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Knowing one's place in a social hierarchy

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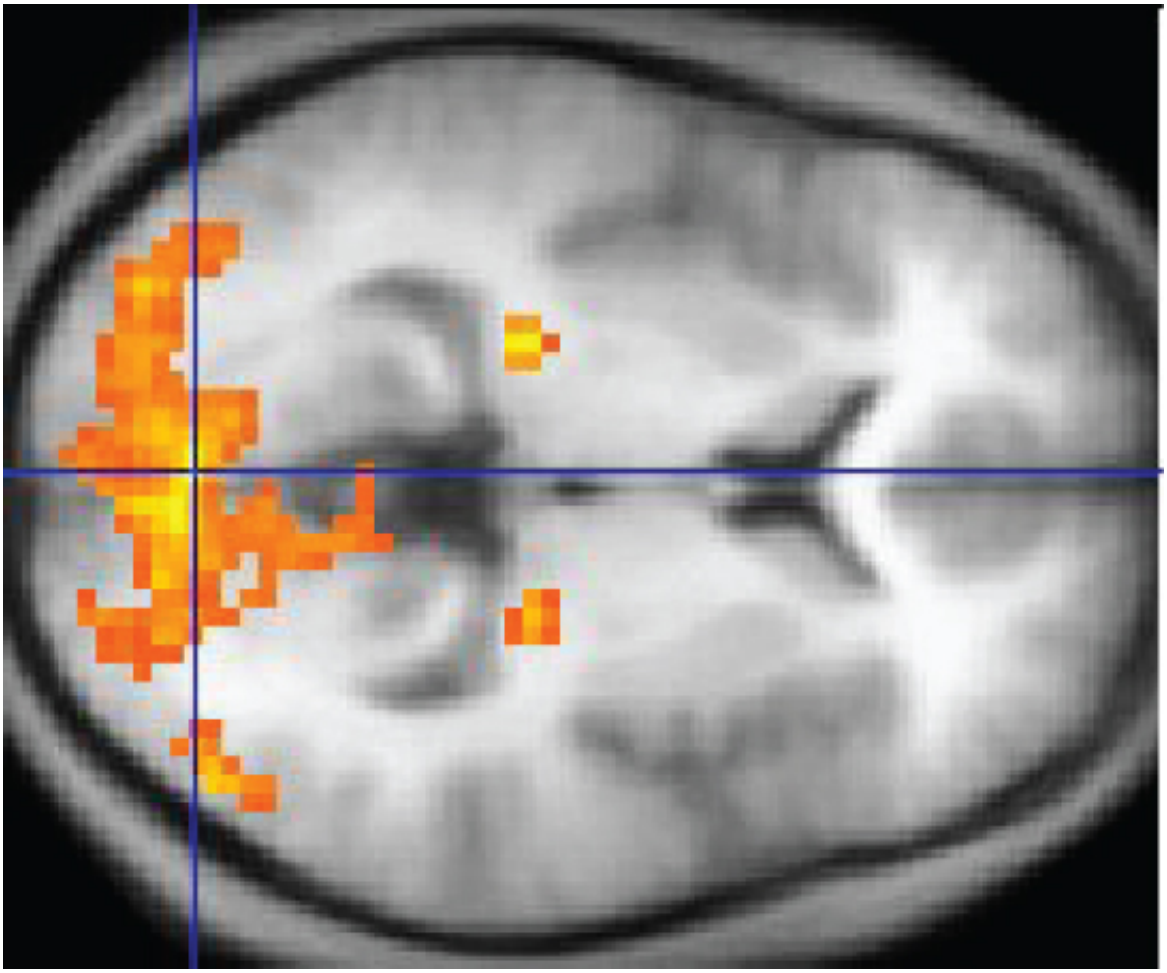

An fMRI image with yellow areas showing increased activity. Credit: Wikipedia/ CC BY 3.0

When you start a new job, it's normal to spend the first day working out who's who in the pecking order, information that will come in handy for

making useful connections in the future. In an fMRI study published December 7 in *Neuron*, researchers at DeepMind and University College London provide new insights into how we acquire knowledge about social hierarchies, reveal the specific mechanisms at play when that hierarchy is our own (as compared to that of another person), and demonstrate that the brain automatically generates signals of social rank even when they're not needed to perform a task. The work could prove useful in guiding future research, not only in neuroscience, but also in artificial intelligence.

In order to determine how we learn about social hierarchies, the authors asked 30 healthy college students to perform a task in the fMRI scanner. In this task, they learned about the power structure of a fictitious company that they imagined working in the future and that of one of their friends. They learned about the relative power of different people in each company, through watching "contests" between pairs of individuals and seeing who won. Once they understood the power structures of both companies, they then saw pictures of individual people from each company and had to decide which company the person worked for.

"We found that the way in which participants learn about the power of individuals was best explained by a process of Bayesian inference" says Dharshan Kumaran, a research scientist at DeepMind. "Essentially you have an estimate about the level of power of each person, which you update as you receive new information (i.e., the outcome of a contest between 2 people."

In this context, you can actually gain knowledge about how powerful someone is when they're not around: for example, if you see that Jane wins a contest against Paul, and later Paul wins many contests against other people, you should probably up your estimate of Jane's power because the evidence suggests that Paul is much better than you might

have previously thought. So what this means is that people are able to rapidly form a coherent understanding of the whole hierarchy through putting together the outcome of different interactions between people, filling in missing pieces.

"We found that different processes seem to be used for learning about and representing a social structure that you yourself are part of, compared to a social structure that involves someone else" says Dharshan Kumaran. "The prefrontal cortex, a region that is highly developed in humans, was particularly important when participants were learning about the power of people in their own social group, as compared to that of another person. This points towards the special nature of representing information that relates to the self." Indeed, sophisticated social interactions necessitate distinguishing one's own thoughts, goals, and preferences from those of other people—a cognitive function we know humans in particular excel at.

"Part of the reason we do neuroscience research at DeepMind is because our ultimate goal is to develop artificial general intelligence that can be applied to solve some of the world's most intractable problems." says Kumaran. "Understanding how we ourselves learn structured forms of knowledge is a key component of what we'd call 'intelligence,' and it is therefore an important focus for our research."

More information: *Neuron*, Kumaran, Banino, Blundell, Hassabis, Dayan: "Computations Underlying Social Hierarchy Learning: Distinct Neural Mechanisms for Updating and Representing Self-Relevant Information" www.cell.com/neuron/fulltext/S0896-6273(16)30802-9 , DOI: 10.1016/j.neuron.2016.10.052

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