Kirk, Spock together: Putting emotion, logic into computational words

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Neuroimaging study shows cold reasoning, hot feelings intimately connected

Kirk and Spock may not need a Vulcan mind meld to share cognition: Virginia Tech Carilion Research Institute [1] scientists have found that our cold reasoning and hot feelings may be more intimately connected than previously thought.

"We tend to believe we have rational parts, like Spock, and separate emotional parts, like Kirk. But our research suggests that's not true," said Read Montague [2], director of the Human Neuroimaging Laboratory [3] at the Virginia Tech Carilion Research Institute, who led the study. "We're all a combination of logical Spock and intuitive Kirk. Cold computations and feelings are coupled in our brains, and this connection is dynamic: when one changes, so does the other. This work may open the way to computational models of emotional processing."

Montague's group used a simple fairness probe called the ultimatum game in the experiment. In the game, one player is endowed with an amount of money, such as $20, and offers any split of this amount with his or her partner. If the second player accepts the offer, the money is divided according to the proposed split; if not, no one gets anything.

"It's a take-it-or-leave-it game," said Montague. "And humans are exquisitely sensitive to the perceived fairness of the offered split."

In this large neuroimaging study, the 127 subjects played the role of responder to the proposals.

"If responders just want to make money, they should act like cold, rational agents and accept all non-zero offers," Montague said. "Yet feelings can get in the way. If people feel an offer is unfair, they'll reject it against their own best interests. We wanted to know how we might manipulate these feelings in a fashion that we could connect to the computations going on in the brain." Montague leads the Computational Psychiatry Unit, at Virginia Tech Carilion Research Institute, which uses computational models to understand mental disease

"One key to our experiment was pre-conditioning," said Montague. "One group of subjects adapted to high offers, while another became accustomed to low offers. After this pre-conditioning, the offers for each group shifted suddenly, to identical medium-sized ones, and this opened up the possibility of seeing a connection between feelings and computations."

The researchers discovered that the subjects' feelings about offers tracked a well-defined computation, which they call a norm prediction error. Subjective feelings about offers correlated with these norm prediction errors, and the measured brain responses to feelings and norm prediction errors overlapped substantially.

"In the ultimatum game, you want to show where you stand and what you'll accept," said Montague. "That's Spock. That's the cold, calculating, ledger-balancing function of prospectively encoding the future and controlling people's expectations of you. But a whole host of feelings come along for the ride. You may know you should accept an offer, but you reject it anyway, in a Kirk-like fury, just to send a signal, to punish someone. Our results showed that there's no clean separation between a cold calculation and the hot anger that an unfair offer engenders. Kirk and Spock are joined at the hip."

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