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Risk aversity visible in the brain

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Sarah Rudorf and Prof. Dr. Bernd Weber. Credit: Barbara Frommann/Uni Bonn

Some people live their lives by the motto "no risk - no fun!" and avoid hardly any risks. Others are clearly more cautious and focus primarily on safety when investing and for other business activities. Scientists from the University of Bonn in cooperation with colleagues from the University of Zurich studied the attitudes towards risk in a group of 56 subjects. They found that in people who preferred safety, certain regions of the brain show a higher level of activation when they are confronted with quite unforeseeable situations. In addition, they do not distinguish as clearly as risk takers whether a situation is more or less risky than expected. The results have just been published in the renowned *Journal of Neuroscience*.

"We were especially interested in the link between risk preferences and

the brain regions processing this information," says Prof. Dr. Bernd Weber from the Center for Economics and Neuroscience (CENs) at the University of Bonn. First, the researchers tested a total of 56 subjects for their willingness to take risks. "In an economic game, the test subjects had a choice between a secured payout and a lottery," reports Sarah Rudorf from CENs, the study's principal author. Those who showed a strong preference for the lottery in this test were categorized as risk takers. Others preferred the secured payout even if the lottery's odds of winning were clearly better. They were put in the risk-averse group.

In risk-averse individuals, certain regions of the brain are activated more strongly

Then the test subjects played a card game in a brain scanner to study their risk perception. Cards carrying numbers from one to ten were shown on the video glasses in front of their eyes. Each time, two cards were randomly drawn. Before the subjects were shown the cards, they were asked to place bets on whether the second card would have a higher or a lower number than the first one. "The statistical probability for either case to occur is always the same: fifty-fifty," says Prof. Weber. "This is important so that all subjects, whether they are risk takers or not, experience risky situations inside the scanner." They were not able to assess their probability of winning their bet until they saw the first card. Here, the researchers found that in the subjects who tended to avoid risks, two specific regions of the brain were activated more strongly than in those who were willing to take risks. These areas are the ventral striatum and the insular cortex. The ventral striatum reacts both to the probability of winning, as well as to how well an individual can predict the outcome of the bet. The insular cortex is particularly sensitive to the risk a situation carries, and for whether it is higher or lower than anticipated.

Risk seekers adjust their strategy after lucky streaks

Sarah Rudorf summarized the results, "Individuals in whom these regions of the brain are activated at a higher level seem to perceive risks more clearly and assess them as more negative than those who are willing to take risks." Risk-averse individuals seem to overestimate the consequences of risk, and they did not distinguish as clearly between situations that turned out to be more or less risky than expected. In contrast, the test subjects who tended to take greater risks also focused their behavior more towards the wins and losses, and more clearly changed their strategy after negative situations.

Study is first to show the neurobiological mechanisms

"This study is the first to show the neurobiological mechanisms of how individual risk preferences determine risk perception," says Prof. Weber. "This also has effects on behavior in the areas of finance and health."

In a next step, the researchers want to study the consequences these results have on economic decisions such as in the stock market. "This might even allow improving the advising process for investors with regard to their individual risk behavior," says Prof. Weber. And he considers health another important area. Smokers know that what they do is very dangerous, and yet they smoke. "If we learned more about smokers' attitudes towards risk, we might be able to provide information for developing better anti-smoking campaigns."

More information: Neural Correlates of Anticipation Risk Reflect Risk Preferences, *Journal of Neuroscience*, DOI: 10.1523/JNEUROSCI.4235-11.2012

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