brain
OCTOBER 2007 BRIEFINGS

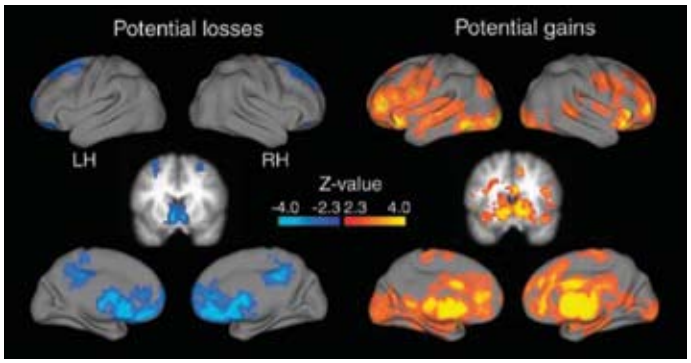
ONCE CONSIDERED A CHARACTER DEFECT, GAMBLING IS NOW KNOWN TO BE A HIGHLY ADDICTIVE DISORDER WITH NEUROLOGICAL CAUSES. THANKS TO NEW ADVANCES IN BRAIN IMAGING, SCIENTISTS ARE BEGINNING TO IDENTIFY THE NEURAL MECHANISMS THAT GO AWRY IN THE BRAINS OF PATHOLOGICAL AND PROBLEM GAMBLERS. WHAT THEY'RE LEARNING FROM SUCH RESEARCH IS ALSO SHEDDING LIGHT ON HOW THESE SAME MECHANISMS DETERMINE INDIVIDUAL RISK TOLERANCE—AND INFLUENCE THE FINANCIAL CHOICES WE ALL MAKE THROUGHOUT OUR LIVES.

GAMBLING AND RISK-TAKING

You hold your breath as the wheel spins on the roulette table. You briefly close your eyes as the croupier deals you another card at the blackjack table. You stand frozen in place as the horse you bet on lunges toward the finish line.

At such moments—when you're anticipating the possibility of a financial reward—certain areas of your brain jump into action. The particular pattern of that activity, neuroscientists are now discovering, helps identify how risk-averse you are—not only when you're at the gambling table or the racetrack, but when you ponder any decision that involves some financial risk. Should you take a new job? Should you invest in a new business? Should you put your savings in potentially volatile stocks or in the "sure thing" of a bank certificate of deposit?

Those same neural patterns may also reveal whether you're at risk of becoming a pathological gambler, someone so addicted to gambling that you continue the activity even while mounting losses ruin your personal finances and relationships. An estimated 2 million Americans have this devastating impulse control disorder. Another 4 million to 8 million are problem gamblers, a slightly less severe form of compulsive gambling that leads to mild to moderate problems with daily life.



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▲ THE TWO SETS OF IMAGES ABOVE ILLUSTRATE HOW BRAIN ACTIVITY DIFFERS WHEN WE CONTEMPLATE FINANCIAL LOSSES AND GAINS. THE BLUE AREAS AT LEFT ARE THOSE THAT BECOME DEACTIVATED AS WE MAKE DECISIONS THAT WILL LIKELY CAUSE US TO LOSE MONEY. THE ORANGE AND RED AREAS AT RIGHT SHOW THE ACTIVATION THAT OCCURS IN THE BRAIN WHEN WE BELIEVE THE ODDS ARE IN OUR FAVOR AND WE'LL WIN MONEY.

Using specially developed gambling games and advanced neuroimaging techniques, scientists can now observe what happens in the brain when people are involved in gambling or other risky financial activities. This research is leading to:

- Greater knowledge about the neurobiology common to gambling and other addictive behaviors.
- The development of more effective treatments for these addictions.
- An explanation of why some drugs for Parkinson's disease trigger gambling and other compulsive behaviors.
- A broader understanding of the connections between neuroscience and economic decision-making, a field called neuroeconomics.

Recent studies have found that when we anticipate financial gains—whether at the gaming tables or on the stock market—an area of our brain known as the ventral striatum becomes activated and flooded with dopamine, a brain chemical linked to pleasurable sensations. The release of this chemical also occurs during physically rewarding activities such as eating, sex and taking drugs, and is a key factor behind our desire to repeat these activities.

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When we start to consider the possibility of losing money, however, the same brain areas become less active. In fact, most people's brains show more negative sensitivity to losses than positive sensitivity to gains—neural evidence of our tendency toward risk aversion. In one study, researchers could predict how tolerant individuals were to risk by analyzing how their brains responded to potential gains versus potential losses. Those whose brains were less turned off by the possibility of increasing their losses tended to be more eager gamblers.

In pathological gamblers, neural activity in the ventral striatum remains remarkably unreactive—even during winning streaks. Their brains also show decreased activation in the ventrolateral prefrontal cortex—the brain's "superego"—which, when functioning normally, keeps people from acting impulsively. This finding may explain why pathological gamblers keep betting despite the havoc it inflicts on their lives. To maintain even a normal level of dopamine in their brains, they must gamble with increasing frequency—and often for greater and greater stakes. And the impulse control in their brain is not functioning properly. Drug addicts show a similar brain pattern—and a similar need to keep feeding their addiction.

Recently, pathological gambling has been found to be a rare side effect of specific types of dopamine agonists, drugs used to treat the tremors and balance problems associated with Parkinson's disease. The dopamine boost from these drugs appears to overload receptors in the ventral striatum, causing an irresistible urge to gamble. The effect does not occur in everybody who takes dopamine agonists and it dissipates once the medication is discontinued.

As neuroscientists continue to study the reward pathway of the brain and its role in gambling and other risk-taking, they're gaining insight into many other neurological illnesses, including bipolar disorder and schizophrenia, which also involve a distorted sense of risk and lack of impulse control. Such research offers hope for new and effective treatment for millions of Americans and their families. And it also promises to help keep the number of visits to the track and gambling table at an affordable level.

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