.29$). There was no formal check on the undoing manipulation, but given its success in previous research (e.g., Boninger, Gleicher, & Strathman, 1994; Wells & Gavanski, 1989), we did not foresee difficulties with it.

Causal potency. The 4 ratings of causal potency directed at the 4 target antecedents were first assessed by MANOVA, in which undoing and outcome were between-subject factors. Only the main effect for outcome was significant, multivariate $F(8, 184) = 8.20, p < .001$. Univariate ANOVAs confirmed that the main effect for outcome was reliable on all 4 ratings ($F_s > 5, ps < .01$). The success-facilitating antecedents (extra references, last year's exam) were rated as less causally potent as the outcome became more negative (averaged $M_s = 5.46, 4.25, 3.99$, respectively). The success-inhibiting antecedents (forgot pill, went out with friends) showed the reverse pattern as the outcome became more negative (averaged $M_s = 3.88, 5.83, 5.78$, respectively). Thus, ratings of causal potency, depending on their facilitative or inhibitory nature, were equivalently influenced by the outcome manipulation.

The above findings represent the expected backdrop against which we tested our central prediction regarding the effect of undoing on causal judgments. This hypothesis centered on the undoing main effect in each of the univariate ANOVAs performed on the 4 causal potency ratings. As expected, of the 4 antecedents, only "pill" ratings were sensitive to the undoing manipulation, $F(1, 94) = 3.80$, $p = .05$; $F_s < 1$ for the other 3 ratings. As expected, Sarah's forgetting to take her pill was rated as more causally potent in the undoing ($M = 5.15$) than in the no-undoing condition ($M = 4.57$). Thus, the counterfactual undoing manipulation did not influence causal perceptions in general, but only the one causal inference that centered on the antecedent that could "undo" the outcome in question.

This latter conclusion was further reinforced by 2×3 ANOVAs of controllability ratings and global internal attribution ratings. In neither analysis was the main effect for undoing reliable. No other effects were reliable on controllability ratings, and only the expected (though uninteresting) effect of outcome was reliable in the internal attribution analysis, $F(2, 94) = 245.74$, $p < .001$. Subjects saw Sarah's actions as playing a larger role in general as the outcome became more negative ($M_s = 1.53, 6.91, 7.35$, respectively).

Hindsight. A 2 (undoing) \times 3 (outcome) ANOVA performed on predictability ratings revealed a marginally significant main effect for undoing, $F(1, 94) = 3.64$, $p = .06$. Subjects able to undo the outcome saw it as more predictable ($M = 5.40$) than those not undoing it ($M = 5.08$). As well, the more negative the outcome, the less predictable it seemed ($M_s = 6.15, 5.56, 4.50$), $F(2, 94) = 8.44$, $p < .01$. The hypothesized interaction between these two factors was marginally significant, $F(2, 94) = 2.82$, $p = .06$, such that the largest effect of undoing occurred, as expected, within the extremely negative outcome condition, $t(94) = 2.44$, $p < .05$ ($M_s = 5.40$ vs 3.79 for undoing and no-undoing, respectively).³ Neither of the other pairwise contrasts were reliable. Means from this interaction appear in Table 1. Another 2×3 ANOVA performed on ratings of inevitability (the other operational measure of hindsight bias) revealed no reliable effects. Informal comments by subjects suggested that some did not understand the meaning of "inevitable," thus invalidating the measure.

These results supported our hypotheses. First, the manipulation of counterfactual availability indicated that a counterfactual that *undoes* an outcome (relative to one that does not) heightens the perceived causal potency of that, and only that, antecedent. This finding is essentially a replication of Wells and Gavanski (1989). More important was our finding that this undoing manipulation also influenced ratings of the outcome's a priori predictability. Thus, generating a counterfactual that undoes the outcome heightened the hindsight bias. This experiment represents the first clear evidence that the relation

³ Unless otherwise noted, pairwise contrasts are 2-tailed and based on the mean square error term from the relevant ANOVA.

TABLE 1
EFFECT OF UNDOING AND OUTCOME ON PREDICTABILITY (EXPERIMENT 1)

	Outcome		
	Neutral	Mildly negative	Extremely negative
Undoing	6.41 (17)	5.40 (15)	5.40 (15)
No-undoing	5.88 (17)	5.71 (17)	3.79 (19)

Note. Higher values indicate greater outcome predictability. Parenthetical values indicate *n*. Means within the last column only differ at $p < .05$.

between counterfactuals and the hindsight bias may be characterized as positive rather than negative.

Further, the motivational basis of our perspective was supported. Although counterfactual thinking heightened the hindsight ratings overall, the counterfactual manipulation exerted its strongest effect when the outcome was extremely negative and unexpected. This finding parallels that of Schkade and Kilbourne (1991), but also supports the assertion that situational factors that motivate sensemaking activity accentuate the impact of counterfactuals on the hindsight bias. In other words, the impulsion to make sense out of unwanted or unexpected circumstances constitutes the psychological glue that binds together counterfactual thinking, causal attributions, and the hindsight bias.

EXPERIMENT 2

One obvious criticism of the first experiment is that it did not examine the hindsight bias per se as it has been traditionally operationalized. All subjects simply rated the a priori predictability of the target outcome after the fact, precluding a comparison of judgments with and without outcome information (as was possible in Fischhoff, 1975; Fischhoff & Beyth, 1975). Also, some of the relations attained only marginal significance. To provide more compelling evidence for our arguments, we sought additional evidence in Experiment 2 within the traditional between-subject hindsight bias paradigm.

Two variables were manipulated orthogonally: a decision made by an actor, and the consequent outcome. Subjects read a scenario that was loosely based on events that occurred during the First World War. Like previous hindsight bias studies using a historical scenario format (e.g., Fischhoff, 1975; Wasserman *et al.*, 1991), several incidents culminated in a focal outcome. The scenario differed from previous studies in that it contained a specific decisional juncture; that is, a critical decision was described (a choice between three options), the consequences of which formed the focal outcome. Although three options for the decision were described, one was clearly a poor choice. The actor's decision constituted the first manipulation (the actor is described as choosing one or the other of the two attractive options). Outcome was also

manipulated (no-outcome, positive outcome, negative outcome). This paradigm allowed for the examination of hindsight effects in their traditional guise (e.g., likelihood ratings of the outcome compared between outcome and no-outcome subjects). It also permitted an assessment of perceptions of what “should have been” (i.e., counterfactual prescriptions for the avoidance of the outcome). That is, a decision to act on one of two attractive options followed by negative consequences was expected to evoke “if only” thoughts about the other option.

Two goals guided this experiment. First, we examined the effect of outcome information on likelihood estimates to document the hindsight bias in its traditional between-subjects guise, and assessed the mediating role of causal attributions by tapping subjects’ cognitive elaboration of the antecedent-outcome contingency. As we have argued, recognition and elaboration of the linkage between a plausible, focal antecedent X and the outcome Y, yielding a causal inference that X caused Y, represents a central mechanism underlying the development of biases of hindsight. In other words, people will find an outcome predictable and unsurprising only to the extent that they can explain it or make sense of it: this explaining and sensemaking resides in identifying a plausible cause for the outcome. From this perspective, the hindsight bias should not reflect the perception that Y was completely inevitable (the actualist interpretation of creeping determinism), but rather that it was inevitable only under the existing conditions that gave rise to it (the scientific determinism interpretation). If X is assumed to have caused Y, people should exaggerate the likelihood of Y only when X is assumed to precede Y; they should evince no such bias when speculating about Y when X is absent. Consequently, we predicted that differences in contingent likelihood judgments would be influenced interactively by both the decision (antecedent) and outcome manipulations. Thus, relative to no-outcome subjects, outcome subjects were expected to view the factual outcome as more likely only to the extent that the observed antecedent option also occurred. However, these same individuals should rate the possibility of the outcome arising from different antecedent conditions as much less likely. This pattern would tell us that the formation of the hindsight bias depends on causal inferences, but more specifically, on the elaboration of a specific antecedent-outcome linkage.

This prediction suggests our second main hypothesis. The greater the postoutcome certainty that outcome Y was inevitable under conditions X, the greater the certainty that changing X would have altered the outcome. To return to the armchair quarterback analogy, at game’s end a disappointing loss seems obvious in its predictability, in large part because specific causes for the loss have now been elaborated (e.g., the quarterback’s lousy pass in the game’s final minutes). At the same time, our armchair aficionado is now utterly convinced that with a completed pass, he would now be reveling in a stunning victory. In other words, outcome information has two hindsight bias effects: Exaggerated certainty directed at the factual outcome (what happened) and

exaggerated certainty directed at a counterfactual outcome (what should have happened). Moreover, both depend on the attribution of the outcome (e.g., the loss) to a plausible causal antecedent (e.g., the quarterback's pass). Thus, agreement ratings with prescriptive statements (e.g., which of several options "should have" been chosen) were expected to be higher in the outcome than no-outcome conditions, but also to vary as a function of the outcome and decision manipulations. Specifically, subjects were expected to endorse counterfactual "should have" statements focusing on an alternative decision option to a greater extent when the option that was chosen resulted in a negative rather than a positive outcome.

Method

Subjects. Subjects were 85 students (45 women, 40 men) enrolled in introductory psychology at the University of Western Ontario who participated for course credit. Subjects were randomly assigned to the 6 conditions of a 2 (decision) \times 3 (outcome) factorial design.

Materials and procedure. Subjects were seated individually in small rooms and given a typed scenario and a separate questionnaire booklet. They completed the study privately and anonymously.

All subjects first read a one-page scenario describing events that occurred during the First World War. The scenario was modeled loosely on the German attack and destruction of the university town of Louvain, Belgium in August, 1914 (see Tuchman, 1962), and focused on a decision made by a protagonist named Jensen. The consequences of the decision could potentially be either the destruction or deliverance of an unnamed Belgian village. One of the options (#1) was designed to be unattractive; the other two attractive options were manipulated (i.e., Jensen chooses either option #2 or #3). The scenario was as follows:

During the first month of the First World War (1914–1918), hundreds of thousands of lives were lost during the Battle of the Frontiers. At this time, the Germans fought the French and the British along the border between Germany and France. In these early weeks, the Germans quickly acquired a reputation for being ruthless and harsh, particularly as they burned and terrorized villages in Belgium and France.

During the battle, a small British force accidentally encountered a much larger German force. The British were forced to retreat into a small village, putting all the peaceful villagers into extreme danger of attack. The villagers were mainly farmers, and among them were many children. Unfortunately, the British commander (Lt. Dorian Moore) was slow, inexperienced, and indecisive. Moore ordered his troops to stay in the village, and to simply wait for a German attack. This spelled certain doom for the village.

One British soldier was Thomas Jensen. He was only 20 years old and, although somewhat shy and uncertain of himself, he was bright and had already involved himself in several minor military decisions for the British. He saw a way of luring the Germans away from the village, thereby saving the village from destruction. The more he worked on his plan, the more he became convinced that he could save the village, as well as his fellow soldiers. The problem was: since he was so young, it was very unlikely that Moore would listen to him.

Jensen faced a difficult decision. As he saw it, he had three alternatives: 1) He could simply forget his plan and follow the orders Moore had already given. 2) Since he was well-liked, he could organize his fellow soldiers to disobey Moore's orders, and to follow his plan instead. 3) He could carefully explain his plan to another officer, and have that officer tell Moore. With luck, Moore might order the troops to follow the plan.

Of these three choices, choice 1 was the least attractive (since it meant certain doom for the village). Choice 2 was the riskiest to Jensen himself (he could be tried and shot for mutiny if his plan failed) but was the most likely to save the village (assuming that the troops were willing to follow Jensen's plan). Choice 3 was safer for Jensen (his conduct could not be questioned) but was less likely to save the village (Moore might not change his mind). After a sleepless night, Jensen decided on choice 2 [3]. The result was that the British troops were not convinced to follow Jensen's plan and the village was destroyed [The result was that the British troops followed his plan and the village was saved].

Three outcome conditions were used. In all three conditions, subjects read versions of the scenario that differed only in the last two sentences. The final sentence conveyed the outcome information (the second to last sentence described which of the three options Jensen chose). In the positive outcome condition, subjects learned that the village was saved from destruction. In the negative outcome condition, subjects learned that the village was destroyed and its residents killed. In the no-outcome condition, subjects were told that they would not learn the scenario's outcome until after they had completed the questionnaire booklet.

For positive and negative outcome conditions, the experimenter orally explained to subjects that they would be completing questionnaires that were written for those in the study who did not learn the outcome of the scenario. Subjects were then asked to put themselves in the shoes of those other subjects and to answer the questions as though they themselves had not learned the outcome (this procedure was adapted from Wasserman *et al.*, 1991).

Subjects then completed 4 sets of measures. First, subjects made 2 predictability ratings, one for the village being saved, the other for its destruction. Subjects rated their agreement with the statements, "It was predictable in advance that the village would be saved" and "... that the village would be destroyed," using 9-point agree/disagree scales. These constituted the first of 2 types of hindsight measures.

Second, subjects recorded likelihood estimates for three possible outcomes (the second type of hindsight measure, patterned after Fischhoff, 1975; Wasserman *et al.*, 1991). Subjects used percentages to indicate the likelihood that the village was saved, that the village was destroyed with no survivors, and that the village was destroyed with some survivors. The total of the three likelihood estimates had to equal 100% (some subjects failed to heed this instruction, but their results were, nonetheless, included in all analyses).

Third, subjects rated their agreement with 3 prescriptive statements on 9-point agree/disagree scales. These statements were "should have" judgments for avoiding the negative outcome. The statements followed the form, "Jensen's best decision would have been option [1, 2, 3]." Finally, 3 estimates of contingent likelihood were made. Subjects recorded the percentage likelihood that the village would be saved given that Jensen had chosen option 1, 2, and 3.

Results and Discussion

Hindsight bias. The 2 ratings of outcome predictability were analyzed using a 2 (decision) \times 3 (outcome) \times 2 (rating) mixed ANOVA. There were no significant main or between-subject interaction effects. The outcome \times rating interaction was marginally significant, $F(2, 79) = 2.81, p < .07$; thus, means for the 2 ratings were compared within the 3 outcome conditions. No-outcome subjects' ratings of the predictability of the village being saved versus destroyed did not differ reliably ($M_s = 5.59$ vs 4.90 , respectively), $t < 1.5$. Positive outcome (village saved) subjects rated this outcome as more predictable than the possibility of the village being destroyed ($M_s = 6.14$ vs 4.79), $t(79) = 2.35, p < .05$. Similarly, negative outcome (village destroyed) subjects rated village destruction as more predictable than the village being saved ($M_s = 6.21$ vs

4.96), $t(79) = 2.17, p < .05$. These within-subject comparisons indicate a hindsight bias.

Next, likelihood estimates for 3 possible outcomes (village saved, village destroyed with no survivors, village destroyed with some survivors) were each analyzed using a 2 (decision) \times 3 (outcome) ANOVA. Of particular interest was variation due to the outcome manipulation, shown in Table 2. The hindsight bias is evident in both between-subject and within-subject comparisons. The former are represented by row comparisons in Table 2 (i.e., between outcome conditions). The likelihood estimates that the village would be destroyed with some survivors (row 2) did not differ between outcome conditions, $F < 1$. Estimates that the village would be saved (row 1), however, did differ as a function of the outcome manipulation, $F(1, 79) = 6.82, p < .01$. Subjects who learned that the village was destroyed gave lower estimates that the village would be saved than no-outcome subjects, $t(79) = 5.61, p < .01$ (but estimates by village-saved subjects did not differ from those of no-outcome subjects, $t < 1.5$). The likelihood estimates that the village would be destroyed with no survivors (row 3) were also influenced by outcome, $F(1, 79) = 5.47, p < .01$. Village-destroyed subjects gave higher estimates that the village would be destroyed with no survivors than no-outcome subjects, $t(79) = 4.77, p < .01$, but again, village-saved and no-outcome subjects did not differ in their estimates ($t < 1.5$). The hindsight bias therefore appeared only in negative outcome subjects, but this could mean either that negative outcomes evoke greater bias (Schkade & Kilbourne, 1991), or that baseline differences in likelihood (evident in no-outcome subjects) created floor and ceiling effects that limited hindsight effects within village-saved subjects.

The within-subject comparisons of likelihood estimates provide stronger evidence for a hindsight bias. These are represented by within-column (i.e., within outcome condition) comparisons in Table 2. Comparing village-saved versus village-destroyed subjects, a clear crossover interaction is evident, with likelihood estimates increasing and decreasing as a function of outcome

TABLE 2
LIKELIHOOD ESTIMATES OF THREE POSSIBLE OUTCOMES (EXPERIMENT 2)

	Outcome condition		
	No-outcome ($n = 29$)	Village saved ($n = 28$)	Village destroyed ($n = 28$)
Possible outcome			
Village saved	42.59 _a	47.50 _a	25.14 _b
Village destroyed/with survivors	29.83 _a	35.36 _a	33.39 _a
Village destroyed/no survivors	27.59 _a	22.68 _a	41.46 _b

Note. Values are mean percentage likelihood estimates. Row means not sharing a common subscript differ at $p < .05$.

valence. Thus, subjects who learned that the village was saved rated this outcome as more likely than the other two outcomes, whereas village-destroyed subjects rated the likelihood of the village being destroyed with no survivors as more likely than the other outcomes. Within columns, these comparisons are significant, $t_s > 3.00$, $p_s < .01$. Within the no-outcome condition, the likelihood that the village would be saved was perceived to be higher than either of the negative outcomes, $t_s > 3.00$, $p < .01$, but these latter 2 did not differ reliably.

Contingent likelihood. Our main predictions focused on whether judgments of outcome likelihood would be heightened by outcome knowledge only *given* the preoccurrence of the causal antecedent. This was assessed using conditional likelihood estimates (i.e., the likelihood that the village would be saved given that Jensen had indeed chosen option 1, 2, or 3). The three conditional likelihood estimates were analyzed using a 2 (decision) \times 3 (outcome) \times 3 (estimate) mixed ANOVA. No main or between-subject interaction effects were significant. However, the 3-way interaction between decision, outcome, and estimate was reliable, $F(4, 158) = 4.11$, $p < .005$.

Table 3 displays the means relevant to this interaction. The top half of the table presents estimates of the likelihood of saving the village given that Jensen chose option 2; the bottom half of the table presents estimates of village-saved likelihood given that Jensen chose option 3. Likelihood estimates for option 1 did not differ reliably and so are not included in this table (these estimates uniformly reflected subjects' perception that option 1 was a poor choice).

If a simple, "actualist" version of creeping determinism is accurate (i.e., that a perception of global inevitability follows from receipt of outcome informa-

TABLE 3
CONTINGENT LIKELIHOOD ESTIMATES (EXPERIMENT 2)

	Outcome condition		
	No-outcome ($n = 29$)	Village saved ($n = 28$)	Village destroyed ($n = 28$)
Likelihood estimate of saving village given option 2			
Decision condition			
Option 2	57.14 _a	63.85 _a	45.71 _a
Option 3	51.00 _a	47.73 _b	58.93 _b
Likelihood estimate of saving village given option 3			
Decision condition			
Option 2	46.79 _a	51.54 _a	51.43 _a
Option 3	62.67 _b	67.00 _b	45.00 _a

Note. Values are mean percentage likelihood estimates (higher values indicate greater perceived likelihood of occurrence). Column means (within each rating) not sharing a common subscript differ at $p < .05$.

tion), then the conditional probability estimates should vary as a function of outcome but not decision. That is, subjects should simply see the outcome as predictable once the outcome is known, regardless of whether Jensen chose option 2 or 3. By contrast, we expected that hindsight perceptions of inevitability depend critically on subjects' perception of a causal antecedent-outcome linkage. Thus, we predicted that subjects would give higher conditional probability estimates only when the decision-outcome information previously received (and hence the causal inference they could draw) matched the estimate being made. As is evident in Table 3, the latter was clearly the case.

Village-saved subjects gave higher estimates of the village being saved given option 2 when they had previously read that Jensen had in fact chosen option 2, relative to subjects believing Jensen chose option 3 ($M_s = 63.85$ vs 47.73), $t(79) = 3.26$, $p < .01$. The pattern was the reverse for village-destroyed subjects ($M_s = 45.71$ vs 58.93), $t(79) = 2.67$, $p < .05$. These subjects viewed the possibility of the village being saved given option 2 as less likely when they believed that Jensen had chosen option 2, relative to subjects believing Jensen chose option 3.

For conditional estimates of the village being saved given option 3, a similar (but reversed) pattern emerged. Village-saved subjects gave lower estimates of the village being saved given option 3 when they believed Jensen chose option 2, relative to subjects believing he chose option 3 ($M_s = 51.54$ vs 67.00), $t(79) = 4.51$, $p < .01$. Although the expected pattern emerged for village-destroyed subjects ($M_s = 51.43$ vs 45.00), this difference was only marginally significant, $t(79) = 1.88$, $p < .10$. Overall, these differences suggest that the presence or absence of causally relevant antecedents can indeed influence likelihood estimates, thus documenting the relation between elaboration of causal contingencies and the hindsight bias.

Prescriptive ratings. Subjects rated their agreement with 3 prescriptive statements focusing on which option Jensen "should have" chosen. If the hindsight bias extends to perceptions of what should have been (i.e., counterfactuals), then these ratings ought to vary as a function of the outcome manipulation.

A 2 (decision) \times 3 (outcome) \times 3 (rating) repeated measures ANOVA revealed a reliable main effect for rating, $F(4, 158) = 7.90$, $p < .001$. Overall, subjects thought that Jensen should have chosen option 3 ($M = 6.93$) over option 2 ($M = 4.60$) and option 1 ($M = 0.86$). All 3 means differed significantly from one another, $t_s > 3.00$, $p_s < .01$. The 3-way interaction between decision, outcome, and rating was marginally significant, $F(4, 158) = 2.22$, $p < .06$ (see Table 4).

The top half of Table 4 shows mean ratings of agreement with the statement that "Jensen's best choice would have been option 2." Subjects agreed that Jensen should have chosen option 2 more when they believed that option 2 resulted in success ($M = 6.46$) than when they believed it resulted in the village's destruction ($M = 4.79$), $t(79) = 3.66$, $p < .01$. Subjects showed margin-

TABLE 4
 AGREEMENT WITH PRESCRIPTIVE STATEMENTS (EXPERIMENT 2)

	Outcome condition		
	No-outcome (<i>n</i> = 29)	Village saved (<i>n</i> = 28)	Village destroyed (<i>n</i> = 28)
Agreement with statement: "Jensen's best decision would have been option 2"			
Decision condition			
Option 2	5.14 _a	6.46 _b	4.79 _a
Option 3	4.00 _a	3.33 _a	4.14 _a
Agreement with statement: "Jensen's best decision would have been option 3"			
Decision condition			
Option 2	6.07 _a	6.08 _a	6.93 _b
Option 3	7.60 _a	7.93 _a	6.79 _b

Note. Values are mean ratings on a 9-point scale (higher values indicate greater agreement). Row means not sharing a common subscript differ at $p < .05$.

ally weaker agreement with this same statement when they believed that option 3 resulted in the village being saved ($M = 3.33$) than when they believed it resulted in destruction ($M = 4.14$), $t(79) = 1.84$, $p < .09$.

The bottom half of Table 4 shows agreement with the statement that "Jensen should have chosen option 3." Subjects agreed that Jensen should have chosen option 3 to a lesser extent when they believed that option 2 resulted in success ($M = 6.08$) than when they believed option 2 resulted in destruction ($M = 6.93$), $t(79) = 2.39$, $p < .05$. Subjects agreed with this same statement to a greater extent when they believed option 3 resulted in success ($M = 7.93$) than when they believed it resulted in destruction ($M = 6.79$), $t(79) = 3.32$, $p < .01$. These patterns clearly show that outcome information differing in valence interacts with antecedent information to influence prescriptive judgments.

Two pairwise comparisons constituted a direct test that the hindsight bias embraces heightened counterfactual beliefs of a prescriptive nature. These comparisons tested whether negative outcome information triggers counterfactual prescriptions (i.e., what should have been done to achieve success) relative to the no-outcome condition. Only one such contrast was reliable. Subjects who believed that option 2 resulted in the destruction of the village were more certain that option 3 should have been chosen instead ($M = 6.93$) than were no-outcome subjects ($M = 6.07$), $t(79) = 2.46$, $p < .05$. Subjects who believed that option 3 resulted in the village's destruction, however, were no more certain that option 2 should have been chosen ($M = 4.14$) than were

no-outcome subjects ($M = 4.00$), $t < 1$, although the means fell in the predicted direction.

EXPERIMENT 3

Experiment 1 indicated that greater availability of counterfactual conditionals could increase hindsight certainty, but this experiment was not based on a traditional hindsight bias paradigm (i.e., there were no comparisons between outcome vs no-outcome conditions). Experiment 2 showed that the hindsight bias is influenced by causal contingencies and, though based on the traditional between-subject hindsight bias paradigm, was not intended to document the effect of counterfactuals on the hindsight bias. Experiment 3 was designed to integrate the foregoing findings within a single experimental design, one that represented a marriage of the between-subject hindsight bias paradigm (e.g., Fischhoff, 1975) and the standard counterfactual paradigm (e.g., Miller & McFarland, 1986).

In this experiment, subjects read a scenario depicting a drive to the airport and a missed flight (familiar to readers of Kahneman & Tversky, 1982). There were two independent manipulations of counterfactual availability: antecedent exceptionality and outcome closeness. Regarding the former, subjects read that the protagonist took either his usual or an unusual route to the airport. Many previous experiments have shown that exceptional preceding circumstances give rise to greater counterfactual effects than normal circumstances (Branscombe & Weir, 1992; Kahneman & Tversky, 1982; Miller & McFarland, 1986). Essential to our purposes is the fact that this manipulation should affect causal inference. As exceptional antecedents are incorporated into the counterfactual conditional, they become salient and plausible causal candidates (Kahneman & Miller, 1986). Thus, an actor who behaved unusually before a negative act tends to be blamed more than an actor who behaved in a routine fashion (Branscombe, Crosby, & Weir, 1993; Branscombe & Weir, 1992; Macrae, Milne, & Griffiths, 1993). This reasoning suggests, as was recently argued by Miller and Taylor (1995), that the hindsight bias should be greater for a negative outcome following a deviation rather than the adherence to customary behaviour.

In contrast, the second counterfactual manipulation, that of "closeness" to a desired outcome, likely does not have this same causal impact. For this closeness manipulation, the protagonist was described as having missed his flight by either 5 or 60 min. Although past research has shown that near misses evoke greater counterfactual reactions than far misses (Kahneman & Tversky, 1982; Miller & McFarland, 1986), this variable centers on the nature of the outcome, and not on the antecedent-outcome link (see Roese & Olson, 1995a). Unique information regarding a specific antecedent, a necessary component of a causal inference derived from a counterfactual conditional, is not varied in this manipulation. We therefore expected that the outcome closeness variable would influence counterfactual thinking, but not causal or hindsight judg-

ments. To assess the hindsight bias, a control group read the same scenario as the above subjects, but their version contained no outcome information.

This yielded a 2 (antecedent: exceptional vs routine) \times 3 (outcome: no-outcome, near miss, far miss) factorial design. Dependent measures included a counterfactual thought manipulation check, hindsight likelihood ratings, and ratings of causality. We expected (a) greater likelihood estimates of the obtained outcome by outcome than no-outcome subjects (i.e., the hindsight bias), (b) both causal and hindsight ratings to be greater in the exceptional than routine antecedent condition, but to not vary as a function of the closeness manipulation, and (c) mediation by causal inferences of the effect of antecedent exceptionality on the hindsight bias, such that the effect is reduced to nonsignificance when causal ratings are held constant, but that the effect of counterfactuals on causal ratings remains significant when hindsight ratings are held constant.

Method

Subjects. Subjects were 183 students (101 women, 52 men, 30 unknown)⁴ enrolled in introductory psychology at the University of Western Ontario who participated for course credit, randomly assigned to the 6 experimental conditions.

Materials and procedure. Subjects were seated individually in small rooms and given a 2-page booklet containing the scenario and dependent measures. They completed the study privately and anonymously. The scenario was as follows:

J.S. was 25 years old, single, and a management trainee at a national bank in downtown Toronto. After his first few months on the job, he was required to participate in a training seminar out of town. This was an important seminar; after completing it he could be certified and assigned his first management position. His flight was scheduled to leave at 4 PM from Pearson Airport in Toronto, so he left early from work to drive to the airport. Having been to the airport several times recently to pick up clients as part of his job, J.S. had settled on a particular route that he liked to take. He decided that today he would stick to this favored route to the airport. [He decided that today he would try a different route to the airport]. However, J.S. was soon caught in a major traffic jam and arrived 1 hour after the scheduled departure time of his flight. When he got to the ticket desk, he learned that his flight had indeed left at the scheduled time [was delayed and had just left five minutes ago].

The scenario read by no-outcome subjects had the last two sentences deleted. After reading the scenario, all subjects completed an open-ended thought-listing task designed to assess spontaneously generated counterfactual thoughts. Next, subjects completed likelihood and causal ratings. For the former, subjects rated the percentage likelihood (ranging from 0%—"not at all possible" to 100%—"completely certain") of three outcomes: (1) "J.S. is not delayed and flies out as planned," (2) "J.S. is delayed by traffic but flies out as planned," and (3) "J.S. is delayed by traffic and misses his flight." This question directed subjects to provide estimates, based on their "knowledge of big city traffic," of the likelihoods "as they were AT THE TIME J.S. LEFT FOR THE AIRPORT" (capitals in original). For the causal ratings, subjects rated on scales ranging from 0 ("not at all") to 9 ("completely") the extent to which J.S. could be blamed for missing his

⁴ Due to experimenter error, sex was not recorded for 30 subjects. Sex effects reported in the results section were based on the remaining 153 subjects.

flight, and the extent to which J.S.'s actions brought about his missing his flight. Subjects in the outcome conditions completed both likelihood and causal ratings in counterbalanced order; those in the no-outcome conditions completed only the likelihood ratings.

Results and Discussion

Preliminary analyses revealed no effects of either sex of subject or order of dependent measures. Thus, they are not discussed further.

Manipulation check. Subjects' thought listings were coded for counterfactual content (defined as any mention of outcome alternatives, using terms such as "at least," "if only," "should've," "could've," etc.). Interrater agreement, calculated from 2 independent codings of a random sample of 30 subjects (16% of the sample), was 93%. The number of counterfactuals recorded was then submitted to a 2 (antecedent: exceptional vs routine) \times 2 (outcome: near miss vs. far miss) ANOVA.⁵ Both main effects were reliable, as expected. Subjects recorded more counterfactuals in the exceptional ($M = 1.17$) than routine ($M = .53$) antecedent condition, $F(1, 144) = 17.47$, $p < .001$, and also more in the near miss ($M = 1.11$) than far miss ($M = .60$) condition, $F(1, 144) = 10.87$, $p < .001$.

Hindsight bias. Preliminary analyses of the likelihood ratings of the 2 non-obtained outcomes (not delayed and flies out; delayed but flies out) revealed no reliable effects of the manipulations. The hindsight analyses reported here are based on ratings of the obtained outcome (delayed by traffic, missed flight). Collapsing the two outcome conditions (far miss and near miss) into one condition enabled a pairwise contrast between no-outcome and outcome subjects. This contrast revealed the hindsight bias, in that outcome subjects rated the obtained outcome as more likely ($M = 55.6\%$) than did no-outcome subjects ($M = 35.3\%$), $F(1, 181) = 21.52$, $p < .001$.

Counterfactuals and the hindsight bias. In order to show that counterfactual conditionals enhance the hindsight bias, there must be evidence that (a) the antecedent exceptionality but not the closeness manipulation affects likelihood ratings among outcome subjects, and (b) antecedent exceptionality does not affect likelihood ratings among no-outcome subjects. Thus, we first examined likelihood ratings using a 2 (antecedent exceptionality) \times 3 (outcome: no-outcome vs near miss vs far miss) ANOVA. As predicted, the antecedent exceptionality manipulation was reliable, $F(1, 177) = 5.50$, $p = .02$. Subjects gave higher likelihood ratings when the outcome was preceded by an exceptional act ($M = 55.8\%$) than when it was preceded by a routine act ($M = 47.8\%$). Outcome was also reliable, $F(1, 177) = 10.89$, $p < .001$, but this effect was due entirely to the effect of outcome ($M = 55.6\%$) versus no-outcome ($M = 35.3\%$). The means for the near-miss ($M = 55.6\%$) versus far-miss ($M = 55.5\%$) did not differ. Second, looking only at no-outcome

⁵ The number of counterfactuals recorded by subjects in the no-outcome conditions was very small and so were excluded from this analysis.

subjects, antecedent exceptionality was not a reliable factor. That is, likelihood ratings were no higher in the exceptional ($M = 37.1\%$) than in the routine antecedent condition ($M = 33.5\%$), $F < .5$. Thus, counterfactual conditionals had the effect of increasing likelihood ratings after, but not before, outcome information was known.⁶

Counterfactuals and causality. The 2 causal ratings were highly correlated ($r = .74$) and were thus averaged to yield a single index of causal impact of J.S.'s actions. A 2 (antecedent exceptionality) \times 2 (outcome: near miss vs. far miss) ANOVA revealed only the predicted main effect of antecedent exceptionality, $F(1, 144) = 21.14$, $p < .001$. Subjects attributed greater cause to J.S. when his actions were exceptional ($M = 4.87$) than when they were routine ($M = 3.25$). Outcome closeness had no effect on causal ratings, $F(1, 144) = 2.35$, $p = .13$.

Mediational analyses. Is the effect of counterfactuals on the hindsight bias due to their causal informativeness? To assess the mediating role of causal ratings, we conducted two analyses. First, using an ANCOVA, we assessed the effect of antecedent exceptionality on likelihood ratings while causal ratings were held constant (i.e., causal ratings were entered as a covariate). The result was that the effect of antecedent exceptionality was reduced to a marginal level of significance, $F(1, 145) = 3.59$, $p > .06$. Second, another ANCOVA was used to examine the effect of antecedent exceptionality on causal ratings while likelihood ratings were held constant. This analysis, in contrast, revealed little change in the effect size, $F(1, 145) = 17.82$, $p < .001$. These findings are somewhat weak, in that the reduction of exceptionality effect size on likelihood ratings was small. Other mediators may well be operating here, but these findings are more consistent with the conclusion that causal judgments mediate the effect of counterfactuals on the hindsight bias than with the alternative pathway of hindsight bias mediating the effect of counterfactuals on causal judgments.

GENERAL DISCUSSION

This research was intended to provide the theoretical basis for a tripartite linkage between counterfactuals, causal attributions, and the hindsight bias.⁷ As we have argued elsewhere (Roese, 1994; Roese & Olson, 1995a, 1995b), many (though not all) of the affective and judgmental consequences of

⁶ One alternative interpretation is that the closeness manipulation had no effect on likelihood judgments not because it lacks causal informativeness, but because the information contained in the near-miss condition might suggest that the miss was unlikely (i.e., it nearly did not occur), thus countering any positive effect on likelihood judgments this condition might have had via the causal inference mechanism. The design of this experiment does not permit a test of this idea, though it remains a worthwhile goal for subsequent research.

⁷ In preparing this article, we discovered another report focusing on the tripartite relation between counterfactuals, causal attributions, and the hindsight bias (Williams, Lees-Haley, & Brown, 1993). However, this essay was not empirically supported and merely noted that some relation between the three variables was likely without documenting or specifying the mechanisms linking them.

counterfactual thinking may be attributed to a causal inference mechanism. That is, thinking that an outcome might have been altered had some antecedent been present or absent results in an inference linking that antecedent causally to the outcome. For example, a student's counterfactual thought that she might have performed better on an exam had she studied leads to an inference of the causal importance of studying. This inference may be linked to judgments of blame (Branscombe & Weir, 1992), intentions to perform such causally potent acts in the future (Roese, 1994), and hopefulness regarding future performance (Boninger et al., 1994). The present research showed that this causal inference mechanism underlies the positive impact of counterfactual thinking on the hindsight bias. The discussion that follows is organized around the three key assertions with which we began this article.

Counterfactuals Heighten the Hindsight Bias

Experiments 1 and 3 demonstrated that manipulations of counterfactual thinking heighten the hindsight bias. In Experiment 1, salience of a counterfactual in which the mutation of a factual antecedent undid the obtained outcome (relative to a counterfactual that did not undo the outcome) heightened hindsight ratings of the outcome's predictability. In Experiment 3, perceptions of hindsight were greater for an outcome preceded by exceptional than routine antecedent actions. Previous research and also manipulation check data from this third experiment show that such manipulations of antecedent exceptionality heighten counterfactual thinking (Kahneman & Miller, 1986; Miller & McFarland, 1986).

It is important to emphasize that the hindsight bias in this research was treated as heightened certainty on conditional, as opposed to unconditional, likelihood estimates of past outcomes. As Experiment 2 showed, hindsight judgments may well be limited to such conditional, or contingent, judgments of past outcomes. Lay perceivers apparently favor a naive conception of scientific determinism, which emphasizes the causal contingency of past outcomes, rather than actualism, which focuses on unconditional judgments of inevitability or predestiny. Although it makes sense that counterfactuals should be negatively related to actualist-based judgments of unconditional inevitability, counterfactuals are not only compatible with but can have a positive effect on conditional hindsight judgments.

Causal Inferences Underlie a Positive Counterfactual-Hindsight Bias Relation

All three experiments suggest that a facilitative effect of counterfactuals on the hindsight bias is mediated by causal inference. In Experiment 1, the counterfactual manipulation increased ratings of causal potency of the target (and only the target) antecedent (replicating Wells & Gavanski, 1989) and also had parallel effects on hindsight ratings. Experiment 2 provided further evidence for this mediating effect by showing that cognitive elaboration of the causal antecedent–outcome contingency is an essential component of the

hindsight bias. According to our reasoning, individuals exaggerate an outcome's predictability only to the extent that they can explain or make sense of it, and this explaining and sensemaking resides in identifying a plausible cause for the outcome. From this perspective, Hawkins and Hastie's (1990) explication of the hindsight bias and creeping determinism in terms of "the tendency to perceive a reported outcome as virtually inevitable" (p. 313) is incomplete. As Experiment 2 demonstrated, an outcome is perceived to be inevitable only under those existing antecedent conditions. Under different conditions, other outcomes are possible, but this realization does not deny, but rather enhances, the certainty regarding what *did* happen. Thus, conditional likelihood estimates made by outcome subjects of their outcome occurring *given* the factual antecedent showed the typical hindsight bias relative to no-outcome subjects. By contrast, when outcome subjects rated the likelihood of the outcome arising from different antecedent conditions, their estimates did not differ from no-outcome subjects. Thus, the actualist version of creeping determinism (that outcomes are viewed after the fact as unconditionality inevitable or predestined) appears not to characterize lay perceivers. Rather, outcome information interacts with assumptions of the outcome's generative conditions, culminating in inferences of antecedent-outcome causal linkages that create the hindsight bias.

Experiment 3 provided somewhat clearer evidence for the mediation of the counterfactual-hindsight link by causal attributions. Consistent with previous research (Branscombe & Weir, 1992; Kahneman & Miller, 1986; Macrae et al., 1993), an outcome preceded by an exceptional rather than a routine act heightened counterfactual thinking and, accordingly, perceptions of the causal potency of that act. Exceptional preceding circumstances also heightened the hindsight bias relative to routine circumstances. The effect of the antecedent exceptionality manipulation on the hindsight bias was reduced to marginal significance when causal perceptions were statistically controlled, whereas the effect of counterfactuals on causal ratings remained significant when hindsight ratings were controlled. Thus, the evidence suggested that causal judgment was a mediator of the counterfactual-hindsight relation, but that the effect of counterfactuals on causal inference was independent of hindsight judgments.

Consistent with our specification of a causal inference mediator, an important limiting condition of the effect of counterfactuals on the hindsight bias is that the counterfactual must be a conditional; that is, it must specify both an antecedent and an outcome. Thus, counterfactuals that specify an alternative outcome only, with no generative antecedent (e.g., the "close counterfactuals" discussed by Kahneman, 1995; Kahneman & Varey, 1990), imply no causal information. A hindsight bias therefore should not follow from counterfactuals that are not phrased as conditionals. This was, in fact, the case in Experiment 3. There, the manipulation of counterfactual closeness (whether a desired outcome was near versus far to having happened), although triggering spontaneous counterfactual thinking, nevertheless had no effect on either

causal or hindsight judgments. As this was a manipulation of the salience of a counterfactual world without any variation in the *means* by which that world might be brought about, the manipulation had no bearing on causal insights. This finding suggests that counterfactuals must take a conditional structure, and thereby specify an antecedent-outcome linkage, to have any impact on the hindsight bias.

The Hindsight Bias Extends to Prescriptive Counterfactual Judgments

The above reasoning leads to the third main assertion, that the greater the post-outcome certainty that outcome Y was inevitable under conditions X, the greater the certainty that changing X would have altered the outcome. To the extent that the outcome was undesirable, individuals are motivated to generate counterfactual prescriptions for what should have been, such that the desired outcome is achieved in their counterfactual world. In Experiment 2, agreement ratings with prescriptive statements (e.g., what “should have” been done) varied as a function of the decision and outcome manipulations, such that subjects saw the “road not taken” more favorably when the obtained outcome was negative, but denigrated such alternatives when the obtained outcome was favorable. The more specific hypothesis that negative outcomes should elicit greater agreement with counterfactual “should have” statements relative to no-outcome subjects received somewhat weaker support: Only one of two possible contrasts was significant, though both were in the predicted direction. Nevertheless, these findings show how counterfactuals, causal inferences, and the hindsight bias intertwine in the mind of the armchair quarterback. A loss by a favored team triggers sensemaking in the form of specification of reasons for the loss (counterfactual and causal judgments), which heightens after-the-fact certainty that the loss was inevitable given those reasons (hindsight bias), but which also suggests means by which a win could have been achieved (counterfactual prescriptions). As British philosopher Geoffrey Hawthorn (1991) stated in an analysis of counterfactuals resembling ours, “an explanation suggests alternatives” (p. 13).

Our perspective applies to cases in which a formal decision was made and then followed by (perhaps negative) consequences (Baron & Hershey, 1988; Gleicher et al. 1990), but also to cases in which actors make no explicit decisions and are not even cognizant of any alternative possibilities at the time they act. Rather, it is only with the crystallizing effect of outcome information that individuals become aware, perhaps for the first time, that there were indeed alternative avenues available to them. For example, if one’s dog has an accident on the carpet, the counterfactual that “he should have been taken for his walk an hour ago” is instantly salient, even though no such walk had been considered all afternoon.⁸ Negative outcome information motivates individ-

⁸ With this anecdote, we formally acknowledge that the foregoing analysis is dedicated to the first author’s dachshund, Willy, and his youthful penchant for “accidents.” Willy has since matured into an adult of remarkable restraint.

uals to seek means by which the past could have been made better (Roese & Olson, 1995a).

When Do Counterfactuals Reduce the Hindsight Bias

Our goal has been to describe and document a mechanism by which counterfactuals increase the hindsight bias. The approach was offered in contrast to the prevailing wisdom that counterfactuals invariably reduce the hindsight bias (e.g., Fischhoff, 1976; Kahneman & Varey, 1990; Sherman, 1991; Slovic & Fischhoff, 1977). Nevertheless, we do not deny that the negative relation may sometimes occur. First, it occurs when the hindsight bias is conceptualized as an unconditional likelihood judgment of global inevitability. Second, when hindsight is conceptualized as a conditional judgment, as was done in the present research, a negative relation will occur to the extent that inferences of causal potency are weakened.

Although the positive counterfactual-hindsight relation may well be the default, one way that counterfactuals might reduce the hindsight bias is if they weaken subsequent inferences of causal potency. For example, counterfactuals following the form of "even if" (labeled "semifactuals" by Goodman, 1983) specify the same outcome occurring under different antecedent conditions than actuality (e.g., "Even if he had bought the study guide, he would still have failed"). Logically speaking, such a statement denies the necessity of the antecedent, thereby reducing the perceived causal potency of the antecedent. By the same token, the assertion that a different outcome would have occurred following the same antecedent as actuality also weakens the perceived causal potency of the antecedent. When cause cannot be located, certainty decreases. Several previous demonstrations of a negative counterfactual-hindsight relation employed precisely these kinds of counterfactuals.

As one example, Slovic and Fischhoff (1977) described a tendency for individuals to find scientific results predictable, that they "knew all along" how specific experiments would turn out. One experimental outcome presented to subjects was that virgin rats injected with blood from mother rats exhibit maternal behavior. When subjects were asked to consider counterfactual (i.e., alternative) outcomes for this experimental finding, their likelihood estimates of subsequent replication (an indirect index of the hindsight bias) were reduced. But it is important to note that the counterfactuals considered by subjects all targeted a *different* outcome occurring under the *same* conditions (that is, with the same antecedent in place, rather than within a "control" condition). If one imagines an alternative outcome following from the same antecedent that preceded the factual outcome, then the perceived causal connection between the antecedent and outcome is weakened (i.e., the antecedent no longer accounts for variation in outcome; see McGill, 1989). This suggests that Slovic and Fischhoff's subjects, after considering outcome alternatives, inferred that maternal blood injection may *not* cause maternal behavior, thereby lowering hindsight certainty.

Findings from the present research support this interpretation: In Experiment 1, consideration of counterfactuals based on a *different* antecedent producing a *different* outcome heightened the hindsight bias relative to consideration of counterfactuals based on a *different* antecedent yielding the *same* outcome. In Experiment 2, after-the-fact conditional likelihood estimates for the *same* antecedent leading to a *different* outcome reduced the hindsight bias relative to estimates for the factual antecedent/outcome pair. From these demonstrations, it is clear that the causal information inherent in a counterfactual conditional (whether it supports or weakens an inference of causal linkage between antecedent and outcome) is what determines the resulting hindsight bias.

Sense Making

Making sense of the past is the focal point of the three processes of counterfactual thinking, causal attributions, and the hindsight bias. But what triggers this sensemaking? Previous work has centered on the unique contributions of outcome valence and expectancy as triggering factors: negative (rather than positive) and disconfirmed (rather than confirmed) expectancies represent classes of situations that for reasons of pure survival demand our attention and our explanatory skills (Olson, Roesse, & Zanna, 1996; Taylor, 1991). Successful explanation yields useful expectancies for future adaptive behavior.

Consistent with this reasoning, our findings suggest that negative outcomes (e.g., failure) are more likely to trigger sensemaking cognitions (e.g., counterfactual and causal explanation), thereby increasing the hindsight bias, than are positive outcomes. In Experiment 1, when the outcome was extremely negative, counterfactual thinking maximally elevated the hindsight bias. Failure apparently triggered the need for sensemaking, and when, additionally, subjects were able to construct a counterfactual that yielded a causal conclusion that made sense of how this failure came about, they were most certain of its a priori predictability. Moreover, in Experiment 2, between-subject comparisons of the effect of outcome information suggested a significant hindsight bias for the negative but not the positive outcome. In our first 2 experiments, then, negative outcomes produced measurable shifts in post hoc perceptions, the general consequence being an increase in sensemaking cognitions.

Recently, Sherman (1991) expressed a similar notion, that "it feels better to know that you would have been (and were) prepared for the worst occurrences" (p. 182), but he then noted that available evidence was not entirely consistent with this proposition. Recent work suggests a more optimistic conclusion. First, Schkade and Kilbourne (1991) demonstrated that failure evoked a larger hindsight bias than success, and also that unexpected failure produced a particularly strong bias. Second, Wasserman et al. (1991) showed in one of two scenarios that the overall bias was three times greater for failure than success. Third, Walster (1967) did not find a main effect for outcome

valence, but did find that extremely positive and extremely negative outcomes evoked larger biases of hindsight than more moderate outcomes, suggesting perhaps that the effect of disconfirmed expectancies overwhelmed any valence effect in this particular case.

Our analysis assumes also that disconfirmed expectancies evoke sensemaking activity, including counterfactual and attributional thinking (Olson, Roese, & Zanna, 1996; Roese & Olson, 1995a, 1995c). Thus, expectancy-disconfirming outcomes should trigger a relatively greater hindsight bias compared to expectancy-congruent outcomes (cf. Fischhoff, 1975). Because valence and expectancy were confounded in Experiment 1, the valence effects noted above can as easily be interpreted in support of the positive effect of disconfirmed expectancies on the hindsight bias. Schkade and Kilbourne (1991) provided clearer evidence by showing that expectancy effects were independent of valence effects (see also Christensen-Szalanski & Willham, 1991). To the contrary, though, some recent evidence suggests that disconfirmed expectancies reduce or even reverse the hindsight bias (a "never-would-have-known-it effect"; e.g., Mazursky & Ofir, 1990; Verplanken & Pieters, 1988). However, both of these research programs suffered from methodological flaws that rendered interpretation problematic (see Arkes, 1988; Hawkins & Hastie, 1990; Mark & Mellor, 1994, for detailed critiques). Given the available evidence, the safest conclusion is that disconfirmed expectancies heighten the hindsight bias by triggering sensemaking cognitions. Nevertheless, our perspective suggests one situation in which a reverse hindsight bias might obtain, namely, if an expectancy is disconfirmed so thoroughly that sensemaking bogs down, overwhelming the individual's powers of causal explanation. This process may well account for the "reverse hindsight" results noted above.

In closing, we address the "biased" nature of hindsight judgments. Much of the hindsight bias literature has appeared in organizational behavior journals, which have focused on the departures of decisions from rationally modeled standards. Indeed, Christensen-Szalanski & Willham's (1991) meta-analytic review of the hindsight bias literature assessed the hindsight bias in terms of its damage to formal decision-making. But it is intriguing to note that there are compelling logicostatistical reasons for greater judgmental confidence in hindsight than in foresight (Dawes, 1993; see also Sherman, 1980). Taking a more pragmatic stance, our conception of the hindsight bias is that of an occasionally annoying byproduct of the essentially useful process of adaptive learning (cf. Fiske, 1992; Hoch & Loewenstein, 1989). That is, adjusting conclusions in light of outcome information is the *sine qua non* of successful learning, but carries the attendant effect of an exaggerated certainty regarding that outcome. As such, the hindsight bias is best viewed on the same conceptual playing field as other functionally sound cognitive simplifications, such as attitudes, stereotypes, and impressions: Quick and often pragmatically useful inferences that are sometimes made at the expense of accuracy.

REFERENCES

- Anderson, C. A., Lepper, M. R., & Ross, L. (1980). Perseverance of social theories: The role of explanation in the persistence of discredited information. *Journal of Personality and Social Psychology*, **39**, 1037–1047.
- Anderson, C. A., & Sechler, E. S. (1986). Effects of explanation and counterexplanation on the development and use of statistical theories. *Journal of Personality and Social Psychology*, **50**, 24–34.
- Arkes, H. R. (1988). Comment on article by Verplanken and Pieters. *Journal of Behavioral Decision Making*, **1**, 146.
- Ayer, A. J. (1968). *The refutation of determinism: An essay in philosophical logic*. London: Methuen.
- Baron, J., & Hershey, J. C. (1988). Outcome bias in decision evaluation. *Journal of Personality and Social Psychology*, **54**, 569–579.
- Berofsky, B. (Ed.). (1966). *Free will and determinism*. New York: Harper and Row.
- Bohner, G., Bless, H., Schwarz, N., & Strack, F. (1988). What triggers causal attributions? The impact of valence and subjective probability. *European Journal of Social Psychology*, **18**, 335–345.
- Boninger, D. S., Gleicher, F., & Strathman, A. (1994). Counterfactual thinking: From what might have been to what may be. *Journal of Personality and Social Psychology*, **67**, 297–307.
- Branscombe, N. R., Crosby, P., & Weir, J. A. (1993). Social inferences concerning male and female homeowners who use a gun to shoot an intruder. *Aggressive Behavior*, **19**, 113–124.
- Branscombe, N. R., & Weir, J. A. (1992). Resistance as stereotype-inconsistency: Consequences for judgments of rape victims. *Journal of Social and Clinical Psychology*, **11**, 80–102.
- Bunge, M. (1970). *Causality: The place of the causal principle in modern science* (2nd ed.). New York: Meridian Books.
- Campbell, J. D., & Tesser, A. (1983). Motivational interpretations of the hindsight bias: An individual difference analysis. *Journal of Personality*, **51**, 605–620.
- Christensen-Szalanski, J. J. J., & Willham, C. F. (1991). The hindsight bias: A metaanalysis. *Organizational Behavior and Human Decision Processes*, **48**, 147–168.
- Dawes, R. M. (1993). Prediction of the future versus an understanding of the past: A basic asymmetry. *American Journal of Psychology*, **106**, 1–24.
- Dennett, D. C. (1984). *Elbow room: The varieties of free will worth wanting*. Cambridge, MA: MIT Press.
- Fischhoff, B. (1975). Hindsight \neq foresight: The effect of outcome knowledge on judgment under uncertainty. *Journal of Experimental Psychology: Human Perception and Performance*, **1**, 288–299.
- Fischhoff, B. (1976). The effect of temporal setting on likelihood estimates. *Organizational Behavior and Human Performance*, **15**, 180–194.
- Fischhoff, B. (1982). For those condemned to study the past: Heuristics and biases in hindsight. In D. Kahneman, P. Slovic, & A. Tversky, (Eds.), *Judgment under uncertainty: Heuristics and biases* (pp. 335–351). New York: Cambridge Univ. Press.
- Fischhoff, B., & Beyth, R. (1975). “I knew it would happen”—Remembered probabilities for once future things. *Organizational Behavior and Human Performance*, **13**, 1–16.
- Fiske, S. T. (1992). Thinking is for doing: Portraits of social cognition from daguerreotype to laserphoto. *Journal of Personality and Social Psychology*, **63**, 877–889.
- Gilovich, T., Medvec, V. H., & Chen, S. (1995). Commission, omission, and dissonance reduction: Coping with the “Monty Hall” problem. *Personality and Social Psychology Bulletin*, **21**, 182–190.
- Gleicher, F., Kost, K. A., Baker, S. M., Strathman, A. J., Richman, S. A., & Sherman, S. J. (1990). The role of counterfactual thinking in judgments of affect. *Personality and Social Psychology Bulletin*, **16**, 284–295.
- Goodman, N. (1983). *Fact, fiction, and forecast* (4th ed.). Cambridge, MA: Harvard Univ. Press.

- Hastie, R. (1984). Causes and effects of causal attributions. *Journal of Personality and Social Psychology*, **46**, 44–56.
- Hawkins, S. A., & Hastie, R. (1990). Hindsight: Biased judgment of past events after the outcomes are known. *Psychological Bulletin*, **107**, 311–327.
- Hawthorn, G. (1991). *Plausible worlds: Possibility and understanding in history and the social sciences*. Cambridge, England: Cambridge Univ. Press.
- Hell, W., Gigerenzer, G., Gauggel, S., Mall, M., & Müller, M. (1988). Hindsight bias: An interaction of automatic and motivational factors? *Memory and Cognition*, **16**, 533–538.
- Hoch, S. J., & Loewenstein, G. F. (1989). Outcome feedback: Hindsight and information. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, **15**, 605–619.
- Johnson, M. K., & Sherman, S. J. (1990). Constructing and reconstructing the past and the future in the present. In E. T. Higgins & R. M. Sorrentino (Eds.), *Handbook of motivation and cognition: Foundations of social behavior* (Vol. 2, pp. 482–526). New York: Guilford Press.
- Kahneman, D. (1995). Varieties of counterfactual thinking. In N. J. Roese & J. M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking* (pp. 375–396). Mahwah, NJ: Erlbaum.
- Kahneman, D., & Miller, D. T. (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 Univ. Press.
- Kahneman, D., & Varey, C. A. (1990). Counterfactuals and propensities: The loser that almost won. *Journal of Personality and Social Psychology*, **59**, 1101–1110.
- Kanazawa, S. (1992). Outcome or expectancy? Antecedent of spontaneous causal attribution. *Personality and Social Psychology Bulletin*, **18**, 659–668.
- Leary, M. R. (1982). Hindsight distortion and the 1980 presidential election. *Personality and Social Psychology Bulletin*, **8**, 257–263.
- Lipe, M. G. (1991). Counterfactual reasoning as a framework for attribution theories. *Psychological Bulletin*, **109**, 456–471.
- Mackie, J. L. (1974). *Cement of the universe: A study of causation*. London: Oxford Univ. Press.
- Macrae, C. N., Milne, A. B., & Griffiths, R. J. (1993). Counterfactual thinking and the perception of criminal behaviour. *British Journal of Psychology*, **84**, 221–226.
- Mark, M. M., & Mellor, S. (1994). “We don’t expect it happened”: On Mazursky and Orif’s purported reversal of the hindsight bias. *Organizational Behavior and Human Decision Processes*, **57**, 247–252.
- 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.
- Mazursky, D., & Ofir, C. (1990). “I could never have expected it to happen”: The reversal of the hindsight bias. *Organizational Behavior and Human Decision Processes*, **46**, 20–33.
- McGill, A. L. (1989). Context effects in judgments of causation. *Journal of Personality and Social Psychology*, **57**, 189–200.
- Miller, D. T., & McFarland, C. (1986). Counterfactual thinking and victim compensation: A test of norm theory. *Personality and Social Psychology Bulletin*, **12**, 513–519.
- Miller, D. T., & Taylor, B. R. (1995). Counterfactual thought, regret, and superstition: How to avoid kicking yourself. In N. J. Roese & J. M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking* (pp. 305–331). Mahwah, NJ: Erlbaum.
- Miller, D. T., & Turnbull, W. (1990). The counterfactual fallacy: Confusing what might have been with what ought to have been. *Social Justice Research*, **4**, 1–19.
- Miller, D. T., Turnbull, W., & McFarland, C. (1990). Counterfactual thinking and social perception: Thinking about what might have been. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 23, pp. 305–331). New York: Academic Press.

- Nario, M. R., & Branscombe, N. R. (1995). Comparison processes in hindsight and causal attribution. *Personality and Social Psychology Bulletin*, **21**, 1244–1255.
- Olson, J. M., Roese, N. J., & Deibert, R. J. (1996). Naturally occurring counterfactual thoughts. In P. E. Tetlock & A. Belkin (Eds.), *Counterfactual thought experiments in world politics* (pp. 296–300). Princeton, NJ: Princeton University Press.
- Olson, J. M., Roese, N. J., & Zanna, M. P. (1996). Expectancies. In E. T. Higgins & A. W. Kruglanski (Eds.), *Social psychology: Handbook of basic principles*. New York: Guilford.
- Read, S. J. (1987). Constructing causal scenarios: A knowledge structure approach to causal reasoning. *Journal of Personality and Social Psychology*, **52**, 288–302.
- Roese, N. J. (1994). The functional basis of counterfactual thinking. *Journal of Personality and Social Psychology*, **66**, 805–818.
- Roese, N. J., & Olson, J. M. (1993a). Self-esteem and counterfactual thinking. *Journal of Personality and Social Psychology*, **65**, 199–206.
- Roese, N. J., & Olson, J. M. (1993b). The structure of counterfactual thought. *Personality and Social Psychology Bulletin*, **19**, 312–319.
- Roese, N. J., & Olson, J. M. (1995a). Counterfactual thinking: A critical overview. In N. J. Roese & J. M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking* (pp. 1–59). Mahwah, NJ: Erlbaum.
- Roese, N. J., & Olson, J. M. (1995b). Functions of counterfactual thinking. In N. J. Roese & J. M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking* (pp. 169–197). Mahwah, NJ: Erlbaum.
- Roese, N. J., & Olson, J. M. (1995c). Outcome controllability and counterfactual thinking. *Personality and Social Psychology Bulletin*, **21**, 620–628.
- Schkade, D. A., & Kilbourne, L. M. (1991). Expectation–outcome consistency and hindsight bias. *Organizational Behavior and Human Decision Processes*, **49**, 105–123.
- Sherman, S. J. (1980). On the self-erasing nature of errors of prediction. *Journal of Personality and Social Psychology*, **39**, 211–221.
- Sherman, S. J. (1991). Thought systems for the past as well as for the future. In R. S. Wyer, Jr. & T. K. Srull (Eds.), *Advances in social cognition* (Vol. 4, pp. 173–195). Hillsdale, NJ: Erlbaum.
- Sherman, S. J., & McConnell, A. R. (1995). Dysfunctional implications of counterfactual thinking: When alternatives to reality fail us. In N. J. Roese & J. M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking*. Hillsdale, NJ: Erlbaum.
- Slovic, P., & Fischhoff, B. (1977). On the psychology of experimental surprises. *Journal of Experimental Psychology: Human Perception and Performance*, **3**, 544–551.
- Taylor, S. E. (1991). Asymmetrical effects of positive and negative events: The mobilization–minimization hypothesis. *Psychological Bulletin*, **110**, 67–85.
- Tuchman, B. W. (1962). *The guns of August*. New York: Macmillan.
- Walster, E. (1967). “Second guessing” important events. *Human Relations*, **20**, 239–249.
- Wasserman, D., Lempert, R. O., & Hastie, R. (1991). Hindsight and causality. *Personality and Social Psychology Bulletin*, **17**, 30–35.
- Weiner, B. (1985). “Spontaneous” causal thinking. *Psychological Bulletin*, **97**, 74–84.
- Weinstein, N. D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology*, **39**, 806–820.
- Wells, G. L., & Gavanski, I. (1989). Mental simulation of causality. *Journal of Personality and Social Psychology*, **56**, 161–169.
- White, P. A. (1990). Ideas about causation in philosophy and psychology. *Psychological Bulletin*, **108**, 3–18.
- Williams, C. W., Lees-Haley, P. R., & Brown, R. S. (1993). Human responses to traumatic events: An integration of counterfactual thinking, hindsight bias, and attribution theory. *Psychological Reports*, **72**, 483–494.