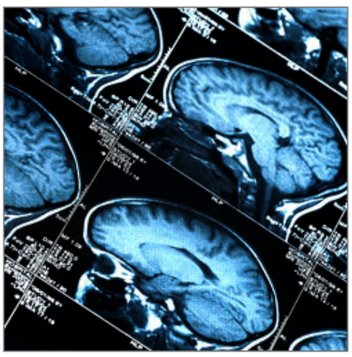
Neuroscience and the Risk Manager

Coates, Shull, other experts weigh in on risk professionals' attention to their discipline

Thursday, May 02, 2013 , By Katherine Heires

Over the past 20 years, advances in brain imaging technology and other methods of analyzing neural activity have yielded important insights into the complex workings and biology of the human brain. It is a discipline, neuroscience, that is closely related to neuroeconomics, which over the last decade has combined knowledge about the brain with biology, physiology, psychology, behavioral finance and economic theory to enhance understanding of decision-making in competitive market environments where risks are taken and rewards earned.



Neuroeconomics makes use of brain imaging to inform economic theory.

To Colin Camerer, Robert Kirby Professor of Behavioral Finance and Economics at the California Institute of Technology, neuroeconomics involves opening up the "black box" of the brain to inform economic theory and potentially to better understand and mitigate risky behavior such as rogue trading. Consultant Denise Shull, president and founder of ReThink Group, a New York firm that advises professional traders, defines it as the study of "what happens in your brain when you are faced with risk and other decisions made under uncertainty."

While making use of brain imaging, neuroeconomics also measures heart rate, blood pressure and facial expressions to assess physiological reactions. And it employs game-like tests and experiments to study decision-making, make inferences about the workings of the brain and build predictive models about human behavior.

These efforts, practitioners say, are designed to advance and enrich our thinking about economic theory, financial decision-making and public policy decisions.

The science has advanced in parallel to recent studies of bubbles and crises and how decision-making and risk-taking, on micro and macro levels, contribute to these events.

Andrew Lo, finance professor and director of the Laboratory for Financial Engineering at the Massachusetts Institute of Technology's Sloan School of Management, has focused on this area of study. Collaborating with Dmitry Repin of Boston University, Lo has conducted neuroscientific tests on professional traders, looking at how the intricate interplay of rational thinking, emotions and stress can affect risk-taking and investment returns. In a 2011 paper, "Fear, Greed and Financial Crises: A Cognitive Neurosciences Perspective," Lo said that "by exploring the neuroscientific basis of cognition and behavior, we may be able to identify more fundamental drivers of financial crises and improve our models and methods for dealing with them."

It is not just a financial markets pursuit: Officially embracing the promise of neuroscience, President Obama in April proposed a $100 million expenditure for the first year of the Brain Research through Advancing Innovative Neurotechnologies project, with the objective of creating a brain map.

Direct Observation

The greatest aid to neuroscience and its offshoot neuroeconomics has come with the availability of functional magnetic resonance imaging (fMRI) over the last two decades, allowing for more informed experimentation and bringing increased attention and recognition to these fields.

With fMRI, scientists are able to scan brains "in action" in a safe, non-invasive manner. They are able to obtain empirical data about what specific parts of the brain are active during a given activity. Although there is still some way to go in terms of image quality and precision, the technology has produced striking imagery and scientific findings.

Several books in the past few years have served to popularize neuroscience and neuroeconomics, including "The Hour Between Dog and Wolf: Risk Taking, Gut Feelings and the Biology of Boom and Bust," by John Coates; and "Market Mind Games: A Radical Psychology of Investing, Trading and Risk," by Denise Shull.

Denise Shull is founder of ReThink Group, a firm that advises professional traders.

In addition, research by Peter Bossaerts, professor of economics, management and finance at the California Institute of Technology, has employed neuroscientific methods in focusing on risk perception, risk learning and human decision-making when uncertainty exists.

Each of these experts has his or her own perspective on the applicability of neuroeconomic studies to the risk management profession.

Coates, a senior research fellow in neuroscience and finance at the University of Cambridge and a former derivatives trader at Goldman Sachs and Deutsche Bank, recalls how risk was surveyed on Wall Street in the early to mid-1990s. "The head of the trading desk would ask what your position was and how you felt about it," and in doing so would make behavioral judgments as to whether or not a trader could handle a particular position. Over time, Coates says, this approach was replaced by statistical metrics and risk managers' conducting stress tests and making snapshot assessments of risk levels.

"We went from a method of personal observation to a more objective, firm-wide, statistical-analytical approach," Coates says. The latter, he adds, has proved incapable of catching "subterranean shifts" -- those points sometimes referred to as "the hour between dog and wolf" -- when people turn either far more risk-seeking or far more risk-averse. Coates says the more statistically-based methods that do not take biology or neuroscience into account fail to catch behavioral shifts in traders and other workers. He is hopeful that this will change.

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"Every major blow-up we've seen on Wall Street has come at the hands of traders taking on more and more risk, thinking they were invincible," Coates says, adding that the biological and neurological reasons behind these actions need to be better understood and managed.

Cognition and Physiology

Coates' book highlights how neuroscience and physiology have shown that financial decision-making is not a purely cognitive activity. It has both cognitive and physical components. "Humans do not regard information dispassionately, as a computer would," says Coates. "We react to it physically, our bodies and brains rev up and down together."

Professor Colin Camerer says neuroeconomics could potentially help mitigate risky behavior such as rogue trading.

Research also shows that much thinking ordinarily takes place automatically and involuntarily, in contrast to controlled thought that is voluntary, conscious and open to introspection. Daniel Kahneman, the psychologist who won the 2002 Nobel Prize in economics, referred to these modes in his 2011 book title as "Thinking Fast and Slow." They have been described by others as hot and cold decision-making.

In the former category are hunches, instincts, intuition and gut feelings -- which Coates explains are the body's way of registering that critical information has been received. It hardly breaks the surface of consciousness but is essential for rational choice. Some scientists question the reliability of intuition or gut feelings, says Coates, but he views intuition as a form of pattern recognition that can, for instance, help traders identify patterns in complex markets and then create algorithms to exploit these patterns.

"The better judgment of the money-making trader may owe something to his or her ability to produce bodily signals and, equally, to listen to them," Coates states. He adds that good judgment may be a trait "as physical as kicking a football."

Coates has delved into the impact of natural hormones on traders and markets, and "the winner effect" on male traders in particular. His biological testing of groups of traders in the City of London has led him to conclude that testosterone and cortisol are chemical messengers to signal economic risk and return.

Moderate levels of testosterone, Coates says, prepare male traders for moderate risks ahead, but higher levels can occur when traders place successful trades and keep winning. The resulting hormonal imbalance can encourage excessive risk-taking, "the winner effect." During bull markets, Coates goes on, testosterone is likely to rise, causing risk levels to increase in the collective trading environment, in turn exaggerating the rally.

Conversely, cortisol, a hormone associated with stress and anxiety, can elevate during a crash, making traders irrationally risk averse.

Coates theorizes that the waves of irrational exuberance and pessimism that destabilize financial markets may simply be traceable to hormones.

The Emotional Component

Shull of ReThink Group, a specialist in trader psychology and experienced futures trader who offers risk and performance consulting to hedge funds and other trading organizations, contends in "Market Mind Games" that much of what we know and have been taught about rational versus emotional thinking is misinformed. Neuroscience has shown that we perceive, judge and decide in ways that largely operate in diametric opposition to the reigning theories in psychology and economics that highlight the benefits of rational thinking above all else.

Shull cites 1992 research of Antonio Damasio and Antoine Bechara, then professors of neurology and cognitive neuroscience at the University of Iowa College of Medicine, on patients who had sustained damage to the orbitofrontal cortex section of the brain, as confirmed by fMRI. They found this area to be part of a broader neural system involved in decision-making. While these patients retained normal, and in some instances exceptional, cognitive abilities despite their brain damage, they also showed a dramatic loss of emotional feeling and, in turn, had begun to make destructive and misguided life decisions.

One patient was described as losing all sense of proportion, spending hours obsessing over trivial details and ignoring more important matters. Such data led to the conclusion that emotion or feeling is "an integral component of the machinery of reason." Subsequent research -- including that of Bossaerts and Camerer at Caltech -- has supported this theory.

Shull also cites 2007 research by Myeong-Gu Seo, associate professor of management and organization at the University of Maryland's Robert H. Smith School of Business, and Lisa Feldman Barrett, distinguished professor of psychology at Northeastern University, on the impact of emotion on stock trading decisions. They asked 101 investors to record their feelings while making investment decisions each day for 20 consecutive business days.

Seo and Barrett found that individuals who experienced more intense feelings while trading made better investment decisions, and thus made more money. The professors concluded that the common prescription "ignore your emotions" appears not to be correct for effective regulation of feelings and their influence on decision-making. Their study suggests that individuals who are better able to identify and distinguish among their current feelings can better control any biases induced by those feelings and, as a result, will achieve better trading results.

Shull draws on such findings in advising traders who want to improve their judgment amid market uncertainties. "Typically, in risk management, what we are trying to do is take the emotion out and come up with a mathematical model," Shull notes. "But research in neuroscience shows that sends us down the wrong path."

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In their white paper "The Art of Algorithmic War," Shull and ReThink Group managing director Bill Long write, "Underlying most of the non-scientific discussion on feelings and emotions is the assumption that a feeling or emotion automatically becomes an action. Logically, this is simply untrue ... In their pure form, feelings and emotions are meant to inform us. Without realizing it, Wall Street adds emotional information to analytic reports."

A Biological Factor

As Caltech's Camerer puts it: "We now know that risk is encoded in the anterior insula section of the brain, and it is a biological feeling activated by the brain. It is not just a number."

Caltech's Peter Bossaerts has applied neuroscientific methods to a variety of risk-related issues.

Much of Shull's work involves asking traders to articulate and analyze their feelings and emotions while trading, so that they may better address risk-aversion issues, "winner effect" behavior as well as fear of regret or fear of missing out (FOMO). From there, Shull describes fear of future regret (FOFR), either from a loss taken and then seeing the trade come back into profitability or over profits not made. Over time, the goal is to help traders become more self-aware -- sometimes employing tools such as heart rate monitors -- to improve trading performance.

"Recognizing one's emotional state at any given moment and what one's pattern is over time will create self-knowledge," says the recent ReThink Group white paper, posted in April and labeled a "work in progress." It goes on to suggest "feeling-analytic questions" -- touching systematically on such emotions as panic, fear, arrogance and various gradations of FOFR -- that can "improve group problem-solving and avert groupthink."

Peter Bossaerts at the Caltech Laboratory for Experimental Finance has applied neuroscientific methods to a variety of risk-related issues, including how individuals process risk in a given situation and make risk-related errors.

In tests conducted by Kerstin Preuschoff, a researcher at the Laboratory of Computational Neuroscience at the Swiss Federal Institute of Technology in Lausanne, and Steven Quartz, a philosophy professor and neuroscience researcher at Caltech, subjects were asked to play card games, controlled in such a way as to allow for fMRI observation of brain areas activated during the processing of risk. The data suggests that the anterior insula section of the brain, considered the seat of feelings and emotional awareness, transmits this information in a rather precise manner -- essentially in the form of mathematical signals.

To Bossaerts, this means risk-processing capability is hard-wired into the brain and formatted like an algorithm, which is "not unlike the GARCH models popular among quants." Bossaerts has further concluded that while an individual might receive new information, the brain's "processing algorithm" for risk stays constant. Some have said future tests may be needed to analyze the degree to which a trader or portfolio manager might consistently err in risk predictions.

"We've discovered cool, mathematical measurements in a quintessentially emotional part of the brain," Bossaerts says. "As such, emotion processing in humans is not something crude, but something that is informed in a reasoned way."

Ready for the Office?

Can fMRI scanning and testing of brain processes actually help risk managers in a practical, real-world way?

Bossaerts says that at this stage, the academic and laboratory work is "much more foundational. There is not yet much that is concrete and applicable for use by risk managers" on an everyday basis.

According to Camerer, on a scale of 1 to 10, with 10 representing maximum relevance, the applicability of these early neuroscience findings is at 1. Eric Turner, a professor of psychiatry at the University of Washington, believes that understanding how the brain works does not necessarily have any practical applications for risk management or, for that matter, other fields. "Whether you are a mouse or a human, individuals have very different reactions to risk," he says.

Books such as "Neuromania: On the Limits of Brain Science" by Paolo Legrenzi, and "Aping Mankind: Neuromania, Darwinitis and the Misrepresentation of Humanity" by Raymond Talis, also question the value and accuracy of neuroscientific efforts.

But some see things differently.

Coates' research into the behavior and physiological reactions of traders under stress has led him to propose something akin to sports training for those -- like traders -- who face persistent uncertainty in their work. This will help to develop greater mental and physical stamina. "Such a possibility may sound futuristic," says Coates, "yet there is a science that has already made remarkable breakthroughs in designing such toughening regimes, and that is sports science."

He points out that athletes have no problems being monitored and tracked and having their training regimes altered, and he proposes employing some of these techniques in the financial workplace. Companies could at least encourage workers to self-monitor and -assess their body chemistry and, in turn, how they are dealing with risks.

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"On an individual level, a trader can train and learn to build resilience, so one's performance is not impaired under stress," says Coates. "And then, when you do go into a period of sustained success, you can learn not to succumb to irrational exuberance."

Vary the Routine

Specifically for risk managers, Coates suggests gaining a better understanding of the biology behind euphoria, fatigue and the stress responses among employees in high-stress jobs. "Without an understanding of the biology behind stress and uncertainty, managers can do wrong things," Coates says. "The usual response when you become fatigued at work is to think you need a vacation, but what you really need to do is change activities." He believes task flexibility would improve risk managers' productivity.

He also maintains that many financial firms operate in a way that exacerbates biological instability in employees, rather than "leaning against" the trend. When traders are on a winning streak and "winner effect" sets in, banks should not up their risk limits -- which tends to reinforce the risk-taking. Instead, Coates says, they should keep risk limits steady and perhaps give the traders time off, so their biology can reset.

"We often see this at Wimbledon," Coates says, referring to the tennis championship, "where a no-name player is beating Roger Federer for a time. But when they come back from a rain delay, the no-name player is invincible no more."

Of course, basic incentives can be misaligned. "By amplifying the compensation, they were amplifying the risk-taking," Coates says, suggesting that banks lessen the frequency of payouts, perhaps extending them over a five-year period, as Deutsche Bank has done with its senior bankers.

Denise Shull believes that if risk managers accept that there is emotion in all decision-making, they should start to treat emotional data as valid and useful and start analyzing it alongside market data. "You can identify a relatively small number of emotions you want to be systematically tracking, to understand, for example, where traders are on a scale of neutral, confident and over confident," Shull says.

She thinks that many firms would benefit from simply analyzing emotional data for FOFR -- a factor that she believes played a major role in some of the recent, headline-making risk-taking blunders -- on a scale of 1 to 5. "Firms should consider making it a part of their risk management culture," Shull says. Ideally, it would be a top-down directive from the board.

Modeling and Profiling

"Firms and boards need to realize when they are making decisions that are not based on reasonable assessments and when they are trying to avoid the fear of regret in some way," Shull explains. "Once they realize it, it will help to lower risk levels." She sees putting all risk management models in an accurate, psychological context, with an assist from neuroscience findings, as the only way to stop recurring boom-and-bust cycles.

Scott Huettel, a professor of psychology and neuroscience at Duke University and director of the Duke Center for Interdisciplinary Decision Science, takes a slightly different view of neuroscience's potential to help risk managers. He has focused his studies on how people make decisions in social settings, offices and while part of communities -- whether on Facebook or elsewhere -- and how these groups exhibit certain biases. He believes that neuroscience can help identify these circumstances in a more precise way .

"The wealth management industry spends $1 billion a year on market segmentation, and while they don't treat everyone the same, they do think there is some predictability to how some people or segments of people approach decisions, and they take advantage of those subtle differences," Huettel says. Over time, neuroscience is going to help risk managers better identify types of people based on their risk preferences, and this will provide a better sense of how individuals or types of individuals perform.

"We'll know the particular types of risk strategies used by some people, groups of people, and we will be able to break up and better understand the population in that way," Huettel says.

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