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How Randomness Rules Our World and Why We Cannot See It

Part two of a series of articles on the neuroscience of chance

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Imagine that you are a contestant on the classic television game show *Let’s Make a Deal*. Behind one of three doors is a brand-new automobile. Behind the other two are goats. You choose door number one. Host Monty Hall, who knows what is behind all three doors, shows you that a goat is behind number two, then inquires: Would you like to keep the door you chose or switch? Our folk numeracy—our natural tendency to think anecdotally and to focus on small-number runs—tells us that it is 50–50, so it doesn’t matter, right?

Wrong. You had a one in three chance to start, but now that Monty has shown you one of the losing doors, you have a two-thirds chance of winning by switching. Here is why. There are three possible three-doors configurations: (1) good, bad, bad; (2) bad, good, bad; (3) bad, bad, good. In (1) you lose by switching, but in (2) and (3) you can win by switching. If your folk numeracy is still overriding your rational brain, let’s say that there are 10 doors: you choose door number one, and Monty shows you door numbers two through nine, all goats. Now do you switch? Of course, because your chances of win­­ning increase from one in 10 to nine in 10. This type of counterintuitive problem drives people to innumeracy, including mathematicians and statisticians, who famously upbraided Marilyn vos Savant when she first presented this puzzle in her *Parade* magazine column in 1990.

The “Monty Hall Problem” is just one of many probability puzzles physicist Leonard Mlodinow of the California Institute of Technology pre­sents in his delightfully entertaining new book *The Drunkard’s Walk* (Pantheon, 2008). His title employs the metaphor (sometimes called the “random walk”) to draw an analogy between “the paths molecules follow as they fly through space, incessantly bumping, and being bumped by, their sister molecules,” and “our lives, our paths from college to career, from single life to family life, from first hole of golf to eighteenth.” Although countless random collisions tend to cancel one another out because of the law of large numbers—where improbable events will probably happen given enough time and opportunity—every once in a great while, “when pure luck occasionally leads to a lopsided preponderance of hits from some particular direction ... a noticeable jiggle occurs.” We notice the improbable directional jiggle but ignore the zillions of meaningless and counteracting collisions.

In the Middle Land of our ancient evolutionary environment, which I introduced in Part 1 of this column last month, our brains never evolved a probability network, and thus our folk intuitions are ill equipped to deal with many aspects of the modern world. Although our intuitions can be useful in dealing with other people and social relationships (which evolved as common and important for a social primate species such as ours when we were struggling to survive in the harsh environs of the Paleolithic), they are misleading when it comes to such probabilistic problems as gambling.

Let’s say you are playing the roulette wheel and you hit five reds in a row. Should you stay with red because you are on a “hot streak,” or should you switch because black is “due”? It doesn’t matter, because the roulette wheel has no memory, yet gamblers notoriously employ both the “hot streak fallacy” and the “dueness fallacy,” much to the delight of casino owners.

Additional random processes and our folk numeracy about them abound. The “law of small numbers,” for example, causes Hollywood studio executives to fire successful producers after a short run of box-office bombs, only to discover that the subsequent films under production during the producer’s reign became blockbusters after the firing. Athletes who appear on *Sports Illustrated’s* cover typically experience career downturns, not because of a jinx but because of the “regression to the mean,” where the exemplary performance that landed them on the cover is itself a low-probability event that is difficult to repeat.

Extraordinary events do not always require extraordinary causes. Given enough time, they can happen by chance. Knowing this, Mlodinow says, “we can improve our skill at decision making and tame some of the biases that lead us to make poor judgments and poor choices ... and we can learn to judge decisions by the spectrum of potential outcomes they might have produced rather than by the particular result that actually occurred.” Embrace the random. Find the pattern. Know the difference.

*Note: This article was originally printed with the title, "A Random Walk through Middle Land".*