CHAPTER 2
Introduction to Behavioral Analysis

1. The Behavioral Pitfalls box on page 36, which discusses the actions of Scott McNealy included the following passage.

> On March 8, 2001, Cisco announced that because the downturn looked like it would last much longer than expected, it was going to lay off 18 percent of its workforce. Some of Sun's executives wanted to follow suit. One stated: "When times are hard, you've got to shoot activities that aren't making money." However, McNealy refused to do so.

Refusing to shoot activities that are not making money is evidence of being averse to a sure loss.

2. The situations are similar. During the late 1990s, both Sun and Merck were highly profitable firms whose market values were well in excess of their book values. The assets of both firms had large components that were intangible, residing in research and development. At the same time, both firms did have tangible assets, and could have held more long-term debt, thereby shielding some of their income from taxes. Both firms appear to have chosen to hold less debt than was optimal, thereby paying more corporate income tax than was necessary.

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3. The valuation metric McNealy mentions is price-to-sales. His comment that Sun had monetized the valuation very well during this period is suggestive of catering or market timing behavior, presumably involving the issue of new shares at the time to exploit the overvaluation.

4. McNealy commented that he might have hired a chief operating officer during his tenure as CEO, rather than undertaking the responsibility himself, at a time in his life when he had four children with whom he also wanted to spend his time, and did. The comments suggests that he was overconfident about his ability, and experiencing the illusion of control, in judging that he could simultaneously be chairman, CEO, and COO at a time when Sun was experiencing major challenges in the wake of the collapse of the dot.com bubble, and when he was also preoccupied with family matters.

5. Sun's net income and cash position did increase substantially during 2000, but this is not the same as monetization stemming from having an overvalued stock. According to Sun Microsystem's Statement of Cash Flows, between 1998 and 2001, the dot.com bubble era, Sun spent more repurchasing shares than issuing new shares. Adjusting for stock splits, the total number of its shares outstanding increased intermittently, usually at the end of a quarter, by 1 or 2 percent. Therefore, the evidence does not support Sun engaging in market timing by issuing new shares. A summary of key financial statement variables appears below. Note that large increases in number of shares reflect stock splits.

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$ millions	Jun-95	Jun-96	Jun-97	Jun-98	Jun-99	Jun-00	Jun-01	Jun-02	Jun-03	Jun-04	Jun-05	Jun-06	Jun-07	Jun-08	Jun-09
Income Before Extraordinary Items	355.8	476.4	762.4	762.9	1,031.3	1,854.0	981.0	-587.0	-3,429.0	-388.0	-107.0	-864.0	473.0	403.0	-2,234.0
Sale of Common and Preferred Stock	122.4	114.4	134.3	165.6	258.3	346.0	422.0	237.0	182.0	239.0	218.0	249.0	389.0	177.0	51.0
Purchase of Common and Preferred Stock	36.1	522.3	456.1	284.4	358.4	631.0	1,321.0	591.0	499.0	.	.	.	428.0	2,764.0	130.0
Cash and Cash Equivalents - Change	-20.1	115.0	131.3	162.1	266.7	748.0	-377.0	552.0	-9.0	126.0	-90.0	1,518.0	51.0	-1,348.0	-396.0
Number of Shares Outstanding	98,514	185,982	370,486	381,262	780,553	1,597,000	3,248,000	3,246,270	3,229,645	3,326,072	3,410,000	3,505,000	3,602,000	752,000	753,364

6. The Behavioral Pitfalls box discussing Merck includes the following passage:

> Surprisingly, Merck's post-approval study appeared to show that Vioxx actually caused heart attacks and strokes. However, the firm's executives resisted that interpretation and invested heavily in promoting the drug.

The chapter text also contains the following passage:

> Researchers at Stanford University, Harvard University, and the Cleveland Clinic wrote scientific articles that raised concerns about Vioxx' safety. Merck challenged these concerns, and continued to promote Vioxx as safe. In February 2001, the FDA issued a letter to Merck's CEO Ray Gilmartin, chastising the firm for deceptive promotional practices. In August 2004, a researcher from the FDA's drug-safety office presented data that showed that higher doses of Vioxx correlated with a tripled risk of a heart attack or sudden cardiac death. Merck responded by issuing a press release reiterating its confidence in the safety and efficacy of its drug.

Both of the above passages suggest that executives at Merck underweighted information that disconfirmed their views about Vioxx being both safe and efficacious. That information came from Merck's post-approval study, and the interpretation of the data from that study by prominent researchers.

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7. If Judy Lewent exhibited behavioral bias in her sales predictions for Vioxx, that bias would be excessive optimism. The first indication of excessive optimism is her June 2001 qualifying statement that placed Vioxx sales at the lower end of her prediction range. Given Merck's past glory, her statement that Merck's pipeline was as strong as any other time is the firm's history seems very optimistic. Exhibit 1-4 displays strong growth in ROE between 1993 and 2000, but a decline in mid-2001. There is no reason to predict that the reduction in Vioxx sales that took place after the August 2001 publication of the *JAMA* article was predictable before the fact. At the same time, given that Merck executives appeared to exhibit confirmation bias, it would have been reasonable to predict that at some point such an event would occur.

8. If naproxen does not reduce the incidence of heart attacks, then in 1999 it might have been reasonable to expect that in the VIGOR study about 4 patients would have experienced a heart attack. (In fact, experts in the field suggest that on average about 3 out of 4000 patients in the VIGOR study would have experienced heart attacks, given that Merck had only included patients that were at low risk of a heart attack or stroke.)

Consider the use of a binomial probability model. Suppose that the probability that a patient in the VIGOR study would normally experience a heart attack is 4 out of 4000, or 0.001. If Vioxx did not increase the probability of a heart attack, with what probability would we expect to observe 20 patients taking Vioxx to experience heart attacks? The answer is

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1 - the cumulative binomial probability associated with 19 heart attacks

given 4000 trials and a binomial probability of 0.001. The Excel function binomdist(19, 4000, 0.001, 1) gives the cumulative probability associated with 19 heart attacks. That number turns out to be 99.999999 percent. Therefore, the probability of observing that 20 patients who took Vioxx experienced heart attacks is 0.000001 percent.

In other words, the probability that the VIGOR result was a fluke is 0.000001 percent, one in 100 million.

9. If the editors' judgment reflected a behavioral bias, it would be bias stemming from availability. In this respect, the editors did *not* raise questions about the incidence of heart attacks in patients who took Vioxx but were not at low risk of a heart attack.

As for agency conflicts, the authors of the article had either received consulting contracts from Merck or were employees of Merck. That does not imply that they must have had a conflict of interest. However, the potential for such a conflict was definitely present. Remember that the VIGOR study took place well before November 2000, and featured 20 patients who were at low risk of having a heart attack taking Vioxx and subsequently experiencing a heart attack. Yet the authors of the article concluded that Vioxx did not increase the incidence of heart attacks among patients who did not appear to be at high risk of having a heart attack.

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10. In its VIGOR study, Merck's subject selection criteria excluded subjects who were at risk of heart attacks and strokes, suggesting that they did have advance concerns about the risks when they launched Vioxx. The FDA was aware of the results of this study, and despite writing to Merck to express concerns it had, the agency did not suggest withdrawing Vioxx from the market, but instead raised issues about misleading marketing. Therefore, the major issue appears to relate more to labeling, and having promoted Vioxx as first line therapy instead of second line therapy, rather than marketing the drug or not marketing the drug.

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Minicase

Case Analysis Questions

1**.** There are at least five important phenomena involved in the minicase, although a case can be made for at least seven. Real world cases are often complex, and unlike psychological experiments that seek to isolate single phenomena, feature several phenomena in ways that can be challenging to sort out.

Availability bias: Excessive reliance on information which is readily available. Earthquake risk is highly salient in Japan, as earthquakes frequently occur, but before 2011 tsunami risk much less so, as tsunamis occur much more rarely, even though "tsunami" is a Japanese word. In terms of event studies pertaining to tsunamis, the minicase states that there was but one primary event studied, which occurred not near Japan but near Chile. Specifically, the minicase states the following: "Originally, TEPCO and NISA agreed on a plant design in which the seawater intake buildings were located 12 feet (4 meters) above sea level and the main plant buildings were located at the top of a slope that was 30 feet (10 meters) above sea level. The basis for these decisions was an earthquake that occurred in 1960 off the coast of Chile, which generated a tsunami having a height of 10 feet (3.1 meters)." Relatedly, some might also point to *anchoring and adjustment* in respect to forming judgments based on the magnitude of the 1960 Chilean tsunami.

Confirmation bias: Downplaying, if not ignoring, information that disconfirms views held, and relative to information that confirms views held. TEPCO ignored lessons associated with

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the incident that took place at Blayais, France, involving risks from a storm surge. In addition, the minicase states that "both Japanese executives and regulators noted the presence of a general Japanese cultural bias against openly discussing worst case scenarios. Prior to the Fukushima Daiichi meltdown, there was little interest in public discussion or media coverage about tsunami safety."

Overconfidence, Excessive Optimism, and Illusion of Control: Overconfidence in knowledge features establishing confidence intervals that are excessively narrow. Excessive optimism is attaching subjective probabilities that are too low for unfavorable events and too high for favorable events. The minicase states that TEPCO was faulted for having taken a series of prudent precautions to protect against damage from storm surges, let alone a severe tsunami. The minicase also states the following: "The Carnegie report communicates the views of some Japanese experts who stated that the accident at Fukushima Daiichi serves to illustrate "supreme overconfidence by decision makers that Japan's nuclear power program would never suffer a severe accident." Given the definition of excessive optimism, this last statement illustrates excessive optimism as well as overconfidence. Relatedly, some might also point to the *illusion of control*, suggesting that TEPCO overestimated the control they exercised to deal with extreme natural disasters. The assumptions about power interruptions being at most 30 minutes in duration is consistent with this illusion of control, as well as excessive optimism and overconfidence.

Risk seeking in the domain of losses: In the cleanup phase, the Japanese government built an expensive permafrost ice wall that some characterized as a "Hail Mary play," meaning an

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action with a lottery-like feature involving only a low probability of a very successful outcome, but a high probability of failure. This behavior pattern is consistent with the fourfold pattern with risk seeking in the domain of losses.

Although probabilistic assessments are no panacea, given what we know about heuristics and biases, avoiding these assessments enhances the susceptibility to poor judgments and decisions as a result of phenomena such as availability, confirmation bias, and overconfidence. Using probabilistic assessments induces additional discipline, and conceivably could have generated some urgency that would have led to swifter action related to the 2008 computer analysis mentioned in the minicase about having underestimated tsunami risk. Avoiding probabilistic assessments increases reliance on instinct, gut feel, and the affect heuristic.

2. The binomial formula in Excel to solve the first part of this problem is =1-BINOM.DIST(2,15,000,0.0001,1). Here BINOM.DIST(2,15,000,0.0001,1) is the probability of 2 or fewer events (core meltdowns) in 15,000 reactor years when the probability of a core meltdown is 1/10,000 = 0.0001. Therefore, 1-BINOM.DIST(2,15,000,0.0001,1) is the probability of at least 3 events taking place. 1-BINOM.DIST(2,15,000,0.0001,1) = 0.19. For the second part of the problem, 1-BINOM.DIST(2,15,000,0.0000001,1) = 5.62E-10.

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