A physical basis for the cognitive process of decision-making

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In experiments studying how fruit flies distinguish between ever closer concentrations of an odour, the researchers led by Professor Gero Miesenböck had previously identified a tiny minority of about 200 nerve

cells in the brain as critical for decision-making.

In new work, the team found that these nerve cells collect evidence for the alternative choices as minute voltage changes across their surface. These changes build up over time until they reach a hair-trigger point, at which the nerve cell produces a large electrical impulse. This impulse signals that a decision has been reached.

The team reports its findings in the journal *Cell*. The work was funded by the Wellcome Trust and the Gatsby Charitable Foundation.

"We have discovered a simple physical basis for a cognitive process," says the lead author of the study, Dr. Lukas Groschner.

"Our work suggests that there is an important analogue component to cognition. People sometimes compare the brain to a digital machine operating with sequences of impulses and silences. But much of what looks like silence is actually taken up by analogue computation."

The decision-relevant neurons are distinguished by the presence of a genetic regulator molecule called FoxP.

FoxP determines how evidence is added and retained. Flies with defective FoxP produce too much of an electrical shock absorber that makes the cells' voltage less likely to change with each new piece of information. Decisions therefore take longer—the flies become indecisive.

Fruit flies have one FoxP gene, while humans have four related genes. Human FoxP1 and FoxP2 have been associated with intelligence and cognitive development, hinting at commonalities.

"Fruit flies have an impressive record for making seemingly

impenetrable biological problems tractable," says Miesenböck. "As a result of studying these insects, we understand the basic principles of how a fertilised egg develops into an organism and how the body clock works, to name just two examples recognised by Nobel prizes."

"Research on fruit flies is now beginning to make significant inroads also into tough problems of cognitive science and psychology. I wouldn't be surprised if the long-term impact were similarly profound."

The paper, "Dendritic Integration of Sensory Evidence in Perceptual Decision-Making," is published in the journal *Cell*.

More information: Lukas N. Groschner et al. Dendritic Integration of Sensory Evidence in Perceptual Decision-Making, *Cell* (2018). DOI: 10.1016/j.cell.2018.03.075

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