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Hindsight Bias

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Abstract

Hindsight bias occurs when people feel that they "knew it all along," that is, when they believe that an event is more predictable after it becomes known than it was before it became known. Hindsight bias embodies any combination of three aspects: memory distortion, beliefs about events' objective likelihoods, or subjective beliefs about one's own prediction abilities. Hindsight bias stems from (a) cognitive inputs (people selectively recall information consistent with what they now know to be true and engage in sensemaking to impose meaning on their own knowledge), (b) metacognitive inputs (the ease with which a past outcome is understood may be misattributed to its assumed prior likelihood), and (c) motivational inputs (people have a need to see the world as orderly and predictable and to avoid being blamed for problems). Consequences of hindsight bias include myopic attention to a single causal understanding of the past (to the neglect of other reasonable explanations) as well as general overconfidence in the certainty of one's judgments. New technologies for visualizing and understanding data sets may have the unintended consequence of heightening hindsight bias, but an intervention that encourages people to consider alternative causal explanations for a given outcome can reduce hindsight bias.

Keywords

hindsight bias, overconfidence, metacognition, "knew-it-all-along" effect, counterfactual, debias

Consider the following situations:

> A patient sues for malpractice after her physician failed to detect a tumor in an earlier X-ray (which looks fine to the unaided eye). In court, a second physician offers testimony on the basis of a more recent X-ray (which reveals the unmistakable growth of a tumor). The second physician argues that the first physician should have been able to see the tumor in the earlier X-ray.[1]

> A manager hires a new employee on the basis of solid credentials and recommendations. After several months of lackluster performance by the employee, however, the manager begins to regret her decision. After a year, the employee is terminated. Senior management investigate the manager's decision and uncover several "warning signs" that the manager should have noticed prior to hiring. The manager receives a poor annual evaluation on the basis of that single hiring decision.

What do these two cases have in common? Both involve blame, in which one person is deemed responsible for having allowed an undesirable situation to ensue. Both cases also involve second-guessing, that is, using currently available facts to pass judgment on a person who had access only to a more limited palette of information at the time the key decision was made. In short, both cases involve hindsight bias.

Hindsight bias is defined as the belief that an event is more predictable after it becomes known than it was before it became known. For example, a voter might believe that after accepting the Democratic nomination for president in August 2008, Barak Obama's chances of winning the U.S. presidency was about 60%. After Obama's victory in November 2008, this same voter might look back, see the victory as more predictable than it was before the outcome was known, and conclude that Obama's chances were at least 80% at the time of the convention. Sometimes termed the "knew it all along effect," hindsight bias involves the inability to recapture the feeling of uncertainty that preceded an event. When there is a need to understand past events as they were experienced in situ, hindsight bias thwarts sound appraisal.

Hindsight bias is one of the most widely studied of decision traps, having been featured in more than 800 scholarly papers.[2] Hindsight bias is evident in people around the world and among both the young and old (Bernstein, Erdfelder, Meltzoff, Peria, & Loftus, 2011; Pohl, Bender, & Lachmann, 2002). Hindsight bias has been documented in diverse domains, including labor disputes (Pennington, 1981), terrorist attacks (Fischhoff, Gonzalez, Lerner, & Small, 2005), medical diagnoses (Arkes,

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Faust, Guilmette, & Hart, 1988), consumer satisfaction (Zwick, Pieters, & Baumgartner, 1995), managerial choice (Bukszar & Connolly, 1988), accounting and auditing decisions (Anderson, Lowe, & Reckers, 1993; Peecher & Piercey, 2008), business startups (Cassar & Craig, 2009), athletic competition (Roese & Maniar, 1997), public policy (Schuett & Wagner, 2011), and political strategy (Blank, Fischer, & Erdfelder, 2003; Leary, 1982). Hindsight bias has important consequences for the legal system, particularly with respect to negligence, product liability, and medical malpractice (e.g., Eberwine, 2005; Harley, 2007; Peters, 1999; Rachlinski, 1998). In legal applications, the danger of hindsight bias is clear, in that the law of many nations states that a defendant may only be judged on the basis of what he or she could reasonably have known at the time of action. Knowledge that is gathered later, such as from accident scene investigations, forensic tests, or the arbitrary discovery of an oddly misused product, is deemed irrelevant in evaluating the quality of the decisions made in the moment, that is, before a focal mishap occurred. As empirical studies have shown, however, hindsight bias routinely afflicts judgments of a defendant's past conduct (e.g., Goodwill, Alison, Lehmann, Francis, & Eyre, 2010; Hastie, Schkade, & Payne, 1999; Kamin & Rachlinski, 1995; LaBine & LaBine, 1996; Smith & Greene, 2005; Stallard & Worthington, 1998). [3]

The reality of hindsight bias is sometimes difficult to convey to seasoned decision makers because hindsight bias can be confused with simple learning from experience. Individuals and organizations innovate, thrive, and prosper when they analyze mistakes and adjust their strategies accordingly. This interpretation follows along the lines of "only fools wouldn't know more after learning an outcome than before it occurred." When, then, is knowledge born of hindsight a benefit to be embraced, and when is it a bias to be avoided? The answer is in the timing of making a conclusion. Knowledge born of hindsight is appropriate and useful when directed at current actions and future plans, in which it informs ongoing strategy. By contrast, knowledge born of hindsight may involve error when directed at past moments in time, as in evaluating the skill of decision makers who had no crystal ball and so could not possibly have known what is known now. In the first example that opened this article, it is perfectly appropriate for a current physician to use available X-ray information to inform ongoing treatment. It is unreasonable, however, to expect that a different physician should have, in the past, "known" what was only knowable from an X-ray that came later. Hindsight bias as a decision trap begins with a flawed assessment of the past (Fischhoff, 1982b; Hawkins & Hastie, 1990).

Two main experimental strategies document hindsight bias: a within-subject memory design and a between-subject hypothetical design (Pohl, 2007). In the memory design, each participant gives two judgments, one before and one after a focal outcome (e.g., Fischhoff & Beyth, 1975; Wood, 1978). For example, before a football game, a fan might estimate the likelihood that the home team will win. After a factual outcome is established (the home team did in fact win), the fan estimates the likelihood of victory as it was before the game was played (which may involve attempting to retrieve one's earlier estimate from memory). Hindsight bias is defined as the difference between the foresight and hindsight likelihood estimates. The hypothetical design involves independent experimental groups that either receive or do not receive outcome information (e.g., Fischhoff, 1975). Returning to the football game example, both groups would watch the game, but only one group would see the ending and learn that the home team had won (outcome condition vs. no-outcome condition). Then participants in the no-outcome condition estimate the likelihood of a home team victory, whereas participants in the outcome condition are instructed to disregard their knowledge of how the game turned out and then make this same likelihood judgment while imagining themselves to be in the shoes of no-outcome participants. Hindsight bias is defined as the difference between these two groups' likelihood estimates. (The hypothetical aspect of the design comes from asking participants to make judgments as if they did not know the answer.) This between-subject difference reveals how difficult it is for individuals to set aside what they already know. Past research has used either method to assess what has been assumed to be a unitary construct, but as discussed in the next section, this assumption has been recently reconsidered.

Levels of Hindsight Bias

Recently, scholars have proposed that there is not just one but three kinds of hindsight bias: memory distortion, inevitability, and foreseeability (Blank, Nestler, von Collani, & Fischer, 2008; Kelman, Fallas, & Folger, 1998; Nestler, Blank, & Egloff, 2010). We conceptualize these varieties as hierarchically organized levels, in which the lowest level involves more basic processes of memory, whereas the highest level involves broad self-inferential beliefs. Figure 1 presents these levels alongside inputs and consequences.

Memory distortion

The memory distortion level centers on the misrecollection of one's earlier judgment (e.g., "I said it would happen"). It is captured when a recall attempt is benchmarked directly against a recorded earlier response, as in the memory design. For example, prior to the 2008 election, respondents might rate the likelihood that Obama would win the election. Then, after the election, respondents would attempt to recall their earlier likelihood estimate, with the deviation between current and past response representing degree of memory distortion.

Inevitability

The inevitability level involves beliefs about the objective state of the world, as in the belief that a past event was predetermined (e.g., "It had to happen"). It may be measured using

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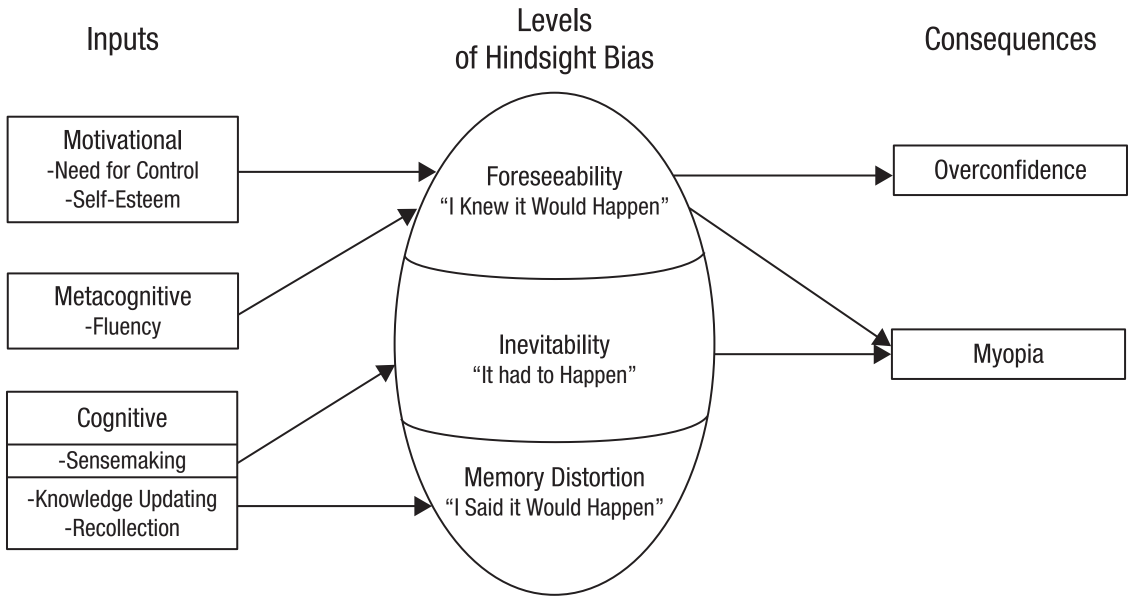

Fig. 1. A model of hindsight bias. This model emphasizes unique interconnections between inputs and consequences with regard to three levels of hindsight bias: memory distortion ("I said it would happen"), inevitability ("It had to happen"), and foreseeability ("I knew it would happen").

ratings that capture belief in inevitability (e.g., "Under the given circumstances, no different outcome was possible"; see Nestler et al., 2010), and as we discuss later, it is governed by higher order processes of sensemaking (which brings together beliefs about causal forces). The inevitability level stacks on top of memory distortion, meaning that inevitability subsumes memory distortion but additionally embraces beliefs about the causal forces that make certain outcomes seem more predictable than others. Inevitability may be demonstrated via either the hypothetical or the memory design, as long as the focal judgment centers on the objective state of the world.

Foreseeability

The foreseeability level is inherently subjective, centering on beliefs about one's own knowledge and ability (e.g., "I knew it would happen"). It involves believing that you personally could have foreseen a now-factual event, thus capturing the feeling that "I knew it all along." Foreseeability is measured with self-report ratings (e.g., "The performance of the stock was easily predictable when it was purchased"). The foreseeability level stacks on top of inevitability, meaning that it subsumes beliefs about the objective status of the world but additionally includes beliefs about one's own prowess at understanding the world.

Nestler et al. (2010) offered experimental evidence that these levels are dissociable. As we discuss later, the more basic cognitive inputs (recollection and knowledge updating) contribute mainly to memory distortion, the more elaborative cognitive determinant (sensemaking) contributes primarily to inevitability, and the motivational and metacognitive inputs contribute mainly to foreseeability. However, it is important to note that these levels are only partly dissociated. That is, because the upper levels involve more expansive beliefs, they can, in a top-down manner, influence the level beneath. For example, a foreseeability belief ("I knew that Obama would win the 2008 election"), by virtue of its informational breadth, suggests inevitability ("Obama's 2008 electoral victory, given the economic events of 2008, just had to happen"), which is the level beneath it. Thus, factors that impact the foreseeability level will tend to affect the inevitability level but not vice versa. The dissociation findings of Nestler et al. (2010) represent a first step toward this conception of levels, but the empirical basis remains sparse: We anticipate further research that will more sharply delineate the levels of hindsight bias and their precise interconnections. Tests of dissociation rest on theoretically specified inputs hypothesized to influence one process but not another. In the next section, we summarize what is currently known about the inputs to hindsight bias.

Inputs to Hindsight Bias

Three kinds of input—cognitive, metacognitive, and motivational—exert differential influences on the three levels of hindsight bias.

Cognitive inputs

Cognitive inputs reflect operations of memory. At least three memory processes feed into hindsight bias: recollection, knowledge updating, and sensemaking.

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Recollection. In recollection, people attempt to retrieve their earlier, pre-event predictions (Erdfelder & Buchner, 1998). Recollection errors are most clearly evident when researchers use the memory design methodology and assess hindsight bias via the memory distortion level. For example, people may fail to retrieve the answer they gave to an earlier almanac question (e.g., "What is the distance from Minneapolis to Chicago?") and instead rely on what they now know to be the correct answer. More elaborative encoding of the earlier question and answer would thus facilitate accurate recall and diminish hindsight bias (Hell, Gigerenzer, Gauggel, Mall, & Müller, 1988). For events that are more complex than almanac answers, people sometimes confuse which bit of information came from which source (i.e., source confusion), a cognitive phenomenon with a rich history of research (Schacter, Chiao, & Mitchell, 2003) that has also been implicated in hindsight bias (Marks & Arkes, 2010). Recollection errors are a first step toward hindsight bias, but comparatively speaking, it is knowledge updating that contributes more (Erdfelder, Brandt, & Bröder, 2007; Erdfelder & Buchner, 1998).

Knowledge updating. The human memory system is remarkably adept at taking in new information and connecting it with what is already known. Knowledge updating refers to the integration of new information into existing memory structures, an instantiation of the reconstructive nature of human memory. On learning of a football victory by the home team, for example, this information will be rapidly interconnected with older knowledge involving players' stats, the coach's performance, league politics, and the like. When new knowledge makes a tight conceptual fit with old, feelings of clarity result: The past is now more easily understood and hence more easily "predicted" post hoc (Arkes, 1991; Blank & Nestler, 2007; Hawkins & Hastie, 1990).

A key aspect of knowledge updating is that new information selectively activates and therefore strengthens compatible information in memory, whereas inconsistent information remains deactivated (Blank & Nestler, 2007; Hoffrage, Hertwig, & Gigerenzer, 2000; Mussweiler, 2003; Pohl, Eisenhauer, & Hardt, 2003; Woodward et al., 2006). Associations in memory are strengthened among bits of knowledge that are consistent with the feedback or the outcome in question. To illustrate, Louie (2005) measured spontaneous thoughts about a company's stock, with the outcome manipulated to involve either improvement or deterioration in stock valuation (benchmarked against a no-outcome control condition). Participants' spontaneous thoughts were disproportionately consistent with whichever outcome was obtained. In a study by Carli (1999), participants read information regarding a romantic encounter that ended traumatically (date rape), whereas participants in a no-outcome control condition did not learn of a tragic outcome. In recall 1 week later, participants who had learned of the rape outcome misremembered details of the romantic encounter in a manner congruent with the rape, whereas control participants recalled events as more in line with a typical romantic encounter. The automatic and associative nature of knowledge updating connects most directly to the memory distortion level of hindsight bias (Calvillo, in press), whereas the next input to be discussed, sensemaking, connects most directly to the inevitability level (Blank & Nestler, 2007; Nestler et al., 2010).

Sensemaking. Sensemaking involves explanation that achieves meaning in terms of the outcome's broader consequences for the sensemaker (Kruglanski, 1989; Lombrozo, 2006; Wilson & Gilbert, 2008). It involves more sophisticated and elaborative processing than that of knowledge updating. For example, a story (i.e., a narrative structure with a beginning, middle, and end) makes a collection of events seem more coherently interconnected, resulting in the perception that the flow of events was obvious and inevitable (Trabasso & van den Broek, 1985). Indeed, the better the story, the greater the hindsight bias (Blank & Nestler, 2007; Hawkins & Hastie, 1990; Wilson & Gilbert, 2008).

Sensemaking stems from causal explanations (Einhorn & Hogarth, 1986; Lombrozo & Carey, 2006; Roese & Morris, 1999). Situations that (after the fact) lend themselves to straightforward causal explanations evoke greater hindsight bias than situations that are more ambiguous (Jennings, Lowe, & Reckers, 1998; Trabasso & Bartolone, 2003; Trabasso & van den Broek, 1985; Wasserman, Lempert, & Hastie, 1991; Yopchik & Kim, 2012). The converse—surprising outcomes—can also heighten hindsight bias but only if people figure out a coherent explanation that successfully resolves the surprise (Ash, 2009; Blank & Nestler, 2007; Calvillo & Gomes, 2011; Nestler, Blank, & von Collani, 2008a, 2008b; Nestler & Egloff, 2009; Pezzo, 2003, 2011; Roese & Olson, 1996; Roese & Sherman, 2007; Schkade & Kilbourne, 1991; Sharpe & Adair, 1993). It is the feeling of explanatory coherence that gives rise to the inevitability level of hindsight bias (i.e., the belief in the objective predictability of past outcomes).

The power of sensemaking to amplify hindsight bias stems from people's tendency to oversimplify cause and effect. Dawes (1993) pointed out that reality contains numerous forms of causal interconnection. There are cases of one-to-one connections, such that a particular cause has only one effect and that effect has only that one cause. Mathematical equations often fall into this category, as does the idea that a chicken egg comes only from a chicken and chickens lay only chicken eggs. Clearly, however, there also more complicated cases, such as one-to-many causal connections (i.e., one cause produces many outcomes, such as a virus causing many symptoms) and many-to-one connections (i.e., many causes are sufficient to produce a single outcome, such as a poor harvest, which might stem from drought, monsoon, or locust plague). Most daunting are the many-to-many connections (many causes can interconnect with many outcomes, as in the spread of gossip through a social network). Dawes argued that even though people are able to appreciate the many-to-many structure of future events, when they turn to the past, they instead fixate on a focal outcome, which implicitly pushes them into many-to-one or even one-to-one assumptions about causation.

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The psychological consequence is a neglect of the role of randomness and a tendency to overestimate the power to predict once-future events. The essence of sensemaking, rooted in oversimplified causal inference, is thus severely compromised from the start of the inferential journey, thereby constituting yet another facet of hindsight bias.

Counterfactual judgments also connect to hindsight bias via sensemaking. Counterfactuals are thoughts of what might have been, of what could have happened if some past action had been different (Roese, 1997). "If she had trained harder, she would have won the match" is an example of a counterfactual conditional, embracing both an antecedent (a past action, here training harder) and a consequent (an unobtained outcome, here a victory). For the average person, counterfactuals take the form of conditionals that connect personal action to desired goals (Epstude & Roese, 2008; Morrison & Roese, 2011). Because counterfactuals make salient alternative outcomes, a straightforward assumption is that greater cognitive emphasis on counterfactuals decreases hindsight bias (e.g., because a victory could have happened, the factual loss was perhaps not so inevitable; see Kahneman & Varey, 1990; Slovic & Fischhoff, 1977). This inverse relation between counterfactuals and hindsight bias tends to occur when the form of counterfactual thinking focuses only on an alternative outcome, without any consideration of how that outcome might have come about (i.e., a counterfactual that does include an antecedent but is merely outcome focused; Nario & Branscombe, 1995; Sanna, Schwarz, & Stocker, 2002). As discussed later, because counterfactuals can reduce hindsight bias, they have the potential to be used as a debiasing strategy (Nario & Branscombe, 2005; Tetlock, 2005). However, when counterfactual thinking spotlights a prominent antecedent cause that furnishes a satisfying explanation for the outcome (in the example above, an athlete's training), then the counterfactual contributes to greater hindsight bias by way of sensemaking (Nestler & von Collani, 2008; Roese, 1999; Roese & Maniar, 1997; Roese & Olson, 1996). Overall, sensemaking reflects a more elaborative process that builds from the more basic associative processes of knowledge updating. The more a person can make sense of and inject meaning into the past, the greater the hindsight bias.

To summarize, three processes comprise the cognitive inputs to hindsight bias: recollection, knowledge updating, and sensemaking. Recollection involves retrieval failure, knowledge updating involves selective activation of outcome-compatible information in memory, and sensemaking involves the causal explanations that yield higher order meaning. In terms of the levels of hindsight bias, recollection and knowledge updating both feed into memory distortion, whereas sensemaking contributes mainly to inevitability.

Metacognitive inputs

Metacognitions are thoughts about one's own thoughts (Flavell, 1979; Werth, Strack, & Förster, 2002). Realizing that you have been able to recite your childhood best friend's phone number since you were a kid or that you do not know the Minnesota state flower are two examples of metacognitive thought. Because metacognitive inputs by definition center on subjective judgments, then they should (and do) exert their greatest effect on the hindsight bias level that is most subjective, namely, the foreseeability level (Nestler et al., 2010).

Of particular interest to theorists has been the subset of metacognition centering on the subjective feeling of ease with which a judgment is made (processing fluency). When people find it easy to come to a conclusion about a particular outcome, they will show greater hindsight bias, particularly in terms of foreseeability, because people misattribute the subjective ease to the judgment itself. In essence, "easy" is misattributed to "certainty." For example, in an experimental session, participants might be asked to generate either two versus 10 explanations for a factual outcome or two versus 10 explanations for alternative (i.e., counterfactual) outcomes. Generating two explanations generally feels subjectively easier than generating 10 explanations. In a variety of studies, generating two as opposed to 10 explanations for the factual outcome increased hindsight bias, whereas generating two as opposed to 10 explanations for alternative outcomes decreased hindsight bias. Stated differently, foreseeability diminished when it felt difficult to explain what actually happened, and foreseeability increased when it felt hard to explain how an alternative outcome might have come about (e.g., Sanna & Schwarz, 2003, 2004, 2007; Sanna, Schwarz, & Small, 2002; Sanna, Schwarz, & Stocker, 2002; Schwarz, Sanna, Skurnik, & Yoon, 2007). Experimental procedures that encourage participants to attribute their feelings of ease or difficulty to arbitrary situational factors, such as the lighting in the room, erase these effects (Sanna & Schwarz, 2003).

Overall, it is not only the informational content that matters for hindsight bias but also the subjective ease with which that informational content is processed.

Motivational inputs

Motives reflect wants and needs. It is primarily the foreseeability level that is sensitive to two main forms of motivational input: need for closure and self-esteem. Both constructs may reflect either stable individual differences or momentary activation of motivational states.

Need for closure. People have a need to see the world as predictable and find it threatening to believe that many outcomes are at the mercy of unknown, random chance. For instance, people prefer to pick their own lottery numbers than have these chosen for them, even though the odds of winning are precisely the same (Langer, 1975). People seek meaning through religion, ideologies, and other worldviews that impose order and predictability on life (Heine, Proulx, & Vohs, 2006; Jost, Banaji, & Nosek, 2004; King, Hicks, Krull, & Del Gaiso, 2006; Kray et al., 2010; Pyszczynski, Greenberg, & Solomon,

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1999). When order and predictability become suspect, people respond by supercharging belief in their ideologies (Kay, Gaucher, McGregor, & Nash, 2010; McGregor & Marigold, 2003) and conjuring coherent patterns out of random stimuli (Kay, Whitson, Gaucher, & Galinsky, 2009; Whitson & Galinsky, 2008).

Hindsight bias also quenches the thirst for order and predictability (Markman & Tetlock, 2000; McGraw, Todorov, & Kunreuther, 2011; Tetlock, 2005; Thompson, Armstrong, & Thomas, 1998; Walster, 1967), such that people who possess dispositionally greater needs for control or closure show greater hindsight bias (Campbell & Tesser, 1983; Musch, 2003; Tykocinski, 2001; see also Hirt, Kardes, & Markman, 2004; Kruglanski & Webster, 1996; Musch & Wagner, 2007). Existential threats, such as terrorist attacks and economic upheavals, may increase hindsight bias and thus thwart the learning from experience that would be essential to overcome such challenges.

Self-esteem. People strive to preserve and enhance positive views of themselves (Baumeister, Campbell, Krueger, & Vohs, 2003; Sedikides & Gregg, 2008). In explaining the past, people make themselves feel better by taking credit for success and blaming others for failure (Miller & Ross, 1975; Roese & Olson, 2007; Shepperd, Malone, & Sweeny, 2008). After a debacle, a person who says "I never could have seen it coming" (i.e., a strategic reduction in hindsight bias) is in essence absolving him- or herself of blame. Several studies have indeed shown that people show less hindsight bias following negative (as opposed to positive) outcomes (Holzl, Kirchler, & Rodler, 2002; Louie, 1999; Louie, Curren, & Harich, 2000; Mark, Boburka, Eyssell, Cohen, & Mellor, 2003; Mark & Mellor, 1991; Pezzo, 2011; Pezzo & Beckstead, 2008; Pezzo & Pezzo, 2007). Other studies, however, have shown the opposite—an increase in hindsight bias after a negative outcome. For example, Israeli supporters of Benjamin Netanyahu, disappointed by his 1999 prime ministerial election defeat, showed greater hindsight bias than did victorious opponents of Netanyahu (Tykocinski, 2001; see also Sanna & Chang, 2003; Tykocinski et al., 2002; Wann, Grieve, Waddill, & Martin, 2008).

How can these contradictory results be explained? Two solutions have been offered. First, it may be that the two patterns differentially map onto two of the three levels of hindsight bias. That is, a problem may initially activate sensemaking processes, and to the extent that sensemaking is effective, it increases hindsight bias at the inevitability level. But further, by connecting to motives to protect self-esteem, the problem may lead to a reduction in hindsight bias at the foreseeability level (Blank & Peters, 2010). Thus, the second solution involves the moderator variable of perceived control operating at the foreseeability level (Pezzo & Pezzo, 2007; Roese, 2004; Roese & Olson, 2007). When people feel that that they are in control of a situation (as in romantic disappointments or work setbacks), they claim reduced foreseeability (i.e., the "I never could have seen it coming" belief noted above). By contrast, when people are mere bystanders (as in electoral or sports defeats), they claim heightened foreseeability ("I just knew it would happen"). In this latter case, people enhance their self-esteem by taking credit for their apparent knowledgeability.

To summarize, motivational factors fuel hindsight bias (particularly foreseeability) in two ways: first, by way of a need to see the world as orderly and predictable and, second, by way of a need to protect and enhance one's self-esteem. Having reviewed the three inputs to hindsight bias, we turn next to its consequences.

Consequences of Hindsight Bias

Hindsight bias matters because it can have serious consequences for decision making (Louie, Rajan, & Sibley, 2007). We focus on two common and important consequences of hindsight bias: myopia and overconfidence. Myopia involves an error in locating the cause of a problem, either by focusing on the wrong cause or by exaggerating the impact of the right cause. Overconfidence involves exaggerating one's own ability to analyze situations, which may result in overlooking other perspectives and advancing risky positions in subsequent decision making. These consequences are defined at an abstract, cognitive level; from them may flow innumerable context-specific judgments, emotions, and behaviors, and as such they will be applicable to the numerous domains in which hindsight bias has been observed.

Myopia

A Concorde supersonic jet crashed shortly after takeoff from Paris in July 2000, killing all 109 people aboard. After the crash, investigators examined the wreckage, sifted through the evidence, and eventually determined the cause to have been a tiny piece of metal on the runway that was sucked into an engine during takeoff, which then started a fire in the engine. Learning the cause of an accident confers enormous power, for such knowledge holds the key to fixes that will prevent future tragedy. Hindsight bias may interfere with learning from experience by systematically biasing one aspect of causal inference, centering on the incorrect specification of the true cause of an event.

When people think myopically, we mean that they fail to perform a thorough search for explanations. Being "cognitive misers," people often seize on the first causal candidate that comes along (Shaklee & Fischhoff, 1982). For example, an observer of the Concorde crash might immediately seize on the causal explanation of pilot error and stop there, failing to dig deeper and therefore missing other viable causal explanations. The explanation that is considered first tends to be whatever is "top of the mind" in terms of greater accessibility from memory (Shah & Oppenheimer, 2009). For instance, research has shown that the person who is visually prominent within a scene (e.g., the person sitting at the head of the table) tends to be seen as more responsible for the outcomes that transpire

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(Taylor & Fiske, 1975). More generally, people's causal understanding of the world often centers on the intentional acts of others (as opposed to mechanical or market forces), which means that the first explanation seized on tends to involve the actions of individual people (Grant & Tybout, 2008; Morris, Moore, & Sim, 1999).

A result of myopia can be placing more blame on a particular individual than is warranted (e.g., "He should have known better!"; Nickerson, 1999). For instance, a study of perceptions of a rape situation found that greater hindsight bias was associated with blaming the victim (Carli & Leonard, 1989). Moreover, hindsight bias led to the belief that there was something deep and pervasive about the victim's character that brought about the tragic outcome. In an organizational setting, myopia occurs when management feels they could easily have predicted a poor outcome that their employees seemingly did not and therefore they blame the employees, even if the outcome was not obvious in foresight. The result may be wariness to accept new initiatives on the chance that an unforeseen event will arise that will produce future (hindsight-driven) blame. More to the point, hindsight bias heightens punitiveness, as demonstrated in numerous studies on hindsight bias in legal decisions, such as those made by jurors (Casper, Benedict, & Perry, 1989; Eberwine, 2005; Goodwill et al., 2010; Harley, 2007; Hastie et al., 1999; Kamin & Rachlinski, 1995; LaBine & LaBine, 1996; Smith & Greene, 2005).

Myopia is a consequence of hindsight bias that implicates causal inference. We should clarify that although at a gross level, causal inference appears to be both input as well as a consequence of hindsight bias, the particular forms of causal inference at these respective stages are different. In terms of input, what is key is the narrative coherence of the causal inference, which by way of sensemaking amplifies hindsight bias. By contrast, causal inference as a consequence of hindsight bias takes the form of a truncated search for additional causes (myopia) and therefore results in the exaggeration of the importance of a single explanatory factor. Although myopia may follow from any of the three levels of hindsight bias, there might be a particularly strong connection from inevitability (because this level involves causal reasoning) and foreseeability (because this level involves self-serving biases in causal reasoning).

Overconfidence

The second major consequence of hindsight bias is overconfidence (Granhag, Strömwall, & Allwood, 2000), that is, unjustified certainty regarding predictions, which is to say that a gap exists between beliefs about one's performance versus objective performance. Overconfidence can manifest itself in various ways, such as seeing smaller confidence intervals than actually exist or when gamblers see their gambles as being likelier to pay off than statistical base rates would suggest (Moore & Healy, 2008).

In terms of unwarranted beliefs in one's own prowess, hindsight bias may yield overconfidence that incites a reluctance to reassess one's own past actions. Decision makers who feel that they "knew it all along" will see little use in considering fresh ways to attack a problem (Bukszar & Connolly, 1988; Cassar & Craig, 2009). Overconfidence about one's inferential abilities encourages overconfident action. For example, in a study of gambles on horse races, participants who had undergone an experimental manipulation that encouraged hindsight bias subsequently reported greater confidence in and willingness to make similar gambles in the future (Petrocelli & Sherman, 2010). That overconfidence leads to unfavorable outcomes has been well documented in work on financial decisions (Klayman, Soll, Gonzalez-Vallejo, & Barlas, 1999; Malmendier & Tate, 2005; Scheinkman & Xiong, 2003; Zacharakis & Shepherd, 2001). In investment bankers, those who show greater hindsight bias also earn less than others (Biais &Weber, 2009). In entrepreneurs, overconfidence breeds risky, ill-informed ventures that underperform in terms of return on investment (Koellinger, Minniti, & Schade, 2007).

Bradfield and Wells (2005) showed how hindsight bias leading to overconfidence can affect beliefs about one's ability to make sound judgments in general. In this research, participants viewed a video that provided background information about a romantic couple. Participants then learned that one member of the couple had an affair, and participants were instructed to predict who it was. Participants' predictions were either confirmed or disconfirmed (the former were presumed to feel a greater sense of "knew it all along" than the latter). Tellingly, those whose predictions had been confirmed were more likely to report that (a) in the initial videotape watching task, they had closely attended to the relevant information, (b) their prediction was well supported by that information, and (c) their judgment had been made easily. Moreover, participants whose predictions had been confirmed later rated themselves as better at interpreting nonverbal behaviors and at understanding other people in general. In sum, the sense that one "knew it all along" translated into beliefs about the excellence of one's own observational prowess.

Although overconfidence may follow from any of the three levels of hindsight bias, we suggest that it has a particularly strong connection to foreseeability. The overconfidence of hindsight bias involves sweeping appraisals of one's own abilities, and it is the foreseeability level that most closely connects to this sort of self-serving judgment (cf. Bradfield & Wells, 2005).

Debiasing

Can hindsight bias be eradicated? Several so-called debiasing strategies have been proposed over the years (Arkes, 1991; Fischhoff, 1982a; Guilbault, Bryant, Brockway, & Posavac, 2004; Harley, 2007; Larrick, 2004). We review one that has

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proven consistently effective, the "consider-the-opposite" strategy. We then discuss whether expertise (which has appeal because it is an individual difference aspect that can be taught and learned) is a defense against hindsight bias. We conclude that there are circumstances in which expertise would seem to offset hindsight bias, but expertise in itself confers no blanket protection.

Consider-the-opposite

In this strategy, the decision maker is encouraged to consider and explain how outcomes that did not occur could well have occurred (Koriat, Lichtenstein, & Fischhoff, 1980; Lord, Lepper, & Preston, 1984). An accountant conducting an audit might be encouraged, for example, to consider a different set of corporate initiatives that might have brought about the same current financial portrait (i.e., what explanation might account for a different antecedent producing the outcome that occurred). Further, the person might consider initiatives that might have produced a completely different financial portrait (i.e., what explanation might account for a different antecedent producing a different outcome from actuality).

The consider-the-opposite strategy neutralizes hindsight bias by attacking (a) the mechanism of knowledge updating (one of the cognitive inputs to hindsight bias) and (b) sense-making, specifically in terms of encouraging causal analysis that is not simply of a one-to-one or many-to-one structure but rather the more realistic many-to-many structure of causal relations (see previous discussion of Dawes, 1993). As noted, learning about an outcome selectively activates semantically associated information in memory. Typical decision makers tend to show what we have termed myopia, in that they settle quickly on the first, most salient, or most accessible explanation and stop searching (Shaklee & Fischhoff, 1982). The consider-the-opposite strategy, however, stimulates counterfactuals about other possible outcomes and, importantly, other causal explanations, thereby illuminating novel, previously unconsidered means by which the same or different outcomes might have occurred (Arkes, 1981; Chapman & Johnson, 1999; Hirt & Markman, 1995; Kray & Galinsky, 2003; Mussweiler, Strack, & Pfeiffer, 2000). The result is that decision makers attain a more nuanced realization of the multiple possibilities inherent in complex chains of events than before the strategy was used (see Dawes, 1993). To the extent that the consider-the-opposite strategy reduces hindsight bias, it can shrink both myopia and overconfidence. "Cultivating humility in our assessments of our own past predictive achievements may be essential to cultivating realism in our assessments of what we can do now and in the future" (Tetlock, 2005, p. 205).

The consider-the-opposite strategy was demonstrated in a study involving physicians' assessments of medical diagnoses (Arkes et al., 1988). Physicians learned of a patient's symptoms and then pondered competing diagnoses (e.g., alcohol withdrawal, brain injury, or Alzheimer's disease). Next, they learned of the outcome of the case (i.e., which diagnosis proved to be correct). Some physicians were not given special instructions, whereas others were asked to provide a reason as to why each of the candidate diagnoses might be true. Providing these mutually incompatible reasons reduced (although did not completely eliminate) hindsight bias. The power of consider-the-opposite has been documented in finance and accounting (Anderson, Jennings, Lowe, & Reckers, 1997; Lowe & Reckers, 1994), political and policy analysis (Tetlock, 2005), legal judgment (Carli & Leonard, 1989), and judgments of scientific and historical outcomes (Davies, 1987, 1992; Herzog & Hertwig, 2009; Slovic & Fischhoff, 1977).

A potential pitfall of the consider-the-opposite strategy is that it could backfire if too many alternative reasons are considered. We noted that metacognitions are an important input to hindsight bias. The subjective feeling of ease in making a judgment (fluency) may be misattributed to any judgment, including inferences of past possibility (Kadous, Krische, & Sedor, 2006; Schwarz et al., 2007). If it feels subjectively difficult to generate many additional reasons for how an alternative outcome (i.e., counterfactual) could have occurred, then the decision maker may interpret this difficulty as an indication of the implausibility of those alternatives, which would then reinforce rather than mitigate hindsight bias regarding the outcome that did occur. Accordingly, the consider-the-opposite strategy is most effective if restricted to consideration of no more than two or three alternative explanations.

Expertise

Does expertise shield the decision maker from hindsight bias? If so, then training and experience within a specific judgment domain might be an effective means of debiasing. The mechanism for such an effect would start with superior initial forecasts, which leave less "room" for hindsight effects to appear. Further, superior recollection would lessen the role of knowledge updating, as noted by Musch and Wagner (2007): "To the extent that experts are better able to reliably recall their original judgment, reconstruction processes are rendered unnecessary, which should result in a smaller bias" (p. 67). We suggest that the memory distortion level is most affected by expertise via this knowledge updating mechanism. Direct evidence for this mechanism versus others has not yet appeared, however, and the overall evidence for expertise effects is mixed. Whereas an early meta-analysis by Christensen-Szalanski and Willham (1991) found that expertise correlated with reduced hindsight bias, a subsequent meta-analysis by Guilbault et al. (2004), using a larger sample of studies and a tighter definition of expertise, found no relation.

Individual studies of expertise have varied in rigor, but one methodologically compelling study instructed expert versus novice baseball players to perform multiple at-bat attempts using a computer batting simulator (Gray, Beilock, & Carr, 2007). Participants swung real bats in response to a simulated ball projected on a large screen. A motion sensor on the bat indicated whether the ball was hit and, if it was hit, where and

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how far it would have gone. Participants predicted their own batting performance on each trial, using a computer mouse to indicate where, on a visual display of the baseball playing field, the ball would end up. Following feedback on each trial (computer animations of where the ball "actually" went), participants reindicated their earlier prediction. The difference between the prediction and recollection constituted the measure of hindsight bias (an example of the memory distortion level of hindsight bias). Across the dozens of batting trials, expert participants showed a smaller hindsight bias than did novices.

Complicating matters, Musch and Wagner (2007) suggested that experts, given their broader range of highly accessible knowledge, might be more likely to experience a subjective feeling of ease of judgment, and if they misattribute this fluency to their retrospective judgments, the result would be an increase rather than decrease in hindsight bias. Note, however, that this metacognitive effect would most likely reveal itself in the foreseeability level of hindsight bias (which involves subjective appraisal of one's predictive ability). As a result, we may hypothesize that expertise reduces hindsight bias as defined in terms of the memory distortion level but at the same time increases hindsight bias as defined in terms of the foreseeability level.

Whether experts are overall better than novices at warding off hindsight bias might be informed by extant research on expertise effects in judgment and decision making. The literature on overconfidence suggests that expertise embodies skills that mitigate bias in domains that afford clear, continuous feedback (Kahneman & Klein, 2009). Experts in chess, weather forecasting, accounting, and insurance receive repeated feedback on their predictions and hence are able to recalibrate their judgments accordingly. In contrast, judges, stockbrokers, political experts, and clinical psychologists receive sparser and more ambiguous feedback and hence lack the opportunity for recalibration (McKenzie, Liersch, & Yaniv, 2008; Shanteau, 1992; Stewart, Roebber, & Bosart, 1997; Tetlock, 2005). In short, the question is not so much whether expertise reduces hindsight bias but under what circumstances it does so. The answer appears to rest on clarity and frequency of performance feedback.

New Directions

Research on hindsight bias has been of interest to scholars for decades, and shows little sign of waning. New research directions on timing and visualization technology seem especially promising avenues for fresh insights.

Timing

From public policy initiatives to managerial strategy, the assessment of an outcome depends on the pinpointing of particular steps, decisions, and developments that led to key outcomes. Recent research suggests that the timing at which judgments are made and the time period that is the focus of the judgment process are of key significance. One relevant finding is that hindsight bias grows bigger the longer the time between the evoking event and subsequent judgment (Bryant & Brockway, 1997; Bryant & Guilbault, 2002; Burrus & Roese, 2006). This finding reflects the reconstructive nature of episodic memory, in which concrete details become blurred or dissipate over time in favor of abstract or gist summaries (Brainerd & Reyna, 1990; Davison & Feeney, 2008; Pillemer, Goldsmith, Panter, & White, 1988; Trope & Liberman, 2003). The greater the reliance on abstract summaries, the greater the room for hindsight bias to create an overly simplistic picture of the past. As a consequence, more accurate assessments of outcomes might be realized when formed immediately after the event rather than after a longer delay. Such a recommendation seems at odds with adages that decision makers should refrain from jumping to premature conclusions. Indeed, other aspects of an event might suggest waiting a modest amount of time before making a decision to give emotions or arousal the chance to dissipate (Baumeister, Vohs, DeWall, & Zhang, 2007). There may well be a "sweet spot," a temporal window of perhaps a few hours after an event during which retrospective judgments will be optimally accurate.

Timing is part of the basic definition of hindsight bias. For example, the prediction of who will win a football game will, obviously, vary over the course of the game: A win by the home team might seem likely in the first quarter only to become far-fetched in the final minutes of play. After the home team is decisively defeated, hindsight bias will involve difficulty in recovering a prior prediction, but at which earlier point in time should hindsight bias be defined? Fessel, Epstude, and Roese (2009) explored the element of timing in a procedure that required participants to make repeated likelihood estimates in foresight while observing an event sequence unfold (via video or text). After participants learned the final outcome, they attempted to recreate the series of earlier likelihood estimates. A graphical plot of likelihood estimates as a function of time shows an "inevitability curve" (Tetlock & Lebow, 2001), which generally takes the form of a positive incline with "wrinkles" corresponding to surprising plot developments and terminating at 100% likelihood at the right end of the *x*-axis. Plotted this way, hindsight bias represents the difference between two curves, the foresight curve versus the hindsight curve (Fig. 2). With these curves in hand, Fessel et al. (2009) characterized hindsight bias with regard to three kinds of bias (note that the focus here is on both the inevitability and the foreseeability level). There was no evidence of bias in the sense of linear accuracy (in that foresight and hindsight judgments correlated highly over time), nor in rate accuracy (in that hindsight judgments accurately recaptured the slope of the curve). Rather, hindsight bias was embodied in a lack of temporal accuracy: In hindsight, people displaced the entire curve earlier in time. In other words, people accurately recalled the pattern by which they had earlier gained confidence in the likelihood of a particular outcome, but each gain in confidence

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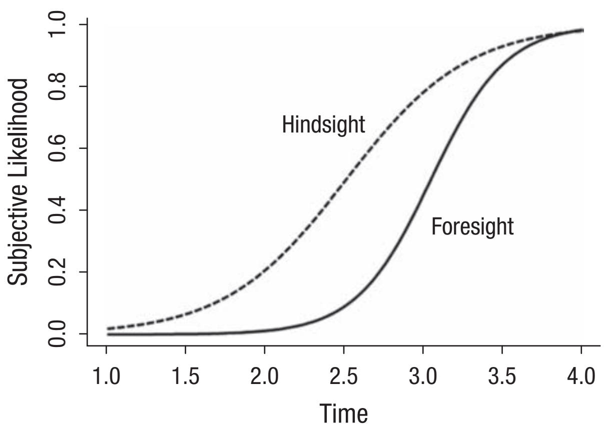

Fig. 2. Hindsight bias plotted over time. Image reprinted from Fessel, Epstude, and Roese (2009). Time is expressed via arbitrary values ranging from 1 to 4 (in this experiment, the total time span was less than 1 min). The smooth curves were derived from the logistic regression parameters extracted from raw data.

was recalled to have occurred at a time point earlier than was the case in actuality. In offering a new way of defining hindsight bias, this research clarified the role of time as the process unfolds.

Visualization technology

If a picture is worth a thousand words, then new computer technologies that can present information more clearly, vividly, and dramatically are likely to be more persuasive than mere text. Microsoft has successfully marketed the notion that an elaborate PowerPoint presentation packs more persuasive punch than hand-scrawled notes on a dry-erase board. Computer generated imagery, such as the seamless Hollywood depictions of action scenes, has increasingly aided lawyers who are beginning to use detailed computer animations of crimes and accidents in courts of law. For example, a vehicular accident may form the basis of a negligence charge. Physical evidence (e.g., tire marks on the road) is translated into a computer model that then forms the basis of a video re-creation of the accident. Ideally, these visual aids would clarify complex information and therefore confer fairer judgment. In practice, however, such forensic animation can obscure the inherent uncertainty of evidence and cause jurors to become overconfident. Roese, Fessel, Summerville, Kruger, and Dilich (2006) examined this issue in an experiment that manipulated the presentation of vehicular accident information such as to be via animation or a combination of static text and diagram. Animation more than doubled the hindsight bias (which was measured in terms of the inevitability level) relative to the text and diagram method of presenting information. Visualization technology may influence hindsight bias via both cognitive and metacognitive inputs (Calvillo & Gomes, 2011; Feigenson, 2010; Fessel & Roese, 2011; Roese & Vohs, 2010).

In terms of cognitive inputs, salient features of a visual display may disproportionately affect causal assessment. Research dating to the 1970s confirms that observers ascribe greater responsibility to individuals who dominate a visual scene, such as when mere camera angle highlights one person in a group (e.g., during videotaped confessions; see Lassiter & Irvine, 1986; Storms, 1973; Taylor & Fiske, 1975). Computer animation may be easily altered to depict an event from virtually any point of view, selected arbitrarily by a software designer or strategically by a lawyer. In events with complex causality, such as traffic accidents, the hindsight certainty that the accident could have been avoided if not for the actions of a particular driver can be heightened if that driver occupies a position of visual salience within the computer-animated scene. The myopia consequence of hindsight bias is most likely to emerge from visual salience effects.

In terms of metacognitive inputs, processing fluency involves the subjective feeling of ease of information processing (Alter & Oppenheimer, 2009; Sanna & Schwarz, 2007). When information about the past is presented in a clear manner (e.g., a sharp rather than blurred visual image), this visual clarity may be misattributed to likelihood judgments. Thus, animation that evokes a feeling of clear understanding may contribute to greater hindsight bias, particularly in terms of the overconfidence consequence (Bernstein & Harley, 2007; Harley, Carlsen, & Loftus, 2004; Sanna & Schwarz, 2007; Winman, Juslin, & Bjorkman, 1998).

The twenty-first century will doubtless continue to bring exponential growth of data, which demand ever more sophisticated techniques for grasping meaningful patterns. The research reviewed here sends a cautionary warning in terms of the overconfidence wrought by visualization technology. In a telling demonstration, brain scientists found research findings to be more persuasive when accompanied by fMRI imagery than when the same results were conveyed via text (McCabe & Castel, 2008; but see also Schweitzer et al., 2011, for null results). If visualization technology has the power to increase hindsight bias, via both myopia and overconfidence, then users of such technology will benefit from insights from basic research. In terms of a practical guide for visualization technology, we suggest two simple rules for minimizing hindsight bias:

1. Use multiple angles, points of view, or mapping algorithms. View different visualizations at the same time, so as to prevent a single, arbitrary angle from dominating interpretation. Just as people tend to focus on a single causal explanation from verbal information, so too do people gravitate toward a single interpretation based on visual perspective. The consider-the-opposite debiasing strategy works for visual as well as verbal input.
2. Use simulated experiments in which some parts of a database are removed as the basis of the visualization. How much does the visualization change? Does this change, support, or contradict the current interpretation? Again via the logic of the consider-the-opposite

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strategy, this rule helps to reduce the misattribution of processing fluency to overconfidence regarding a favored interpretation.

Conclusion

As the old adage goes, hindsight is 20/20. Drawing on diverse literatures spanning psychology, law, economics, finance, medicine, marketing, and management science, in this article, we have profiled the inputs and consequences of hindsight bias in terms of three levels: memory distortion ("I said it would happen"), inevitability ("It had to happen"), and foreseeability ("I knew it would happen"). Hindsight bias derives from cognitive (recollection, knowledge updating, sensemaking), metacognitive (fluency), and motivational (need for closure, self-esteem) inputs. The consequences of hindsight bias include myopia and overconfidence. To reduce hindsight bias, the consider-the opposite strategy has proven effective—this strategy involves raising a person's awareness of other possible explanations and cause–effect linkages. Expertise can shield people from hindsight bias but only in domains that afford clear and frequent performance feedback. Hindsight bias may have the power to compromise sound decision making, but 40 years of empirical research have clarified its operation and in so doing conjured new means for overcoming it.

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Notes

1. This example was also the opening example in Berlin (2000) and in Harley, Carlsen, and Loftus (2004).
2. A literature search (updated in August 2012) for scholarly papers containing a substantive discussion of hindsight bias identified 818 publications.
3. Contemporary thinking on hindsight bias within the American legal system appears in the following passage from the authoritative codification of case law, the American Law Institute's (2010) *Restatement of the Law (Third, Torts: Liability for Physical and Emotional Harm).* Legal scholars are generally aware of hindsight bias as a challenge to fair legal decisions, yet recognize a lack of consensus as to remedy:

> Determinations of negligence are commonly based on findings as to which harms are foreseeable. An interesting feature of the negligence system is that given the inevitable timing of a tort claim—which is filed after harm has in fact occurred—the relevant judgments as to foresight are rendered from what can fairly be called the perspective of hindsight. This obviously introduces the possibility of a hindsight bias into the consideration of the foresight question. Psychologists and behavioral economists have studied and documented this bias, and courts should be cognizant of its existence and tendency to distort judgments. . . . Yet some scholars have expressed the view that the distortions of hindsight bias are tolerable for tort law or, at least, do not justify wholesale reform in an effort to eliminate it (American Law Institute, 2010, pp. 47–48).

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