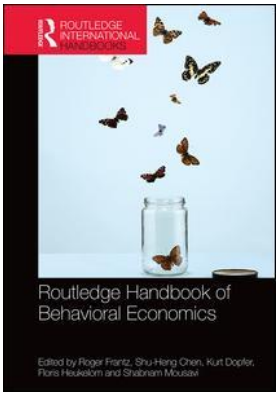

Routledge Handbook of Behavioral Economics

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Publication details
https://test.routledgehandbooks.com/doi/10.4324/9781315743479.ch17
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Published online on: 27 Jul 2016

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IGNORANCE
Literary light on decision's dark corner

Devjani Roy and Richard Zeckhauser

Introduction

Rational decision theory requires that the decision maker attach von Neumann–Morgenstern utilities to possible outcomes. Each outcome represents the combination of the state of the world and a decision taken. In a broad range of decision problems, however, the decision maker is unable to identify important outcomes, hence potential significant outcomes remain unknown. Ignorance represents a situation in which some potential outcomes cannot be identified. Ignorance has received surprisingly scant attention in the behavioral economics literature.[1] This chapter examines the concept of ignorance and identifies the behavioral propensities that arise when it is present—some well known and others specific to decision situations that involve ignorance. It also introduces a new methodological approach to behavioral decision, drawing on the choices of characters in great literature as qualitative evidence of human behavior. Portions of this chapter draw on our recent studies (Roy and Zeckhauser, 2015).

The impulse to forecast the future is etched indelibly in our DNA. Hunches, prophecies, divining the future through patterns found in nature or in our palms or our food, and speculations about divine intention inferred through oracular utterances—intelligent and rational human beings have attempted it all to make sense of a universe that continually challenges our predictive capabilities. Early-nineteenth-century French mathematician Pierre-Simon Laplace posited what is known today as "Laplacian determinism": if blessed with omniscience, or a complete knowledge of the universe and the laws of nature, the human intellect would be able to predict accurately every detail of the future.[2] But, as Laplace concluded, since omniscient intelligence is nowhere to be found, our best hope is probabilistic prediction. But Laplace was an optimist; probabilistic prediction trips us up as well.

Frank Knight (1921) first drew the critical distinction between risk—wherein potential outcomes and their probabilities are both known—and uncertainty, or conditions in which potential outcomes are known, but not their probabilities.[3] Knight also categorized probability situations by degree of predictability, into "*a priori* probability," "statistical probability," and "estimates," adding that forecasting "estimates" is the most challenging of all since "there is *no valid basis of any kind* for classifying instances" for this unique form of probability. In the past century since Knight, decision scientists have focused broadly on engaging uncertainty so that it can be treated like risk. A principal tool has been refining unknown probabilities. Thus, we have

become skilled at predicting the likelihood of precipitation tomorrow, and assessing the probability of whether or not someone with particular characteristics will complete college. Fancy models and large data sets support such efforts. For many problems, however, there are no data sets to distill. Decision scientists then turn to methods that calibrate subjective probabilities,[4] which are then treated no differently from objective probabilities. With these methods, they need not shrink from assessing the likelihood that China and Japan will be involved in a shooting war in the next decade, or that an interview will lead to a job offer.

However, with ignorance, the embrace of subjective probability methods is not sufficient for rational decision, because the decision maker cannot know all of the possibilities to which probabilities should be attached. Ignorance commonly arises with unique events, such as the rise of ISIS or the long-term consequences of climate change. These events encounter deep uncertainties, and deep uncertainties both defy traditional predictive methods and challenge the usual procedures for assessing subjective probabilities.

On the continuum that proceeds from risk to uncertainty, ignorance lies beyond both. Ignorance, as we show below, is the starting point of a fertile, untapped area for decision research. Given that ignorance adds the additional complexity of unidentified outcomes, it encounters all the behavioral biases of uncertainty (some magnified), plus additional biases of its own. The rational decision paradigm (see Savage, 1954 and Raiffa, 1968) employs the expected utility (EU) framework. This normative framework attaches a probability, often subjective, and a utility to each potential outcome. Finally, it prescribes that the decision maker assess the decision tree and choose the preferred branch. Alas, ignorance defeats the straightforward application of such methods: metaphorically, some branches of the tree remain shrouded in darkness. Compounding these difficulties, the presence of ignorance often goes unrecognized: what is unseen is not considered.

The EU model, if embraced, must be extended to allow for ignorance in every life area, from international diplomacy to intimate relationships. Decision making under ignorance suffers crucial errors, affecting governments, financial institutions, and individuals alike. Here we identify a path forward, highlighting broad prescriptions that incorporate the approach of rational decision theory while recognizing the challenges that ignorance introduces.

Ignorance falls into two broad categories: *primary* and *recognized*. *Primary ignorance* characterizes situations where the decision maker does not see its presence. *Recognized ignorance* applies when the decision maker knows that important potential outcomes exist that remain hidden in darkness.

The concept of the *consequential amazing development* (CAD) is at the heart of ignorance. Where ignorance is present, a CAD may follow. While a CAD may be good or bad, it will always be memorable. To be consequential, a CAD must be better or worse than the extreme events in a typical month. To be amazing, it must lie beyond the decision maker's horizon of contemplation. Not every event of significance is a CAD. It is not an objective concept but a subjective one, defined from the standpoint of the individual affected. A mere outlier would not qualify, nor would a Black Swan event, such as a plummeting financial market or windfall spectacular job promotion, because such outcomes can be easily foreseen as a possibility.

We classify CADs according to the difficulty involved in conjecturing them: CADs are *deep*, *conventional*, or *blindered*.[5] *Deep* CADs describe events that could not possibly have been contemplated and often emerge "out of the blue." *Conventional* CADs are those that are difficult to envision, but through some cognitive effort we might have envisioned them.[6] *Blindered* CADs are outcomes that might easily be visualized but are not, often due to the role of visceral factors such as drive states, feeling states, and negative emotions (Loewenstein, 2000). Such forces act in the manner of blinders on a horse, thus restricting the field of view, in this case blocking the recognition of possible outcomes. In short, cognitive efforts can potentially transform conventional and blindered CADs into contemplated outcomes, but such efforts would be futile where deep CADs are concerned.

We also classify CADs according to impact. This chapter is predominantly addressed to CADs that strike one or a few individuals; we label them *narrow* CADs. Think of being cheated by one's long-term trusted business partner. *Broad* CADs impact large swaths of society. The implosion of the Soviet Union, the 2007–8 financial meltdown, and the rise of ISIS are prime examples of broad CADs. Professionals were paid to predict these broad CADs. That they failed suggests that cognitive effort alone would not have led to their anticipation. Broad CADs inevitably trickle down into multitudes of narrow CADs, beginning life as society-wide developments that end up changing the life circumstances of thousands, sometimes millions. Deng Xiaoping's 1979 opening of China to market reforms provides a salient example, ultimately affecting the lives of multitudes not merely in China but also throughout the world.

What makes ignorance a challenge for decision scientists? First, they present the problem of chronicling and classification: namely, situations of ignorance rarely get recorded in the same manner as, say, sports performances or corporate profits. Since CADs are unique occurrences, they defy easy classification, and classification is often the *sine qua non* of serious investigation and study. Second, though potential CADs are many, those that actually occur are few. Third, most potential CADs reside below the stage of contemplation. Absent data sets, statistical methods—the forecaster's prime weapon—are rendered impotent. Fourth, behavioral biases complement these statistical challenges. For example, when contemplating the future, people tend to be limited by the parameters of what they have already seen or experienced. CADs do not repeat; at their second appearance they become predictable phenomena. The third section delves into heuristics and biases that afflict ignorance.

Ignorance will always be with us, and it will particularly afflict highly consequential choices. Thus, just as decision theory developed the concept of subjective probability to cope with decisions under uncertainty, it should provide methods to grapple with ignorance. Thus this chapter does not merely describe; it sets forth four prescriptive recommendations as a first step.

1 *Build intellectual capital*. Understand that ignorance is both widespread and important. Beware of the behavioral biases that humans suffer when they fail to recognize ignorance, and when they respond to it. Build intellectual capital on ways to recognize and respond to ignorance, as best as possible.
2 *Scan for potential CADs*. Scan choice situations inexpensively for the potential for CADs. Cognitive computation and information gathering cost time and effort (Payne, Bettman, and Johnson, 1993), but the scanning we recommend is neither a detailed investigation nor a foolproof method; rather, it is intended to sound a warning when one should seriously attend to ignorance. The scan should be particularly on the lookout for conventional or blindered CADs, since they are possible to anticipate. Given a negative scan, employ traditional decision procedures.
3 *Devote attention to a decision after a positive scan*. A CAD threatens when the product of estimated likelihood for CADs times their expected magnitude is substantial. Particularly for deep CADs, one may not know its nature but be aware of its potential.
4 *Adjust choices given ignorance*. If ignorance is substantial, undertake actions that may prevent adverse CADs or improve the outcome if a CAD does strike.

Ignorance, behavioral decision, and literature

Uncertainty is the favored child of behavioral decision. It gets disproportionate attention relative to certainty and risk. Ignorance, in contrast, suffers neglect. One explanation for this is that ignorance is difficult to study. While studying future conditions and future preferences under

uncertainty is difficult enough, predicting preferences under conditions never before encountered, indeed not even foreseen as a possibility, is a daunting challenge. The tried-and-tested ways of examining human behavior empirically do not work in the study of ignorance:

1 The behavioral scientist's familiar tools—namely, the randomized controlled studies in the field or online, the laboratory experiments with small economic payouts, the large data sets subjected to statistical analyses—are poorly suited to or simply unavailable for the study of ignorance. Poetically expressed, ignorance has been behavioral decision's will-o'-the-wisp—a shapeless ephemeron.
2 For both theoretical and practical reasons, primary ignorance defies study in laboratory settings. Merely raising the possibility of ignorance would give away the game.
3 CADs tend to be unique, *sui generis*, one-time-only incidents. As such, they are difficult to categorize, much less predict. And events not even conjectured, a prime characteristic of CADs, are still more unfathomable.
4 CADs are low in frequency, and most potential CADs never occur. Even if we take protective actions to avoid potential CADs, we have no way to learn or study whether or not these actions have had any effect. In contrast, empiricists overwhelmingly investigate phenomena that occur regularly. Even if single individuals encounter events rarely, if the events are roughly the same across individuals—think heart attacks—they can be readily tallied and studied.

Given these difficulties, perhaps the most promising way to study ignorance is to draw lessons from multiple realms, such as personal medical thunderbolts, stock market crashes, and spontaneous events of human contagion, such as the Arab Spring. Here we concentrate on insights from literature, with strong justification: authors chronicle the way individuals confront ignorance and CADs that occur in their lives. Literature offers adaptive value in two ways: it models social life and it also molds our cognitive models of social life (Oatley and Mar, 2005). Literary fiction offers what evolutionary psychologists call "universals": behavioral and cognitive traits that remain true across cultures (Brown, 1991; Dunbar, 1996, 2004). We draw on insights from the choices of literary characters in some of the world's best-known stories.[7] This qualitative "database" provides us with a descriptive model of behavior when facing ignorance. Such a model is the first step toward our ultimate goal—to produce prescriptive recommendations for making decisions facing possible ignorance.

Literature brings six great virtues to the study of human behavior in general and of ignorance in particular:

1 *Scope*. Literature sketches decision making under ignorance on a large canvas. CADs frequently provide the fuel and the fodder for fictional narratives. Authors, unlike social scientists, have little interest in predictive models but are greatly interested in how literary characters face unprecedented situations.
2 *Induction*. Authors depict how literary characters make choices within everyday decision-making contexts such as love, marriage, education, and saving for the future, to name only a few. Through a process of induction, the nimble-minded decision scientist can extrapolate from these stories to build general descriptive models of behavior. Literature also depicts broad CADs such as revolutions and natural disasters, and the unanticipated consequences in wars and financial upheavals, including the behavior of humans confronting broad CADs. Here the induction task is more challenging, since the circumstances tend to be disparate, but literature still provides a great deal of qualitative data.

3 *Cultural learning*. Discussing how to prepare for uncertainty, Weber and Johnson (2008) observe: "Individuals who live in cooperative groups with the ability to communicate information in symbolic form can use the experience of others not just by direct observation, but also receive it in condensed form."[8] We add that stories *are* the "condensed form" of the "experience[s] of others," honed finely against the whetstone of time. Authors from Aeschylus to Angelou have transmitted didactic content about both human ability and fallibility (the latter is what the decision scientist would call a "bias") within the descriptive boundaries of the fictional narrative.
4 *Anticipation*. "What happens next?" This single question prompts us to read, and keep reading, a work of literature. This impulse—to predict the future while knowing that a great margin of error underlies our speculations—is one of the joys of fiction. It can also provide subject matter for study by behavioral economists, many of whom investigate the psychological motivations behind anticipation and expectation through such concepts as intertemporal choice and risk-taking behavior. The mere title of perhaps the most famous paper in behavioral decision, "Prospect Theory," is revealing of the central role of anticipation in that field.
5 *Contemplation*. Recent decision research emphasizes the importance of noticing, and the dangers of not noticing, information that is easily available but often ignored (Bazerman, 2014). Literary fiction teaches us the importance of contemplation and of exercising the imagination through timely noticing, both qualities critical to envisioning the nature of CADs or merely their potential.
6 *Insights into behavioral decision making*. Decision theory came late to behavioral decision making, given the implicit assumption, which leaked from economics, that descriptive behavior would be driven to the standards of its prescriptive model. Literature never suffered from this handicap, starting instead by being built on observations of human behavior.

Fiction depicts human beings across a range of social, cognitive, and behavioral environments. Thus, reading fiction brings an awareness of how humans actually make decisions in a range of situations, usually banal, frequently consequential, and occasionally astonishing. Fiction also documents severe violations of EU maximization in choices made under risk, uncertainty, and ignorance. Although behavioral decision has now come into its own, it has shown its ignorance of ignorance.

The rich history of literature as a mimetic, or imitative, model, both ideal and cautionary, for human behavior begins with Plato's recommendation to banish poets from the republic, because their stories represent attractive and often undesirable behavior for the future philosopher-ruler. Aristotle builds on this concept to promulgate his more positive theory of mimesis in *The Poetics*, according to which a poet (or writer) should imitate (i.e., portray) things not simply as they are but also as they should be. That concept has had a long-reaching influence on Western literature and theater. Roman poet Horace posits literature as learning for life by providing exemplars of behavioral strategies to writers. Storey (1996) and Scalise Sugiyama (2001) hypothesize that literature transmits accurate psychological information and functions as a storage device for a range of behaviors.

Ignorance serves as the foundation for deception, as Shakespeare shows in many of his plays. From mistaken identities (*A Comedy of Errors*) to psychological ignorance, or obliviousness to the true motives of others (*Much Ado about Nothing*), from gender-based disguise (a woman impersonating a man in *As You Like It*) to masquerading as someone else (King Henry disguising himself as a common soldier and circulating among his troops in *Henry V*)—in each of these instances, the deceived suffer from primary ignorance and fail to imagine the possibility of what is real.

Stories are universal in their descriptive illustration of behavior in a world of ignorance. For instance, over two millennia, the Bible has shown human beings the importance of ignorance,

something decision theorists have overlooked. Usually its message takes the form of parables and stories with deeper, metaphorical meaning. Abraham is commanded by God to sacrifice his son Isaac. Abraham proceeds, but at the last moment, Isaac is saved—it was all a test of faith. Ignorance was critical. Abraham's faith would hardly have been tested had he suspected the outcomes that occurred. When the Israelites sought to flee Egypt but the Pharaoh refused, God sent plagues to afflict Egyptians. The Pharaoh, convinced of the power of his own gods, could not imagine any of these catastrophes as sent by a rival deity. The tenth plague, death of the first-born son in each Egyptian family, finally changed the Pharaoh's mind.

Literature, particularly wisdom literature, has long been sought out as a source of insight in a world of unexplained events.[9] It is fitting that economist Thomas Schelling (1984), a lifelong practitioner of the literary form of the essay, despite practicing the dismal science, describes fiction thus: "Novels, plays ... and stories give the reader ... a stake in the outcome. ... The characteristic that interests me is the engrossment[,] the participation, the sense of being in the story or part of it, caring, and wanting to know."[10]

Writers represent the human experience through a range of emotional and cognitive processes. They provide an unconventional, and entirely unexplored, education in behavioral decision making. The central problem with ignorance—the complete lack of information that could serve as the basis for establishing a prior probability distribution on potential outcomes—may be illuminated through greater exposure to literary fiction.

Heuristics and biases associated with ignorance

Human beings have always relied on simple cognitive mechanisms, termed "heuristics," to make decisions within the natural restraints of information-gathering and processing power (Simon, 1957). The word "heuristic," in the decision-making sense of "relating to, or enabling discovery or problem-solving [...] through relatively unstructured methods such as experimentation, evaluation, trial and error" first appeared in eighteenth-century German philosopher Immanuel Kant's *Essays and Treatises on Moral, Political, and Various Philosophical Subjects* (1798).[11] Heuristics conserve cognitive effort. However, while some are valuable, others can lead us astray.[12] Heuristics that put us off-track are labeled "biases." The word "bias" first appears in the English language in 1530 and it originally meant "an oblique or slanting line," a sense that we retain today when using "bias" as automatic thinking in favor of something or someone, independent of the evidence.[13]

In the mid-twentieth century, Herbert Simon (1955) introduced the concept of *satisficing*, or adaptive thinking to find a satisfactory decision instead of the optimal one. Psychologists Amos Tversky and Daniel Kahneman's initial research on heuristics and biases (1973, 1974) addressing *availability*, *anchoring and adjustment*, and *representativeness* was supplemented over the next thirty years by a generation of behavioral scientists identifying dozens of additional proclivities in this realm. These range from Fischhoff and Beyth's *hindsight bias* (1975), Samuelson and Zeckhauser's *status quo bias* (1988), Johnson and Goldstein's *default heuristic* (2003), to the sports-related *gaze heuristic* (Gigerenzer, 2004).

A general pattern observed with behavioral decision is that as we move from certainty to risk to uncertainty, heuristics and biases play an ever-greater role. Indeed, many biases—such as the nonlinear weighting of probabilities or the law of small numbers—could not even exist under either certainty or risk. Ignorance adds a dimension of the unknown beyond uncertainty. Thus, decision makers confronting it also suffer more from biases and heuristics than when faced merely with uncertainty. We address three that arise under primary ignorance:

1 *Overconfidence*. Individuals are frequently overconfident in their assessment of the future. In the simple case of predicting a numerical magnitude, their assessed distributions are too

tight (Alpert and Raiffa, 1982). CADs, which hardly fall on a defined quantitative spectrum, are much harder to assess. They are often ignored; when not, they are likely underestimated.

2 *Availability*. In predicting the future, individuals tend to focus on prior events already experienced and cognitively available (Tversky and Kahneman, 1973; Epley and Gilovich, 2006). When CADs occur, the availability heuristic tends to impede successful decision making. For example, since 9/11, it is not surprising that the United States has invested vast amounts in airplane safety and relatively very little on protecting our ports.

3 *Selective attention*. Individuals recall and retell some events more prominently than others, notably surprising events with non-trivial consequences. Idiosyncratic circumstances thus find their way more easily into cultural narratives such as stories, films, and historical anecdotes, or, for that matter, accounts from personal experiences. CADs presumably get over-represented in these sources, a possible counterbalance to our natural tendency to miss situations of ignorance. When CADs occur, selective attention complements the availability heuristic: it makes us overestimate the likelihood of these events reoccurring merely because they are available to us.

When ignorance does get recognized, additional biases impede measured decision making. We identify four:

1. Action bias

Action bias (AB) is the excess inducement to take action when gains seem likely and individuals seek recognition or acclaim for their choices (Patt and Zeckhauser, 2000). There is thus a close connection between ignorance, the anticipation of favorable CADs, and AB.[14] Given ignorance, we often will not know what would have happened on the road not taken. If so, it will never be known whether sticking with what was would have proved superior to taking action. Blame comes from bad outcomes, or even from good outcomes if another choice would have been demonstrably superior. Given ignorance, when outcomes including surprises are likely to be good, action bias can claim credit yet avoid blame.

Throughout recorded history, the value of action has been upheld and endorsed. No doubt selective recall contributes, since history is written mostly by the victors—a process that publicizes conquerors and suppresses the tales of agents who took actions and lost. Such endorsements make AB both hard to critique and hard to overcome. In philosophical literature, for instance, the widespread recommendation is that taking action is good; it is the path towards self-improvement and justification of human existence.[15]

2. Status quo bias

Status quo bias (SQB) refers to the tendency to stick to a pre-existing choice, particularly when moving away from this choice, whose outcome serves as a reference point, might incur losses (Samuelson and Zeckhauser, 1988). Loss aversion is a prime promoter of SQB, but other forces also contribute. These include the desire to avoid the cost (in time and money) of studying of new options, and the fear of going against the consensus if a popular status quo already exists.

We hypothesize that ignorance reinforces SQB. Behavioral decisions research supports this conjecture. Weber et al. (2005) demonstrate that familiarity with asset name ("recognition bias") and or location ("home bias") makes assets more appealing, since they are judged to be less risky than unfamiliar assets. Cognitively speaking, the individual adheres to the familiar ("better the devil you know than the one you don't") when ignorant of what the future holds.[16]

We should observe, as the reader has no doubt noted, that AB and SQB pull in opposite directions. There is no tension, however, because AB tugs when the weather conjecture is sun, that is, favorable CADs seem likely, and SQB when it is rain. Most surprises are unpleasant, as Warren Buffett once observed, and CADs surely are surprises. Thus, SQB will prevail in most situations where ignorance abounds.

With its high degree of reliance on unknown-unknowns, detective fiction provides some of the best examples of ignorance as a promoter of SQB. Edgar Allan Poe's "Murders in the Rue Morgue" is hailed as the world's first detective story. An old woman Madame L'Espanaye and her daughter Camille are violently murdered in a Parisian apartment, respectively by decapitation and strangling, inside a room locked from the inside. Who is the murderer and how has s(he) managed to escape? The tale reveals how SQB afflicts thought processes, and not merely choices. Various printed reports in the Parisian newspapers follow established and seemingly logical lines of thinking; they thus demonstrate status quo framing.

The brilliant detective C. Auguste Dupin exposes the flaws in this ratiocination and reveals the real murderer: an orangutan on the loose. The escaped primate, owned by a sailor who acquired the animal overseas, mimicked his owner's daily ritual of shaving (learned by observing his master) by similarly "shaving" Madame L'Espanaye. Strangling the daughter Camille, he stuffs her body up a chimney in an attempt to hide his crime and escapes through the window. The combination of an understanding of simian psychology and the willingness to bounce to new alternatives when ignorance abounds despite the cognitive costs involved—both require moving one's mindset beyond the familiar—is required to solve the crime. In most detective fiction, the local police force makes an initial decision and hysteresis sets in. The initial decision constrains their choices at each subsequent juncture. Often this status quo force is reinforced by concerns about sunk costs, anxiety about errors of commission (not wanting to lose face with their superiors), regret avoidance, and a drive for consistency and safety in the face of uncertainty. Mere mortals have a hard time thinking in new directions, though detective stories shine a spotlight on ignorance and regularly demonstrate that fresh thinking is needed. Only brilliant detectives—Auguste Dupin, Sherlock Holmes, Hercules Poirot—are able to step psychologically to "out-of-the-box" hypotheses.

3. Indecision bias

Indecision bias (IB) arises when individuals who recognize that they are ignorant get frozen with indecision; inaction sets in. IB is far from SQB. It is not a choice to stick with what they have. Rather, they consciously steer clear of making a decision, perhaps standing by waiting for an ill defined something to happen. Even shreds of knowledge may give them hope that a critical indicator will appear. When confronted with ignorance, the already indecisive become doubly so. They frequently require far too much positive evidence before switching from a choice where probabilities are known to one where they are unknown. They fail to recognize that choosing the unknown probability often offers valuable learning opportunities, opportunities that would otherwise be missed. In short, they neglect option value (Trautmann and Zeckhauser, 2013). The magnification of indecision bias by ignorance is particularly disturbing given that consequential decisions often need to be made under conditions of little or no information.

Indecisiveness has been studied as fostering "worst-case scenario" reasoning, and has been explained as a fear of the threat of ambiguity. Indecisiveness has been said to influence not only the decision-making process (e.g., time taken) but also decision-making content or quality (Rassin and Muris, 2005). In effect, indecision bias makes individuals seek out more-than-optimal information before making a decision. CADs, by their very nature, do not announce their coming arrival, rendering information gathering fruitless. Recognized ignorance could

magnify indecision bias, since it highlights the fear of possibly committing to an inappropriate course of action, a variant of the fear of an error of commission.

Characters in literature commonly display indecision bias. They "play safe" or delay inordinately because uncertainty or ignorance tends to paralyze the choice process. Some characters are much more indecisive than others. Writers frequently identify great intelligence and capacity for affect as promoting indecision. Shakespeare, a master student of human psychology, portrays Hamlet's indecisiveness in his "To be or not to be" speech. *Macbeth* presents a noble, sensitive, and courageous military general who becomes the king of Scotland by murdering the *in situ* king Duncan. However, courage hardly assures swift or effective decision making. Macbeth worries pathologically and obsessively before he commits the murder, only acting after his wife derides his indecisiveness and his masculinity. In Edith Wharton's *The Age of Innocence*, the morally upright lawyer Newland Archer is strongly attracted to the separated-but-not-divorced Countess Ellen Olenska, the cousin of his fiancée, May Welland. Fearful of flouting social conventions, Archer waffles endlessly, but ultimately chooses the easy path and marries May, even though he is aware they are ill suited. His indecision persists to the end of his life when, many years after May's death, he has the chance to reunite with Ellen but decides not to do so.[17]

4. Herd behavior

Herd behavior is the tendency of humans who would pick A in isolation to choose B so as to conform with the choices of others. As with herding in animals, moving with the herd can be individually rational, even though the collective outcome can be far from optimal (Schelling, 1978a). Sometimes an inferior equilibrium is reached. Other times no equilibrium is optimal, because the individuals' actions impose externalities on one another.

Herd behavior by humans has been attributed to three causes (Zeckhauser et al., 1991):

1 Free-riding in information acquisition, whereby individuals hope that others know better what decision should be made.
2 Protection from adhering to the group. For example, if individuals are to be judged by their performance relative to others, choosing like others reduces the risk that could come from being an outlier. Similarly, one cannot be blamed for one's beliefs if one adjusts those beliefs, or at least one's expression of beliefs, to accord with the beliefs of others.
3 Adherence to group norms as a means to curb self-reproach.

The famed Asch conformity experiments (1956) demonstrate the strong attraction of sticking with the herd. All three of the causes above have been presented as explanations.

Ignorance has the potential to reinforce these tendencies. We provide two examples:

1 *Regret avoidance*. Once ignorance is recognized, aversive events may occur at any time. Thus, regret as a concern looms large. But regret from our own bad choices may be reduced when other members of the herd have fared equally badly. (One might call this an insidious, yet common form of schadenfreude.)
2 *Safety*. When judged by others, or even oneself, there is always safety in numbers. Ignorance magnifies concerns for safety. Wandering alone in the vast unknown is threatening, both cognitively and to one's reputation. If you know nothing, others may know something, hence imitation may bring protection from danger. Equally important, when all are acting alike, none can be blamed for choosing differently and receiving a poor outcome. Following this logic, the major investment banks all bought commercial mortgage-backed securities, an instrument they did not understand, before the 2008 financial meltdown.

Literary fiction frequently recounts herd behavior in many of the same domains as real life: politics and finance. In *A Tale of Two Cities* by Charles Dickens, the mob mentality under Robespierre's reign during the French Revolution creates untold violence and deaths, making for a situation expressed by the idiom, "the blind leading the blind." The purported goal of the revolutionaries is to bring about social change but the herd behavior produces chaos, not coherence.

In Anthony Trollope's *The Way We Live Now*, based partly on the financial panics of the 1870s, the unprincipled but rich financier Augustus Melmotte draws members of the British upper class to invest in his dubious railway schemes. While individually contemptuous of Melmotte as a social *arriviste*, the aristocrats function collectively as a herd attracted to the future prospect of economic gains and "safety in numbers"—since other established members of their clique also invest with Melmotte. At a historical period when investment schemes were in a nascent stage, and railway investments particularly dubious, Melmotte's investors are collectively ignorant of the future. Their herd behavior proves calamitous when Melmotte is revealed as a forger. Bernard Madoff capitalized on similar herd effects to promote his Ponzi scheme.

Literature frequently portrays gossip, or the creation and social dissemination of reputation, as a facilitator of herd behavior. Gossip, in real life as in fiction, is rarely used to spread honest information or praise. More likely, we see malicious or erroneous gossip that is used to lead the herd in the wrong direction. Mr. Darcy in Jane Austen's *Pride and Prejudice* has the disadvantage of being proclaimed a disagreeable, arrogant man for much of the novel, because his reputation precedes him, nearly all of it circulated by his enemy George Wickham. In Richard Brinsley Sheridan's play *The School for Scandal*, one brother spreads gossip about the other brother's spending habits, seeking to damage his reputation. Lily Bart, the tragic heroine of Edith Wharton's *The House of Mirth*, is banished from the herd in affluent New York society when her reputation is called into question through a series of inaccurate accounts of her behavior spread by prominent members of her former in-group.

After a CAD strikes, two additional biases come into play:

1. Retrospective recollection of contemplation

Retrospective recollection of contemplation (RRC) represents a self-deluding effort to gain comfort with our past failure to recognize ignorance. RRC essentially whitewashes our cognitive failings. We failed to contemplate the CAD that transpired (although with a conventional CAD we *might* have and with a blindered CAD we *should* have). RRC handily leads us to recollect erroneously that the CAD was on our menu of possible outcomes. Falling prey to RRC is akin to creating a "highlight reel" of images of a reconstituted, "cherry-picked" past. It enables us to avoid self-blame in the present because, as we tell ourselves, we saw this coming in the past.

RRC may arise from the human imperative to believe that life makes sense, intuitively speaking; and that as intelligent beings on this planet, we can envision the events will transpire according to some mostly discernible patterns. RRC may be described as the impulse to make sense of apparently anomalous events, much as religious faith does for some individuals.

In William Shakespeare's *Othello,* a CAD strikes the newly married Othello when his meaningful gift of a handkerchief to his wife Desdemona is discovered with Othello's lieutenant, the young and handsome Cassio. Othello's scheming ensign, the "trusty" Iago, has been gradually convincing Othello that Desdemona and Cassio are having an affair. The discovery of the handkerchief (it once belonged to Othello's mother) ignites Othello's already suspicious mind, and sets off a cascade of events: Othello's sexual jealousy produces ever successive lows. First, he smothers his innocent wife to death. Then a new CAD follows: he realizes his error. That CAD in turn leads him to commit suicide.

The "handkerchief episode," upon closer examination, provides crucial understanding of how RRC works on the mind. When a CAD occurs, the past is reconstituted to repress or submerge evidence of our past ignorance. "Of course we saw this coming," we tell ourselves. Desdemona, always of irreproachable, pristine conduct, is now, in Othello's deluded mind, recast as a woman who was always capable of adultery. Falling prey to RRC, he concludes he was too infatuated, and he rebukes himself for failing to recognize Desdemona's true character. Action bias springs forward and Othello murders Desdemona, since he knows he will credit himself for appropriate revenge. The Othello story is a cautionary tale against indulging in impetuous action bias when a CAD strikes. Othello would have been better served by considering alternative strategies, such as openly discussing his concerns with his wife. Ultimately, he might come to question the motives of his source, Iago, who is the only informant to Desdemona's adultery. Othello, however, ricochets from deep love to deep suspicion of Desdemona. Where was Ann Landers when he needed her?

Othello goes to his death lamenting he is a man "that loved not wisely, but too well." And while the world of sixteenth-century Cyprus may seem eons away from ours, we too erroneously recollect that we had contemplated a specific CAD once this CAD has become a reality. To do otherwise would be a betrayal of our past self (Schelling, 1978b). As in fiction so in life, the individual fails to draw inferences from the presence of clues that, were they more carefully noticed, would be warning bells for ignorance, sometimes before a CAD strikes, and sometimes after.

2. Barn door closing

This describes post-CAD behavior when one encounters a chance at a similar decision, albeit in a new environment. Patel et al. (1991) apply the concept to investors who make the investment choices today that they should have made yesterday, figuratively securing the barn door after the horse has bolted. When victims of a negative CAD, decision-makers attempt to rectify history by making today's decision the right retrospective decision. Flawed reasoning leads to poor decisions. Barn door closing provides temporary comfort at the risk of compounding errors. If today's context differs from yesterday's, for example if we are buying equities now when we should have bought them a year ago, the past becomes an oracle of false guidance. Economists have written extensively about the problematic conception of the self when dealing with future behavior (Thaler and Shefrin, 1981; Schelling, 1984; Ainslie and Haslam, 1992), but the phenomenon of barn door closing after a CAD has not hitherto been investigated.[18]

Barn door closing represents a cognitive attempt to look at what lies ahead not through the windshield, but through the rear-view mirror. We tell ourselves, "I can do better this time around." The investor who, with grim tenacity, attempts to avoid mistakes from the past by employing a by now outmoded, investment strategy in effect creates a new barn door to be closed tomorrow.[19]

In literary fiction, we encounter barn door closing most commonly in the domain of intimate relationships—a domain in which individuals are compelled, through some vicious, inexorable force, to draw inappropriate lessons from history. And who can forget Jay Gatsby's cloying desperation as he attempts to rectify his past error in letting the now-married Daisy Buchanan slip out of his life, in *The Great Gatsby*:

> "Can't repeat the past?" [. . .] "Why of course you can!" He looked around him wildly, as if the past were lurking here in the shadow of his house, just out of reach of his hand. "I'm going to fix everything just the way it was before," he said, nodding determinedly. "She'll see."

Prescriptions for ignorance

Our strategy for dealing with ignorance incorporates the four recommendations presented in the first section: first, build a repository of intellectual capital; second, scan the decision environment for potential CADs; third, dedicate attention once a scan has revealed that CADs are imminent; and finally, adjust choices through cognitive diversity and flexibility.

We advocate building intellectual capital by developing decision-theoretic methods, but on an expedient basis from empirical study of instances of ignorance. For that empirical study, we recommend adding to the literature on behavioral and rational decision studies from the world of fiction—specifically, the decision-making adventures of literary characters who are frequently grappling with the complexities of ignorance. Writers, poets, and dramatists know that decisions are not made in environments such as those in decision theory texts, where potential future outcomes are readily identified. A large body of research, from evolutionary psychology to cognitive studies, has noted the evolutionary benefits of storytelling in helping human beings deal with physical and social environments that are hard to predict. Most notably, this body of research speaks loudly and concertedly that stories, disseminated first orally and then through the medium of writing, have instructed human beings in understanding the thoughts and actions of other human beings.[20]

Ignorance poses big challenges. In coping with it, we should first dampen aspirations. For example, we will never foresee deep CADs, and conventional and blindered CADs may just be missed. A systematic approach, however, can improve performance.

Often, the recognition of ignorance changes our choices. Recognizing that emotions are strong, implying that a blindered CAD may lurk, we may opt to delay a life decision, such as getting married. In other contexts we might pursue a more flexible strategy—for example, renting not buying in the new city in case the job does not pan out. For many consequential decisions, advice from the outside is worth gathering. With adverse CADs, prevention is better than mitigation, and actions may be available that reduce a CAD's likelihood. To be sure, such actions entail costs, which are wasted if the CAD would not have occurred. But on an expected value basis, these costs may be worth paying, particularly once we recognize that a CAD is a reasonable possibility.

Analytic tools are often most helpful when they are hardest to employ. Knowledge of decision theory provides modest benefit when shopping at the supermarket, but can be of great value when dealing with a complex medical decision or an elaborate R&D undertaking, both CAD-related events, even if we employ only the theory's basic approach. Thus, we propose a decision-theoretic approach to ignorance. We call our approach *measured decision*, hoping to suggest doing something reasonable and "good enough," if not optimal.

Let us start with CAD magnitude. Many CADs involve consequences that are not readily assessed on a monetary basis: a marriage destroyed, a betrayal by a dear friend. Prescriptive decision theory has just the measuring tool, von Neumann–Morgenstern (VN-M) utilities. An excellent reference outcome would be pegged at 100.0, which would be the status quo. Then a poor outcome would get a value –X.[21] Each CAD outcome would then be placed on this scale using traditional lottery procedures.

If the concern is about the consequences of CADs and the assessment of ignorance, negative or positive values of the same magnitude would get the same weight. Thus, we would compute the expected absolute value of a CAD. These are VN-M utilities; thus weighting them by probabilities is appropriate. No doubt, this calibration process would be challenging: assessing the magnitude of consequences that you often cannot even identify. However, making a crude estimate is better than simply not considering the problem.

Figure 17.1 shows the expected consequences of consequential amazing developments. Any individual CAD would be represented by a point on the graph, where greater probability or greater consequences imply greater importance. The figure darkens and the expected consequences of ignorance grow as we move in a north-easterly direction. The figure shows two points, A and B, each representing a CAD. Their aggregate contribution to ignorance is point S, computed by adding together the two points' probabilities and computing the expected value of their consequences. The expected consequences are the same at any point along a rectangular hyperbola.

How should we respond when we recognize our consequential ignorance? What, in such a context, would characterize a "measured" decision? One strategy would be to conceptualize decisions most favorable to a potential CAD, with an emphasis on diversity and flexibility. But "diversity" and "flexibility" are easier to recommend than to implement. Diversity would imply having at our disposal a miscellany of cognitive prototypes of decision making, some from real life and some from literature—let us call it a mental warehouse—filled with decision-making "anecdotes" that we draw from in times of need.[22] Flexibility could imply gathering more information before we bite the bullet, and testing the waters with a range of strategies when early indications of dark CAD clouds threaten on the horizon.

Diversity and flexibility are also adaptive strategies for macro institutions—namely, governments, financial institutions, policy-making bodies—since the decisions they make when CADs threaten or happen affect us all. (Think of the Western world in 2015 as it confronts ISIS.)

These macro institutions frequently get trapped in a warren of bureaucratic and political processes when attempting to protect against unfavorable CADs, or indeed after CADs happen. We recommend that the body of intelligentsia that works for these institutions—that is, the policy researchers and the analysts—create a depository of decisions to draw upon and learn from in parlous and unprecedented situations.

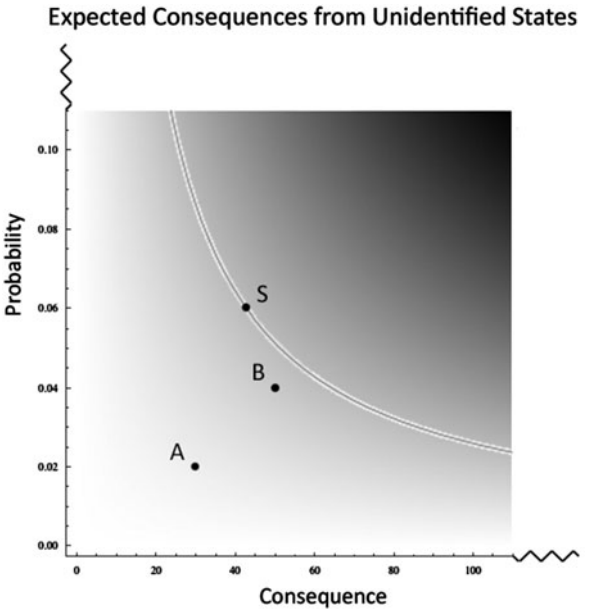

Figure 17.1 Expected consequences from unidentified states

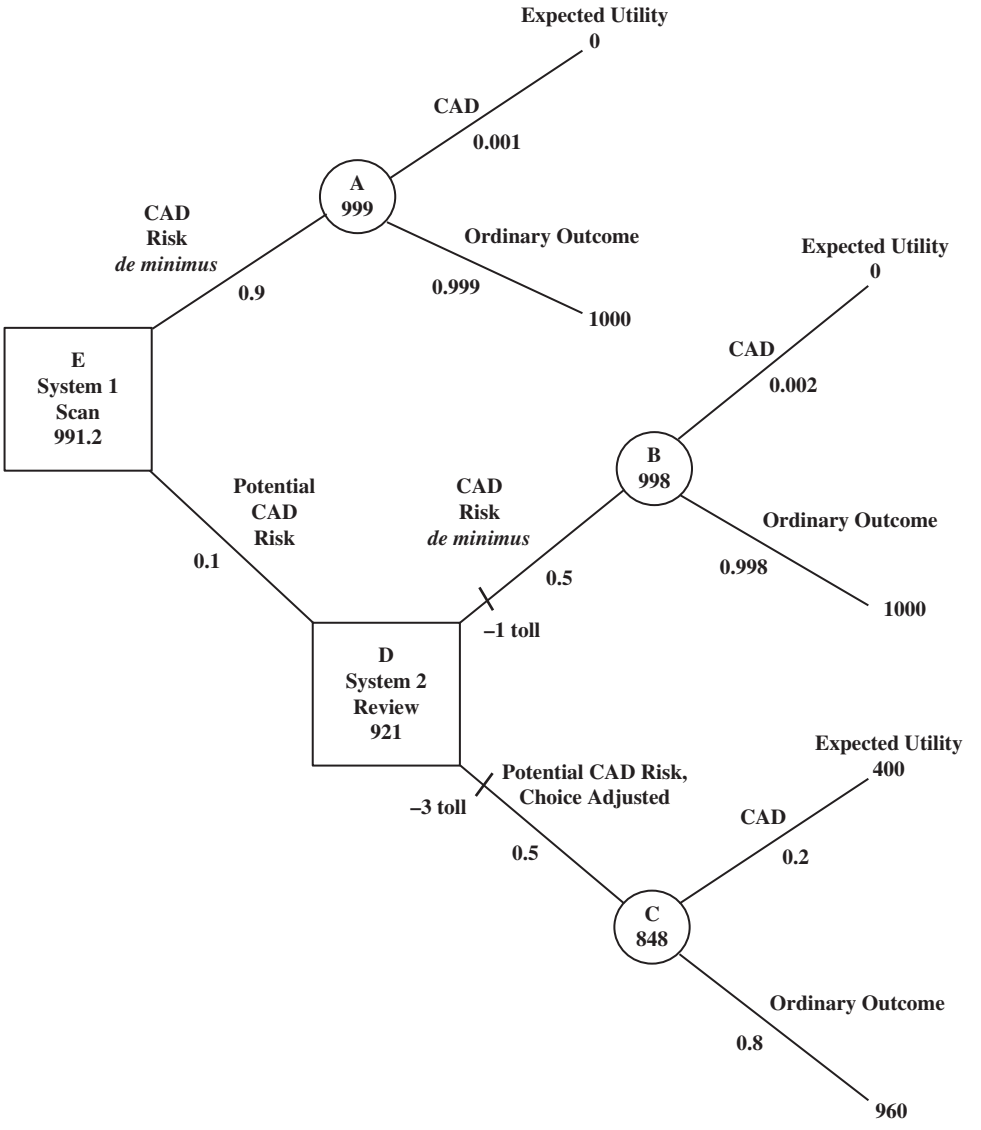

Figure 17.2 Prescriptive illustration attending to ignorance

Say we have built capital to understand ignorance and CADs. What next? Figure 17.2 illustrates our prescriptive recommendations given hypothetical numerical values. We assume that an individual first employs fast and intuitive System 1 (Stanovich and West, 2000; Kahneman, 2003, 2011) to scan each potentially important decision to vaguely assess the base rate for CADs in that decision. That scan might show 10 percent of decisions to have CAD potential.[23] Those 10 percent are then addressed by cautious and deliberate System 2 (Evans and Stanovich, 2013). Posit that half the time (5 percent), System 2 determines that CADs do threaten. System 2 then adjusts choices for those one in 20 decisions.

To put this all together, we need utility values and some further probabilities. The expected utility payoffs are as follows: normal outcome, 1000; CAD outcome, 0; CAD outcome with an adjusted choice, 400;[24] and normal outcome with an adjusted choice, 960.[25] The CAD occurs 0.1 percent of the time when System 1 finds it insignificant, 0.2 percent when System 1 alerts but System 2 finds it insignificant,[26] and 20 percent when System 2 assesses a threat and choices get adjusted. System 1 effectively costs nothing to employ. The initial System 2 review has a utility cost of 1. System 2 costs an additional 2 if CAD risk is identified and the choice is adjusted.

On the decision tree, expected utilities—computed by folding back—are shown at each choice or chance node. Let us proceed. If ignorance is simply neglected, there is a 0.021 chance of a CAD. Expected utility will be 0.021*0 + 0.979*1000 = 979. If ignorance is recognized and a choice is adjusted, as shown in box E, expected utility is 991.2. Attending to ignorance cuts the expected cost of CADs by 58%, from 1000-979 = 21 to 1000 – 991.2 = 8.8.

Discussion and conclusions

> What might have been is an abstraction
>
> Remaining a perpetual possibility
>
> Only in a world of speculation.
>
> *(T. S. Eliot, Burnt Norton)*

These lines from T. S. Eliot provide the perfect coda to our study of ignorance. They elegantly delineate the challenge of anticipating CADs. They also indicate that the type of mental processes represented by the lower branch of Figure 17.2 represent our hope to both anticipate and grapple reasonably effectively with ignorance. Our natural proclivity is to proceed along Figure 17.2's upper branch—namely, to pay ignorance no heed. While we cannot predict deep CADs, human beings have the potential to employ System 2 methods and foresee the two other categories: conventional CADs and blindered CADs. In terms of strategies for ignorance, our strongest endorsement goes to developing vigilance by engaging cognitive assists from multiple sources.[27]

One of the world's most trusted sources of decision making wisdom, the Bible notes the virtues of looking ahead and planning, observing, "A prudent man foreseeth the evil, and hideth himself: but the simple pass on, and are punished" (Proverbs 22.3). The Proverbs, the Book of Job, Ecclesiastes, among other biblical texts, lead us to conclude that ignorance abounds in the universe, unpleasant CADs intervene constantly in our lives, and sometimes people deserve these CADs and sometimes they do not. But, as our opening verse exhorts, it is in preparation that lies our victory over ignorance. The Bible, like much of wisdom literature, is replete with situations where human beings failed to envision the extreme events that happened. Job loses his family, riches, and health, with no divine explanation offered (until God's final appearance at the end). The author(s) of Ecclesiastes cautions that risk underscores human existence ("chance happeneth to [us] all") and that "[w]isdom is better than strength" and "better than weapons of war" (Ecclesiastes 9.16-18).

Literature provides powerful insights on the subject of ignorance. Great works of literature often represent the theater of life with its scenes of drama, conflict, and resolution. And the characters it portrays frequently tread paths not knowing to what outcomes they lead. We can recreate from these narratives cause-and-effect prototypes of decision making that translate to real-life situations.[28]

A central lesson from life is to learn from the past and stay alert to the future. With literature, we can learn from the lives of myriad others, and the ignorance and CADs they experience, not merely from our own experience. Putting these lessons to work alongside those emerging from our analytic framework, we can better anticipate CADs. When CADs seem to threaten, focused attention and System II thinking can replace naïve complacency and reflexive responses. Ignorance will always be a threat, but if we draw effectively on both literature and decision theory, ignorance will be a less-frequent and less-harmful surprise visitor.

Notes

1 Although, see Gomory (1995) and Zeckhauser (2006) and their discussions of the unknown and unknowable. See also Congar and Maniquet (2010).

2 As Laplace eloquently puts it:

> We may regard the present state of the universe as the effect of its past and the cause of its future. An intellect which at a certain moment would know all forces that set nature in motion, and all positions of all items of which nature is composed, if this intellect were also vast enough to submit these data to analysis, it would embrace in a single formula the movements of the greatest bodies of the universe and those of the tiniest atom; for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes.
>
> *(Laplace, 1951: 4)*

3 Frank Knight (1921: 224–5). For a fresh, innovative reading of intuition and Knight's work on risk and uncertainty, see Frantz (2005).

4 Howard Raiffa (1968: 273).

5 We recognize that the word "blindered" does not exist in the dictionary. We use it in the sense of having blinders on, in the manner of a horse.

6 The dual characteristics of contemplation and cognitive effort intersect also with Herbert Simon's (1957) concept of "bounded rationality." Because we have limited cognitive processing power that is typically applied towards "good enough" choices as opposed to the "best possible" ones, a CAD will fly in and turn our lives inside out, leaving us at sixes-and-sevens because we were "bounded" in our ability to envision it.

7 In this chapter, we use "literature," "literary fiction," "stories," and "fiction" interchangeably, a usage apt to shock the purist. Our reader should take these terms to imply any story created by the imagination, including novels, plays, epics, and short stories.

8 Elke Weber and Eric Johnson (2008: 132).

9 The term "wisdom literature" is applied primarily to selected biblical texts that impart didactic wisdom on certain common themes: family, ethics, faith, and making sense of suffering, among others. From the Old Testament, they include the Book of Job, Proverbs, Ecclesiastes, and the Song of Solomon. From the Aprocrypha (or the Deuterocanon), they include Ecclesiasticus and Wisdom of Solomon. James L. Crenshaw (1993).

10 Thomas Schelling (1984: 331).

11 "heuristic, n. and adj.". OED Online. September 2014. Oxford: Oxford University Press. Available at: www.oed.com/view/Entry/86554 (accessed November 27, 2014).

12 Some scholars hold a contrary view. For example, Gigerenzer and Brighton (2009) assert that despite the widely held view (also advanced here) that faster processing—hence less cognitive effort—impairs accuracy, it actually fosters decision making, noting: "Contrary to the belief in a general accuracy–effort tradeoff, less information and computation can actually lead to higher accuracy, and in these situations the mind does not need to make tradeoffs. Here, a *less-is-more* effect holds." Gigerenzer and Brighton (2009: 109).

13 "bias, adj., n., and adv.". OED Online. June 2014. Oxford University Press. Available at: www.oed.com/view/Entry/18564 (accessed July 23, 2014).

14 We digress for a moment to observe it is not coincidental that the distinguishing feature of epics—from Virgil's *Aeneid* to the Mesopotamian *Epic of Gilgamesh*—is their depiction of action as a means towards

the resolution of uncertainty. Beowulf, the English epic hero, takes on both the monster Grendel and Grendel's mother because the hope for the halo of heroism outweighs the presence of the possibility of death. The Old English poems *The Seafarer* and *The Wanderer* describe the hardships of life on the vast, uncaring seas, based on the knowledge that, despite the inevitability of suffering, sailors would venture forth impelled by AB.

15 For instance, the Hindu spiritual text the *Bhagavad Gita* posits action as virtue, stating, in its most famous passage, that only action performed selflessly and continually will free human beings from the never-ending cycle of attachment and loss, and success and failure: "You have the right to work [action], but never to the fruit of work. You should never engage in action for the sake of reward, nor should you long for inaction" (2.47). (The absence of reward seeking, of course, would prevent the action bias that arises in the Western canon.)

16 The recommendation to stick with the known when ignorant, thus promoting SQB, is a frequent theme in fairytales, folklore, and myths, which, as Carl Jung, Joseph Campbell, Claude Lévi-Strauss, and Roland Barthes have argued, depict behavioral and cognitive archetypes. Characters—consider Hansel and Gretel in the nineteenth-century Brothers Grimm fairytale—are punished when they tread into unknown paths in deep woods.

17 Wharton ends her novel in Paris where Archer and his now-adult son are visiting Ellen and Archer has the chance to reunite with her at a time when he is widowed. He chooses not to go up to her apartment: "'[Ellen's image is] more real to me here than if I went up,' he suddenly heard himself say; and the fear lest that last shadow of reality should lose its edge kept him rooted to his seat as the minutes succeeded each other." Archer's inner monologue, which portrays his struggle with the anxiety produced when contemplating an act of commission, shows his indecision bias at work in an environment of ignorance.

18 In "Egonomics, or the Art of Self-Management" (1978b), Schelling observes wryly that whether quitting smoking or adhering to diets "everybody behaves like two people, one who wants clean lungs and long life and another who adores tobacco, or one who wants a lean body and another who wants dessert. The two [selves] are in a continual contest for control; the 'straight' one often in command most of the time, but the wayward one needing only to get occasional control to spoil the other's best laid plan." To this we would add that barn door closing is a way for the "wise" present self to wipe clean the errors of the "foolish" past self.

19 Many investors act as if securities markets are like physics experiments, where what happened yesterday will happen again today. They fail to recognize that investors learning from and responding to yesterday's market will change the behavior of the market today.

20 For seminal research in this area, see Storey (1996), Scalise Sugiyama (1996), and Carroll (2004).

21 Note: We do not require that the bad outcome get a utility value of exactly -100, because no plausible outcome may have that value, and any bottom value can serve as a reference point.

22 Evolutionary scholars describe stories as cognitive models of cause-and-effect representations of goals and strategies for pursuing these goals within certain environments (Scalise Sugiyama, 2001). Our recommendation is that decision researchers should create a depository of stories as cause-and-effect models generally, and that they draw on them in particular when confronted with consequential ignorance.

23 We simplify by assuming that the capital-building step imposes negligible cost on a decision when amortized over the individual's lifetime, and that System 1 scanning is effectively costless, not unlike looking both ways before crossing the street. We scale the top outcome to 1,000, not the more conventional 100, to reduce decimals. All calculations are carried through without rounding. However, the values at nodes in the decision tree are rounded to the nearest tenth.

24 Some CAD outcomes may be favorable, which presents no problem since this is an expected utility.

25 If it were known that a CAD would not occur, it would be better not to adjust one's choice.

26 Even though System 2 is much more thorough than System 1, it is screening decisions pre-selected for high CAD risk. Hence, there is the 0.2% probability here versus 0.1% when System 1 finds an insignificant risk.

27 Consider the blindered CAD of the subprime market crisis. Both its occurrence and that it triggered the market crash of 2008 demonstrate a complete absence of cognitive vigilance. As early as 2003, economists Karl Case and Robert Shiller cautioned of the impending bubble in the housing market. But despite easily available information, public policy analysts, credit agencies, and lenders chose to ignore "the canary in the coalmine" of runaway house prices unrelated to fundamentals, and continued to extend credit to ever-riskier borrowers.

28 See Tooby and DeVore's (1987) pioneering work on strategic modeling within the context of evolution; one of their observations is that human beings create and transmit models of their environment through culture.

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