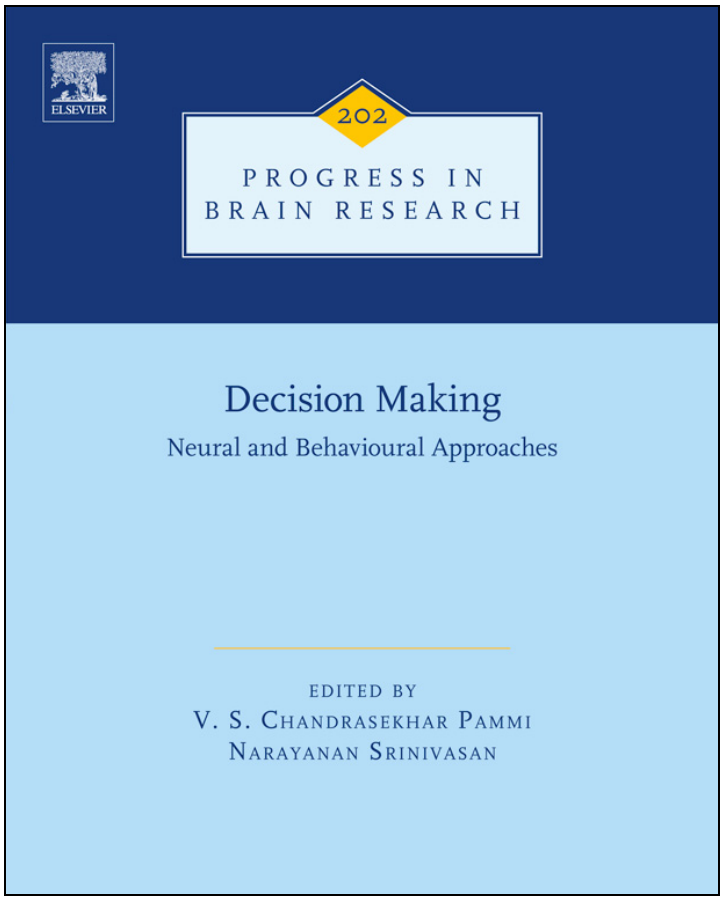

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CHAPTER

Surprise: A belief or an emotion?

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Abstract

Surprise is a fundamental link between cognition and emotion. It is shaped by cognitive assessments of likelihood, intuition, and superstition, and it in turn shapes hedonic experiences. We examine this connection between cognition and emotion and offer an explanation called decision affect theory. Our theory predicts the affective consequences of mistaken beliefs, such as overconfidence and hindsight. It provides insight about why the pleasure of a gain can loom larger than the pain of a comparable loss. Finally, it explains cross-cultural differences in emotional reactions to surprising events. By changing the nature of the unexpected (from chance to good luck), one can alter the emotional reaction to surprising events.

Keywords

surprise, beliefs, emotions, decisions, feelings, overconfidence, hindsight bias, cross-cultural

Surprise is an important aspect of human behavior. We disproportionately notice and focus on surprising events (Meyer et al., 1991). We learn more from surprising information (Rescorla, 1988), and we are often more persuaded by a surprising argument (Petty et al., 2001).

What is surprise? It is the sense of astonishment and wonder that one feels toward the unexpected. Some view it as a belief-based experience that reflects the likelihood of events (Lorini and Castelfranchi, 2007). Yet it also depends on coincidences, hunches, and superstitions. Others view surprise as an emotion (Gendolla and Koller, 2001; Maguire et al., 2011). Ekman et al. (1983) called surprise a basic emotion, on par with happiness, sadness, anger, fear, and disgust. We will argue that it is a bridge between cognition and emotion.

In this chapter, we focus on surprise in the context of decision making. We will discuss the effects of surprise when the unexpected is external to the decision maker (as with gambles and games of chance) and internal to the decision maker (as with

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tasks of skill). We will also discuss the effects of surprise on loss aversion, the affective consequences of belief errors, and cross-cultural effects of surprise. We will argue that surprise connects beliefs and emotions and has valuable implications for human decisions.

Normative decision theories make many bold assertions. One of the strongest is the assumption that utilities are independent of beliefs. Several studies have demonstrated that utilities and probabilities are related (e.g., Windschitl and Weber, 1999), and surprise serves as an important bridge between them. Beliefs influence surprise, surprise influences emotions, and emotions influence utilities. A surprising pleasurable event can produce unusually strong positive feelings, much stronger than an expected pleasurable event. Likewise, a surprising negative outcome can be peculiarly vexing or painful, more so than if the same outcome was to be expected.

Early evidence of surprise effects came from gambling studies (Mellers et al., 1997). Subjects were given binary gambles represented as pie charts with monetary outcomes. A spinner appeared in the center of the pie chart, rotated, and eventually stopped. Subjects learned their outcome and rated their emotional reaction on a category rating scale ranging from "very happy" to "very unhappy." Not surprisingly, larger monetary amounts resulted in greater happiness. But there were other factors that contributed to pleasure. Outcomes were more pleasurable when a salient reference point (such as the outcome that could have occurred if the spinner had stopped in the other region) was worse. A $10 win felt better if the outcome in the other region was a $6 loss instead of a $20 gain.

Another variable that influenced emotions was surprise. Due to the simplicity of the gambling task, we assumed that surprise was one minus the chance the outcome would occur, although we later operationalize surprise in other ways. Surprise effects from the gambling studies (Mellers et al., 1999) are shown in the left-hand panel of Fig. 1. Reactions to $8 wins (upper curve) and $8 losses (lower curve) appear as a function of the probability of the outcome occurring. The divergent interaction revealed a striking pattern; emotional reactions to monetary wins and losses were amplified as surprise increased.

Similar patterns emerged in tasks where surprise was an internal assessment of one's own skill or ability. In one study, McGraw et al. (2004) asked recreational basketball players to take shots from different locations on a basketball court. Before each shot, players rated the likelihood of success. Surprise was represented as one minus the judged probability of the event. After each shot, the players rated their happiness or unhappiness with the outcome. Surprising successes were more pleasurable than expected successes, and surprising failures were more painful than expected failures. This pattern is shown in the middle panel of Fig. 1.

Finally, in a third study, Mellers (2000) asked college students to compete in a Spelling Bee. After spelling each word, participants rated their confidence in their answer. Afterward, they learned the correct spelling and rated their feelings about the outcome. Unexpected outcomes—either correct or incorrect—resulted in stronger emotional reactions. The right-hand panel of Fig. 1 shows these interactions between beliefs and outcomes.

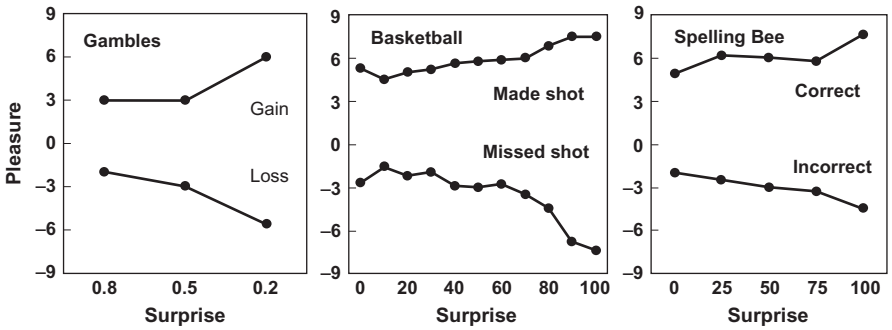

FIGURE 1

Surprise effects in three domains. Feelings experienced with the consequence of a decision are plotted against measures of surprise with separate curves for good and bad outcomes. In the left-hand panel, surprise is represented as one minus the probability that the outcome would occur. In the middle and right-hand panels, surprise is represented by self-reports. Good outcomes are successful basketball shots or correct spellings, and bad outcomes are unsuccessful shots or incorrect spellings. The divergent interactions show that emotions become more intense as surprise increases.

Decision affect theory provides a psychological account of these effects (Mellers, 2000; Mellers et al., 1999). Surprise modulates the comparison between what occurred and what might have occurred under another state of the world, making unexpected events greater in emotional intensity. To illustrate this theory, consider a gamble with a 10% chance of winning \$20 and a 90% chance of losing \$5. Decision affect theory predicts the emotional reaction to winning \$20 is

$$R(\$20) = a + b[u(\$20) + d[u(\$20) - u(-\$5)](1 - s(0.1))], \quad (1)$$

where $R(\$20)$ is the judged emotion, a and b are linear constants, $u(\$20)$ is the utility of a \$20 gain, $u(-\$5)$ is the disutility of a \$5 loss, $d[u(\$20)-u(\text{-}\$5)]$ is a disappointment/elation function that compares the obtained with the foregone outcomes, $s(0.1)$ is the subjective probability of winning \$20, and $1 - s(0.1)$ is the surprise of winning \$20. Surprise has a multiplicative effect on the disappointment/elation function. The emotional reaction to losing \$5 is

$$R(-\$5) = a + b[u(-\$5) + d[u(-\$5) - u(\$20)](1 - s(0.9))]. \quad (2)$$

The pain of the loss is greater than $u(-\$5)$ because the decision maker could have won \$20. However, the surprise effect is relatively small since the loss was extremely likely.

1 SHIFTING REFERENCE POINTS

Outcomes can be compared to many reference points—the status quo, personal aspirations, or social desires, among others. Athletes might use their personal best as an aspiration level; any score that exceeds that target is pleasurable and any score

that falls short is painful. Someone looking for work might judge his/her success or failure based on comparisons with an unemployed friend. Suppose both got jobs. The person with the less desirable position might feel bad if he used his friend's job as the reference point or good if he adopted his previous state of unemployment as the reference point.

Points of comparison can change over time. When students imagine their performance before an exam, they are often overconfident in their abilities. After the exam, they have more information. With a difficult exam, they might lower their expectations. A lower grade that seemed "surprising" before the exam might be an expected grade after the exam.

We wondered how surprise effects would change as expectations about grades declined. Would surprise continue to interact with good and bad outcomes or would students feel greater uncertainty and more surprise about all grades after the exam? To find out, we asked college freshmen and sophomores taking a course in Introductory Psychology to estimate their midterm grade a few days before the exam, immediately after the exam, and a week later when grades were distributed.

Figure 2 shows the three grade distributions. Students had relatively high expectations before the midterm (light gray bars); 61%, 36%, and 3% of students expected to get As, Bs, and Cs (or lower), respectively. After the exam (medium gray bars), 24%, 64%, and 12% of students said they expected to get As, Bs, and Cs (or lower), respectively. Actual grades were even lower (black bars). Students accurately predicted the percentage of As but underestimated the percentage of Cs by 16%.

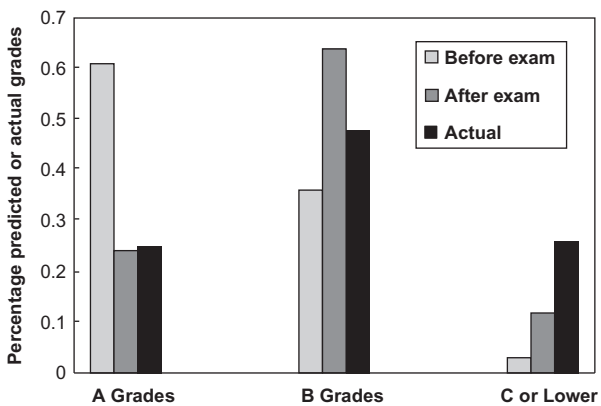

FIGURE 2

Decreasing aspirations followed by reality. Students made two predictions of the grades they would receive in an Introductory Psychology class. One estimate was made a week before the exam (light gray bars), and the second was made shortly after the exam (medium gray bars). A few days later, students learned their actual grades (black bars). Percentages of As declines, and percentages of Bs and Cs increases.

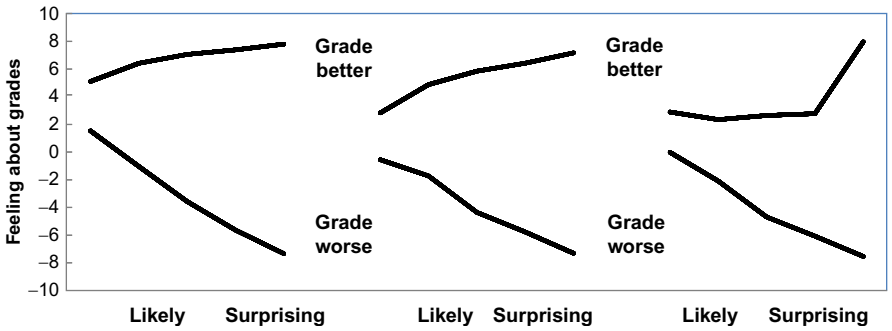

FIGURE 3

Surprise effects remain, despite decreasing aspirations. Feelings about grades at the three time periods are shown in Fig. 2. Upper curves show feelings about grades that exceed expectations and lower curves show feelings about grades that fall short of expectations.

The average predicted grade was an A− before the midterm and a B+ after the exam. The average actual grade was a B.

Before and after the exam, students predicted how they would feel about the grade they expected and all other possible grades. They also rated how surprised they would feel with all possible grades. Before the exam, average feelings about expected grades were 4.20 (on a scale from −8 to 8). Immediately after the exam, average feelings dropped to 1.08 ($t(242) = 2.40$). When grades were distributed, average feelings declined again to −1.43 ($t(242) = 6.21$).

Figure 3 shows two sets of predicted emotions (before and immediately after the exam) and actual emotions. The left and center panels display affective forecasts for grades that exceeded students' expectations (upper curves) or fell short of expectations (lower curves) plotted against judged surprise. As surprise increased, pleasure and pain were amplified, although the pain of doing worse than expected increased faster than the pleasure of doing better. Despite the downward shift in reference points, the interaction between outcomes and surprise was robust.

The panel on the right shows feelings about actual grades (relative to expectations immediately after the exam). The upper curve shows feelings about grades that exceeded expectations, and the lower curve shows feelings about grades that fell short of expectations. Once again, surprising grades—both positive and negative—were emotionally amplified. Surprise interacted with comparisons between actual and expected outcomes, even as reference points declined.

2 LOSS AVERSION

Loss aversion is a cornerstone of prospect theory (Kahneman and Tversky, 1979) which states that, the disutility of a loss is greater than the utility of a comparable gain. Kahneman and Tversky expressed the principle in hedonic terms: "The aggravation

that one experiences in losing a sum of money appears to be greater than the pleasure associated with gaining the same amount" (p. 279). This principle has been used to explain many violations of economic theory, including the endowment effect. The endowment effect was first demonstrated by Kahneman et al. (1990, 1991). They randomly distributed mugs to half the students in a classroom. Those who received mugs were sellers. Sellers were asked to state the minimum amount of money they would be willing to accept to give up their mug. Those who did not get mugs were buyers. They reported the maximum amount of money they would be willing to pay to purchase a mug.

Since mugs were distributed randomly, there was no reason to assume that the utility of the mug would differ across groups. Economic theory asserts that prices for buyers and sellers should be approximately equal. Nonetheless, sellers wanted significantly more to give up their mugs than buyers were willing to pay. According to loss aversion, sellers view the exchange as a loss, and buyers perceive it as a gain. Losses loom larger than gains, so selling prices should exceed buying prices.

Hundreds of studies have used this paradigm and demonstrated that selling prices exceed buying prices. However, relatively few have tested the hedonic prediction implied by loss aversion in experimental markets. Mellers and Ritov (2010) asked sellers to imagine the pain of losing their mug. Buyers were asked to imagine the pleasure of getting a mug. If loss aversion described anticipated emotions as well as utilities, the pain of the imagined loss should be greater in magnitude than the pleasure of the imagined gain. Yet the opposite pattern emerged. The anticipated pleasure of the gain exceeded in magnitude the anticipated pain of the loss, ($t(110) = 4.57$), as shown in Fig. 4.

Mellers and Ritov suggested that this pattern could occur if surprise influenced judged emotions. The absence of "hedonic" loss aversion—and perhaps even the reversal—as shown in Fig. 4, could occur if buyers thought that gains were surprising, and sellers thought that losses were expected. Decision affect theory predicts

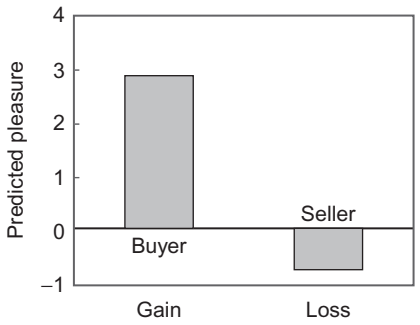

FIGURE 4

Anticipated emotions in experimental markets. Contrary to loss aversion, sellers' pain of imagined losses is less intense than buyers' pleasure of imagined gains. This effect could occur if buyers were surprised about gains and sellers expected losses.

that, under these circumstances, pleasure would increase and pain would decrease, perhaps even reversing the pattern of loss aversion.

To test this hypothesis, Mellers and Ritov (2010) asked buyers and sellers to rate their surprise with their outcome and the alternative one (i.e., endowment or the absence of endowment). Despite the equal odds, both buyers and sellers said that an endowment was more surprising than the absence of an endowment (5.1 and 3.0, respectively, on a scale of 1 (not at all surprising) to 7 (extremely surprising), ($t(54) = 4.15$)). This result may have occurred because subjects are typically not given mugs to take home when they participate in experiments. The pattern was consistent with the predictions of decision affect theory. Even if the utilities in decision affect theory were loss averse (see Eq. 1), surprise reversed the relative magnitude of judged pleasure and pain.

Several researchers have examined the hedonic implications of loss aversion in nonmarket contexts, and results are mixed (see Harinck et al., 2007; Kermer et al., 2006; Liberman et al., 2005; Rozin and Royzman, 2001). In a recent paper, McGraw et al. (2010) offered an explanation for the data. They suggested that when judging emotions, people naturally tend to use similar types of outcomes for comparison. Losses are compared to other losses and gains to other gains. Bipolar scales (anchored with "very happy" and "very unhappy" at the ends) have a natural zero point, and because of these natural comparisons, subjects may use the negative and positive sides of the scale differently. Pleasurable and painful ratings might not be comparable if people used different contexts for comparison.

McGraw et al. (2010) offered a method of judging pleasure and pain that encouraged direct comparison of gains and losses. With this procedure, people are asked to consider the pleasure of a gain and the pain of a loss. Then they are asked, "Which feeling is stronger?" McGraw et al. (2010) used this method with fair 50/50 gambles and stakes of $200. The majority of subjects said that the pain of the loss was more intense than the pleasure of the gain. But with bipolar ratings (used by Mellers and Ritov, 2010), McGraw et al. (2010) found that judged pleasure and pain were equal in magnitude.

By this account, the pattern of judged pleasure and pain found by Mellers and Ritov (2010) was due to the use of a bipolar response scale that did not force participants to directly compare gains to losses. To find out whether this method would reverse the pattern of loss aversion found by Mellers and Ritov (2010), Mellers and Berman (2012) asked buyers and sellers about their feelings using direct comparisons. Buyers and sellers were told, "We would like you to consider the emotional impact of two situations, A and B. In situation A: You did not get a mug. How much pleasure would you feel if you got one? In situation B: You got a mug, but had to give it up. How much pain would you feel if you had to give it up? In which situation would your feelings be stronger (not better or worse, but rather, more intense)? Situation A, Equal, or Situation B?" Participants who answered "Situation A" or "Situation B" were then asked to rate the intensity of the difference on a 5-point scale ranging from 1 = "very little" to 5 = "extremely." Results were still inconsistent with loss aversion. Gains and losses were no different in their intensity. This leaves

decision affect theory as the remaining account of why gains loomed larger than losses in the experimental markets.

To find out whether the direct comparison method suggested by McGraw et al. (2010) was sensitive to surprise effects, Mellers and Berman (2012) conducted another experiment in which people anticipated their feelings about the monetary outcomes of gambles. Outcomes were gains and losses of either $10 or $100, and the probabilities of winning were 10%, 50%, or 90%. Participants compared the pleasure of the gain to the pain of the loss and indicated which feeling was stronger. A follow-up question asked, "By how much?" Responses ranged from 1 = no difference to 5 = extremely different. Figure 5 shows the results.

The relative intensity of pleasure and pain is plotted on the *y* axis for the six gambles with light gray bars for $10 and dark gray bars for $100 gambles. According to McGraw et al. (2010), direct comparisons should result in "hedonic" loss aversion; all bars should fall below the zero point, regardless of the probability of outcomes. With fair 50/50 gambles, Mellers and Berman (2012) were able to replicate the results of McGraw et al (2010). Losses loomed larger than gains. But when the probabilities of winning were small, the relative magnitudes of pleasure and pain reversed. When gains were surprising (i.e., a 10% chance of winning), pleasure exceeded pain for the $10 gamble and pleasure was identical to pain for the $100 gamble. Figure 6 shows judged surprise for the outcomes of the gambles. Differences in surprise ratings (surprise of a gain − surprise of a loss) indicated that, when the probability of winning

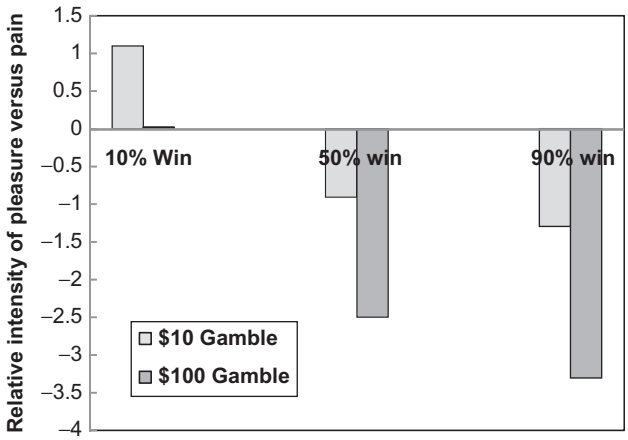

FIGURE 5

Judged feelings about monetary outcomes of gambles using the direction comparison method suggested by McGraw et al. (2010), shown with $10 and $100 stakes. When the odds of winning are small (10%), gains are more intense than losses for $10 stakes and equal in magnitude for $100 stakes. When the odds of winning and losing are equal (50%) and when the odds of losing are small (90% chance of winning), losses are more intense than gains, consistent with loss aversion.

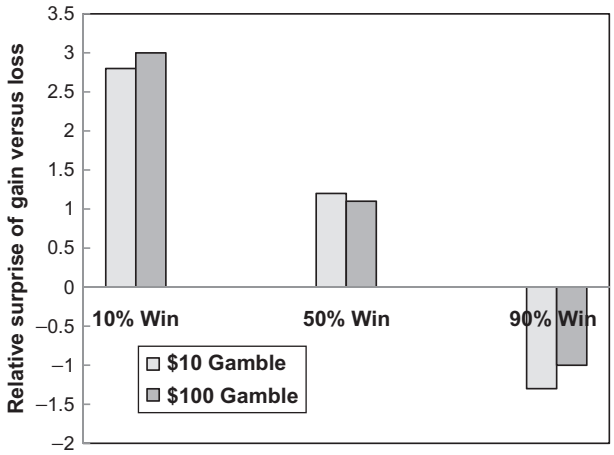

FIGURE 6

Judged surprise of outcomes. When the odds of winning are small (10%) or equal to the odds of losing (50%), gains are more surprising. When the odds of losing are small (90% chance of winning), losses are more surprising. This pattern of surprise could help explain judged feelings in Fig. 5 if surprising gains were more pleasurable than expected losses (on the left) and surprising losses were more painful than expected gains (on the right). Loss aversion could appear with fair 50/50 gambles if loss aversion in the utilities outweighed surprise effects.

was 10%, gains were more surprising than losses for $10 and $100 gambles, and when the probability of losing was 10%, losses were more surprising than gains.

To summarize, surprise effects may have made the pleasure of a surprising gain of $10 exceed the pain of an expected $10 loss and the pleasure of a surprising gain of $100 equal in magnitude to the pain of an expected $100 loss, even when judgments were placed on a common continuum. Our results in Fig. 5 show that the relative magnitude of pleasure and pain is not fixed; it depends on the probabilities of occurrence. Surprise amplifies emotional experiences. The pleasure of a surprising gain can exceed the pain of an expected loss, and the pain of a surprising loss can be greater in magnitude than the pleasure of an expected gain.

3 ERRORS IN BELIEFS

Our account of how surprise influences emotions also provides insights about the affective consequences of belief errors. One example is overconfidence. Overconfidence occurs when one's belief in one's ability exceeds reality. Studies that compare average confidence to average success rates are called calibration studies. A person is deemed "well calibrated" if, over a large set of trials, his or her average confidence

rating is equal to his or her success rate. Numerous studies show that, in most domains, overconfidence is the norm, not the exception.

Some of the classic experiments on overconfidence used general knowledge questions (Baron, 2008; Lichtenstein et al., 1982; Phillips and Wright, 1977; Yates, 1990). Participants were given statements such as "The population of London is greater than that of Paris." Participants then indicated whether the statement was true or false and rated their confidence in their answer on a scale from 50% (guessing) to 100% (absolutely certain). Most people were too confident. For example, when participants were 100% confident in the correctness of their answers, their accuracy rates were only 75% (Fischhoff et al., 1986). Overconfidence has also been documented in physicians' medical diagnoses, psychologists' assessments of psychological profiles, and predictions of the outcomes of sports events made by fans and players (Christensen-Szalanski and Bushyhead, 1981; Jagacinski et al., 1977; Oskamp, 1965; Ronis and Yates, 1987).

Decision affect theory makes predictions about the effects of overconfidence on pleasure. Exaggerated beliefs of success will have two detrimental effects on pleasure, as shown in Fig. 7. First, overconfidence makes success seem more likely. This effect is illustrated with the gray arrow on the upper curve pointing to the left. Less surprising successes are less pleasurable. Second, overconfidence makes failure seem more surprising, as shown by the gray arrow on the lower curve pointing to the right. More surprising failures are more painful.

McGraw et al. (2004) investigated this prediction with two groups of basketball players. One group served as a control group and performed the task described earlier. The other group was trained to be better calibrated. They were told about the

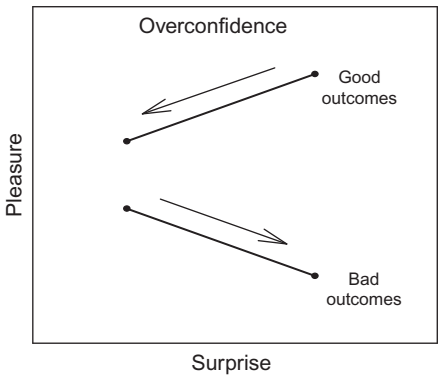

FIGURE 7

Predicted effects of overconfidence. Decision affect theory implies that overconfidence will (1) make good outcomes seem less surprising and therefore less pleasurable and (2) make bad outcomes seem more surprising and therefore more painful. Both types of outcomes will feel worse.

tendency of people to be overconfident. They were also provided with average success rates of other players like them at each location from which they took shots on the court. The manipulation produced significantly better calibration in the "debiased" group, with no difference in performance between groups.

In the control group, basketball players had an average confidence rating of 57% but made only 41% of their shots. In the treatment group, basketball players had an average confidence rating of 48% and made 44% of their shots. Most important, the better calibrated group experienced significantly greater pleasure than the control group. When overconfidence was reduced, successes were more surprising and failures were less surprising. Pleasure increased accordingly.

Another well-known belief error is called the hindsight bias (Fischhoff, 1975). People remember their probability judgments as being more accurate than reality suggests. Hindsight biases have been documented in elections (Leary, 1982; Synodinos, 1986), medical diagnoses (Arkes et al., 1981), and business ventures (Bukszar and Connolly, 1988). Figure 8 illustrates the affective consequences of the hindsight bias. With hindsight, everything is less surprising. The gray arrows on the upper and lower curves both point to the left. With less surprise, both positive and negative events become less emotional. People often try justifying a negative outcome, such as the results of an election or a sports game, by telling themselves that the positive outcome (i.e., their favored candidate or sports team) "never had a chance." This rewriting of history makes negative outcomes less surprising and therefore less painful.

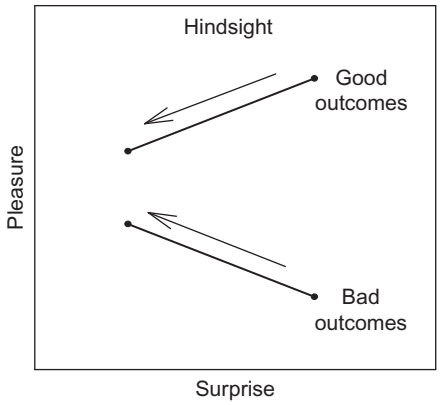

FIGURE 8

Predicted effects of hindsight. Decision affect theory implies that the hindsight bias will (1) make good outcomes seem less surprising and therefore less pleasurable and (2) make bad outcomes seem less surprising and therefore less painful. There is an overall decrease of emotional intensity.

4 CROSS-CULTURAL DIFFERENCES IN SURPRISE

Surprise is often desirable in marketing contexts. Firms want to "delight their customers." Delighted customers experience the pleasure of a surprising positive outcome, such as a gift, a new product feature, or a sales promotion. They become more loyal and engage in more positive endorsements (Oliver et al., 1997). Surprises can pay off. But does it work cross-culturally? Do people from different cultures experience delight from similar types of unexpected pleasurable experiences?

Studies that compare the emotional reactions of Westerners and East Asians have identified numerous cross-cultural differences. The frequency and intensity of positive emotions are stronger in Western cultures than in Asian cultures (Heine et al., 1999). Compared to East Asians, Westerners consider pleasurable states, such as happiness, to be significantly more desirable (Kitayama and Markus, 2000). Asian cultures place greater emphasis on both pleasant and unpleasant states and, as a consequence, report lower levels of overall well-being (Diener and Suh, 1999). Of course, there are many reasons why Western and East Asian cultures differ in their average levels of well-being (Deiner and Lucas, 2000). For example, if the experience of positive affect is more desirable in Western cultures than in Eastern cultures, emotions might be reported differently. Westerners might err on the side of reporting greater pleasure than they actually felt, and East Asians would err on the side of saying they felt less pleasure than they actually felt (Tsai et al., 2006).

Several differences have been documented in cognitive processes as well. Westerners and East Asians differ in their reasoning styles. Nisbett et al. (2001) argued that East Asians tended to use dialectical reasoning, while Westerners tended to use analytical reasoning with formal rules of logic. When confronted with contradiction, Asians may reconcile the opposing propositions, seek a middle way, or transcend the points of disagreement. Westerners are more likely to attack contradictions head on and reject the less plausible proposition (Peng and Nisbett, 1999).

Because they hold more complex and holistic views of the world, East Asians are less likely to experience surprise than Westerners. Choi and Nisbett (2000) found that East Asians were less surprised by outcomes that directly contradicted their expectations (e.g., a generous seminary student who behaved selfishly). East Asians also exhibited greater hindsight (Fischhoff, 1975) than Westerners. If one understands the world as explained by multiple factors with complex connections, one may be more likely to find post hoc explanations for unexpected events.

Valenzuela et al. (2010) wondered whether surprise gifts would have different emotional effects on Westerners and East Asians. Their experiment had two conditions. In one condition, Western and East Asian students were told at the beginning of the session that they would receive a gift as a token of appreciation at the end of the study. In the other condition, no such announcement was made. After choosing from among a bag of potato chips, a coffee drink, or a large pack of chewing gum, participants were asked, "How pleased (excited, happy) are you currently feeling?" on a rating scale of 1 (not at all) to 7 (a lot). A composite variable was constructed from the measures.

Figure 9 shows momentary feelings of pleasure after the receipt of the gift. There was a significant interaction in pleasure ($F(1,171) = 4.31$). When the gift was expected, Westerners and East Asians did not differ in their feelings. But when the gift was unexpected, Westerners were significantly more pleased than East Asians.

Valenzuela et al. (2010) reasoned that East Asians were less surprised than Westerners when confronted with an unexpected gift due to stronger feelings of "knowing it all along." Figure 10 examines the effects of surprise on judgments right after the receipt of the gift. East Asians and Westerners reported roughly equal amounts of surprise when the gift was announced early. But when the gift was unannounced, Westerners reported significantly more surprise than East Asians ($F(1,60) = 4.24$). "Delighting" East Asians required some different tactics.

Another difference between East Asians and Westerners is their concept of luck (Hong and Chiu, 1988). East Asians are more likely to believe that luck is a personal attribute that positively influences control of the environment. Since East Asians believe in good luck as a way to buffer uncertainty, they might have a stronger positive reaction to an unexpected positive event that is associated with good luck. *Luck-based* surprise might increase their pleasure.

Valenzuela et al. (2010) conducted another experiment in two bookstores, one in the United States and the other in Hong Kong called "The Lucky Game." Patrons were screened for being either Caucasians born in the United States or Chinese born in Asia. People were approached as they were leaving the bookstore and were asked whether they would participate in a short customer survey. Those who accepted were told that they would be given a gift as a token of appreciation (either a $5 gift certificate or a coffee mug). Half of the participants were randomly assigned to a condition called "The Lucky Game" in which they could win the gift. The other half simply received the unexpected gift after completion of the survey. In "The Lucky

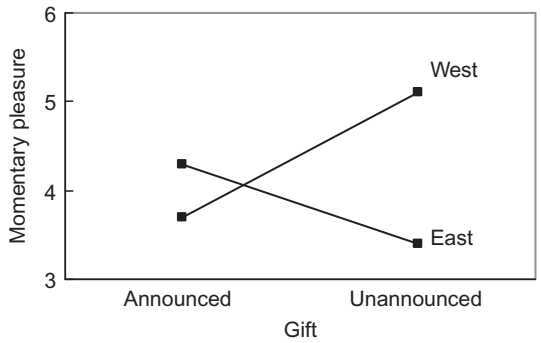

FIGURE 9

Westerners, but not East Asians, experience surprise effects. Momentary pleasure of a small gift that was either announced in advance or unannounced (and surprising). Westerners derived greater pleasure from the surprise, whereas Easterners felt no additional enjoyment.

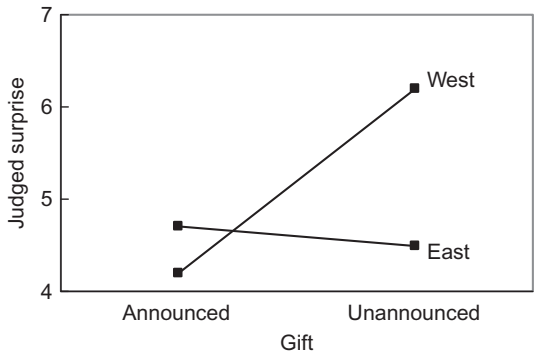

FIGURE 10

Judged surprise of small gifts that were either announced or unannounced for Westerners and East Asians. Westerners are more surprised by unannounced gifts, but East Asians are not.

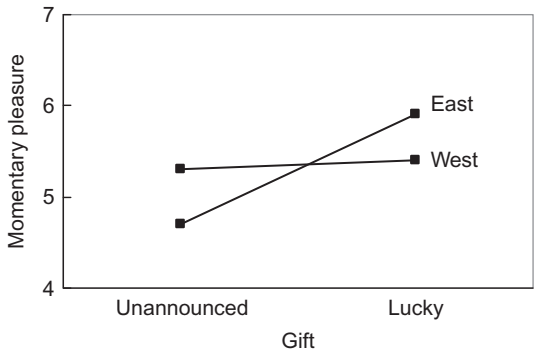

FIGURE 11

When surprise is framed as good luck, East Asians are more surprised than Westerners by small "lucky" gifts.

Game," participants had to draw a ticket from a jar filled with tickets. Those with winning numbers received the gift. Participants believed the chance of winning was 50%, but in reality, all tickets were winning numbers. After receiving their gift, participants were asked, "How pleased (excited, happy) do you feel?" Figure 11 shows the results. When surprise was attributed to good luck, East Asians experienced more delight than Westerners. To East Asians, delight was captured in terms of pleasurable events enhanced by good luck.

5 CONCLUSION

Surprise is an important link between cognition and emotion. Beliefs, hunches, and intuitions influence our sense of surprise, and surprise influences our affective experiences. There are parallels between human studies showing surprise effects and electrophysiological studies of dopamine neurons in monkeys (Schultz et al., 1992, 1993, 1997).When monkeys expect a reward, dopamine neurons start to fire. When monkeys receive that reward, neuronal firing depends on prior expectations. Unexpected rewards lead to greater firing than expected rewards. In short, surprise effects occur in other mammals, and it is easy to construct evolutionary reasons for the effects.

In our chapter, we show how surprise intensifies emotions. Surprise effects are robust across changing reference points; and surprise effects help explain why the pleasure of a gain can be greater in magnitude than the pain of an equivalent loss. By understanding the effects of surprise on emotions, we can predict the affective consequences of belief errors, such as overconfidence and hindsight, the relative magnitudes of pleasure and pain, and cross-cultural differences in unexpected events.

It is surprising that, despite its importance in human behavior, surprise still lives up to its name. The effects of surprise are a constant source of amazement, wonder, and mystery in all walks of life.

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