

# Justice in the brain: Equity and efficiency are encoded differently

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The study sought to shed light on the neurological underpinnings of moral decision-making, said Ming Hsu, a fellow at the U. of I.'s Beckman Institute and co-principal investigator. Photo by L. Brian Stauffer, U. of I. News Bureau

Which is better, giving more food to a few hungry people or letting some food go to waste so that everyone gets a share? A study appearing this week in *Science* finds that most people choose the latter, and that the brain responds in unique ways to inefficiency and inequity.

The study, by researchers at the University of Illinois and the California Institute of Technology, used functional magnetic resonance imaging (fMRI) to scan the brains of people making a series of tough decisions about how to allocate donations to children in a Ugandan orphanage.

The researchers hoped to shed light on the neurological underpinnings of moral decision-making, said co-principal investigator Ming Hsu, a fellow at the U. of I.'s Beckman Institute for Advanced Science and Technology.

"Morality is a question of broad interest," Hsu said. "What makes us moral, and how do we make tradeoffs in difficult situations?"

An interest in such issues kept the study subjects in the scanner, despite the pain of grappling with difficult choices, Hsu said. "Quite a few came out saying: 'This is the worst experiment I've ever been in. I never want to do anything like this again!' "

The subjects were told that each child would start out with a monetary equivalent of 24 meals, an actual gift from the research team to the orphanage. An undetermined number of meals would have to be cut from some children's allotments, however. The number of meals cut and the individual children who would be affected depended on how the subjects selected from options the researchers presented.

Every decision pitted efficiency (the total number of meals given) against equity (how much the burden of lost meals was shared among the children).

One could choose to take 15 meals from a single child, for example, or 13 meals from one child and five from another. In the first option the total number of meals lost would be lower. Efficiency would be preserved, but one child would bear the brunt of all the cuts. In the second option more children would share the burden of lost meals but more meals would be lost. The equity was better – but at a cost to efficiency.

"This dilemma illustrates the core issues of distributive justice, which

involves tradeoffs between considerations that are at once compelling but which cannot be simultaneously satisfied,” the authors wrote.

The study was designed to address the psychological and neurological dimensions of two longstanding debates about distributive justice. First, is equity or efficiency more critical to our sense of justice? And second, are such questions solved by reason alone, or does emotion also play a role?

In the experiment, subjects watched an animation on a computer screen. In the animation, a ball traveled from right to left toward a lever that could direct the ball toward one or the other option. Photographs of the affected children represented each option, with numbers for the number of meals that would be lost to those children if that option were selected. By moving the lever, the subjects steered the ball to the option they preferred. At the end of each trial, the subject’s choice was highlighted in red.

In these trials, subjects overwhelmingly chose to preserve equity at the expense of efficiency, Hsu said. “They were all quite inequity averse.” The findings support other studies that show that most people are fairly intolerant of inequity.

The animation, in conjunction with the fMRI, allowed the researchers to view activity in the brain at critical moments in the decision-making process. After analyzing the data, they found that different brain regions – the insula, putamen and caudate – were activated differently, and at different points in the process, Hsu said.

Activation of the insula varied from trial to trial in relation to changes in equity, while activity in the putamen corresponded to changes in efficiency, he said.

In contrast, the caudate appeared to integrate both equity and efficiency once a decision was made.

The involvement of the insula appears to support the notion that emotion plays a role in a person's attitude towards inequity, Hsu said.

The insula is known to play a key role in the awareness of bodily states and emotions. Studies have shown that it is activated in people experiencing hunger or drug-related cravings, and in those feeling intense emotions such as anger, fear, disgust or happiness. Other research has implicated the insula in mediating fairness.

The putamen and the caudate are activated during reward-related learning.

"You're seeing the signal in the insula and the putamen initially," Hsu said. "When they hit the lever you see the insula activation. And when the ball gets to the end you see (activation of) the caudate."

"The putamen is responding only to the chosen efficiency, which is how many meals get taken away from the kids or how many meals they end up with," Hsu said. The insula, however, responded to how equitably the burden of lost meals was distributed.

Together, the results "show how the brain encodes two considerations central to the distributive justice calculus and shed light on the cognitivist/sentimentalist debate regarding the psychological underpinnings of distributive justice," the authors wrote.

Source: University of Illinois at Urbana-Champaign

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