People Use Separate Brain Mechanisms to Make Ambiguous and Risky Choices

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Distinct regions of the human brain are activated when people are faced with ambiguous choices versus choices involving only risk, Duke University Medical Center researchers have discovered.

The investigators found that they could predict activation of different brain areas, based on how averse study participants were toward either risk or ambiguity. The finding confirms what economists have long debated -- that different attitudes toward perceived risk and ambiguity in decision-making situations may reflect a basic distinction in brain function, the researchers said. Such fundamental knowledge of neural functioning will contribute to an understanding of why people make risky choices, and how such risk-taking can become pathological, as in addiction or compulsive gambling, they added.

Their study appears in the March 2, 2006 issue of *Neuron*. The research was supported by the National Institute of Mental Health, the National Institute of Neurological Disorders and Stroke and Duke.

"We were able to see individual differences in brain activation depending on the person's preferences or aversions to risk and ambiguity," said Scott Huettel, Ph.D., lead author and a neuroscientist with the Brain Imaging and Analysis Center at Duke University. "People who preferred ambiguity had increased activation in the prefrontal cortex, and people who preferred risk had increased activation in the parietal cortex. This opens up the possibility that there are specific neural mechanisms for different forms of economic decision making,

which is a very exciting idea."

The team collected data from 13 adult participants who were asked to choose between pairs of monetary "gambles" that were predetermined to be 'certain', 'risky' or 'ambiguous'. For the risky choices, subjects were told the odds that they would win the gambles, but for the ambiguous choices, subjects were not given this information. The participants were rewarded with a cash payout based upon whether or not they won their gambles.

The team used functional magnetic resonance imaging (MRI) to determine which areas of the brain were activated while people were making risky or ambiguous choices. Functional MRI is a widely used brain imaging technique that uses harmless magnetic fields and radio waves to measure cerebral blood oxygenation, which reflects brain activity in a region. The researchers determined the subjects' preferences by examining how frequently they chose each type of gamble during the experiment.

They found that activation of specific brain regions depended on participants' preferences for risk or for ambiguity. They soon learned that the activation of an area in the lateral prefrontal cortex depended upon whether people tended to choose ambiguous gambles, while activation of an area in the posterior parietal cortex depended on whether people tended to choose risky gambles. Furthermore, whether or not a person is, by nature, impulsive appears to correlate with whether or not their brain preferred risky gambles to those that were ambiguous, the researchers said.

"Some people are impulsive, some people are not; some people think through their decisions while others don't, and sometimes this can become pathological," said Michael Platt, Ph.D., a neurobiologist and co-author of the study. "Impulsive behavior can be associated with all sorts

of mental disorders like addiction or problem gambling. If it could be demonstrated that we could change the way people perceive risk and ambiguity by introducing a medication that could influence brain chemistry, someday we might be able to alleviate some types of pathological decision making."

The results provide important data for the emerging field of "neuroeconomics," Huettel added. Neuroeconomics is a relatively new area of research in which neuroscientists, economists, psychologists and psychiatrists collaborate to better understand how the brain works when people make decisions, evaluate risk, and receive rewards.

"By understanding these mechanisms, we may be able to make better predictions about how people will behave or interact in different circumstances," Huettel said.

Further, the team's results should yield new insights in economics, according to Jill Stowe, Ph.D., a decision scientist with Duke's Fuqua School of Business and co-author of the study.

"The results are exciting because they suggest that people evaluate risky and ambiguous options in different ways," she said. "That element is not currently embedded in current economic models of decision making under risk or ambiguity, so this may very well lead to better economic models in the future, as well as hold implications for future economic policy."

Source: Duke University

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