Fruit flies show mark of intelligence in thinking before they act

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Drosophila sp fly. Credit: Muhammad Mahdi Karim/Wikipedia

Fruit flies 'think' before they act, a study by researchers from the University of Oxford's Centre for Neural Circuits and Behaviour suggests. The neuroscientists showed that fruit flies take longer to make more difficult decisions.

In experiments asking fruit flies to distinguish between ever closer

concentrations of an odour, the researchers found that the flies don't act instinctively or impulsively. Instead they appear to accumulate information before committing to a choice.

Gathering information before making a decision has been considered a sign of higher intelligence, like that shown by primates and humans.

'Freedom of action from automatic impulses is considered a hallmark of cognition or intelligence,' says Professor Gero Miesenböck, in whose laboratory the new research was performed. 'What our findings show is that fruit flies have a surprising mental capacity that has previously been unrecognised.'

The researchers also showed that the gene FoxP, active in a small set of around 200 neurons, is involved in the decision-making process in the fruit fly brain.

The team reports its findings in the journal *Science*. The group was funded by the Wellcome Trust, the Gatsby Charitable Foundation, the US National Institutes of Health and the Oxford Martin School.

The researchers observed *Drosophila* fruit flies make a choice between two concentrations of an odour presented to them from opposite ends of a narrow chamber, having been trained to avoid one concentration.

When the odour concentrations were very different and easy to tell apart, the flies made quick decisions and almost always moved to the correct end of the chamber.

When the odour concentrations were very close and difficult to distinguish, the flies took much longer to make a decision, and they made more mistakes.

The researchers found that mathematical models developed to describe the mechanisms of decision making in humans and primates also matched the behaviour of the fruit flies.

The scientists discovered that fruit flies with mutations in a gene called FoxP took longer than normal flies to make decisions when odours were difficult to distinguish – they became indecisive.

The researchers tracked down the activity of the FoxP gene to a small cluster of around 200 neurons out of the 200,000 neurons in the brain of a fruit fly. This implicates these neurons in the evidence-accumulation process the flies use before committing to a decision.

Dr Shamik DasGupta, the lead author of the study, explains: 'Before a decision is made, brain circuits collect information like a bucket collects water. Once the accumulated information has risen to a certain level, the decision is triggered. When FoxP is defective, either the flow of information into the bucket is reduced to a trickle, or the bucket has sprung a leak.'

Fruit flies have one FoxP gene, while humans have four related FoxP genes. Human FoxP1 and FoxP2 have previously been associated with language and cognitive development. The genes have also been linked to the ability to learn fine movement sequences, such as playing the piano.

'We don't know why this gene pops up in such diverse mental processes as language, decision-making and motor learning,' says Professor Miesenböck. However, he speculates: 'One feature common to all of these processes is that they unfold over time. FoxP may be important for wiring the capacity to produce and process temporal sequences in the brain.'

Professor Miesenböck adds: 'FoxP is not a "language gene", a "decision-

making gene", even a "temporal-processing" or "intelligence gene". Any such description would in all likelihood be wrong. What FoxP does give us is a tool to understand the brain circuits involved in these processes. It has already led us to a site in the brain that is important in decision-making.'

More information: "FoxP influences the speed and accuracy of a perceptual decision in Drosophila," by S. DasGupta et al. www.sciencemag.org/lookup/doi/ … 1126/science.1252114

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