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A role for neural noise in animal behavior

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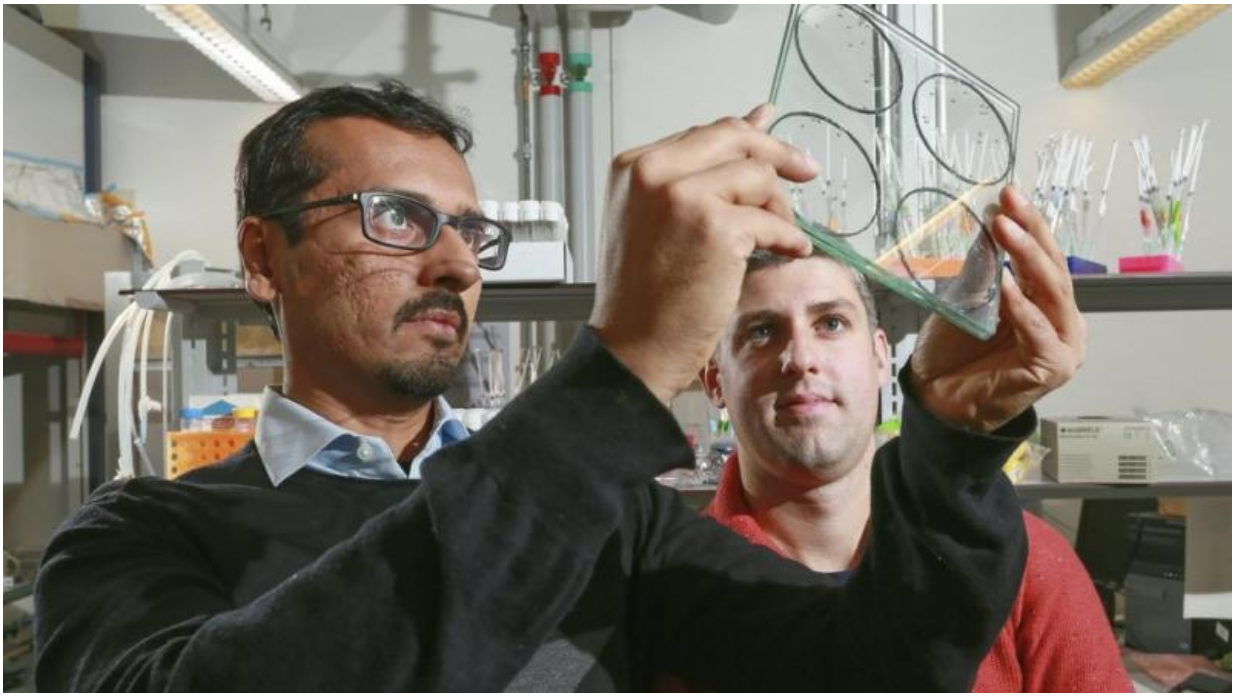

Researchers from EPFL and UNIL have used flies to show how behaviors may be shaped by seemingly random brain activity. This study raises new questions about the role of neural noise in moment-to-moment decisions.

What processes lie behind voluntary actions like when to walk or rest? According to a study carried out by EPFL and the University of

Lausanne, these choices may be shaped in part by neural fluctuations. Neurons in the brain are never quiet. They are constantly producing and receiving signals – like background noise – yet the influences of these signals on behavior remain largely mysterious.

The researchers studied the fruit fly, Drosophila melanogaster - a popular experimental animal model - to determine the impact of noisy neural fluctuations on the timing of flies' walking behaviors. They recorded the behaviors of thousands of flies and tested if it was possible to mimic their largely unpredictable walking patterns using a computer simulation of networks of artificial neurons driven by random fluctuations.

Their study showed that fluctuating neural signals were indeed required to reproduce fruit fly behaviors. Most surprisingly, by looking closely at these neural networks, they found that these signals did not simply disrupt neural activity, but could actually sculpt behavior in a meaningful way. "Our models predict that these fluctuations affect the relationship between what a fly senses and how it reacts," said researcher Pavan Ramdya. "With noise, otherwise weak sensory signals may have a surprisingly strong influence on walking behaviors."

Genetic component

Using these results, Ramdya and colleagues have generated unexpected, new hypotheses about the role of noise in animal behavior. They wonder whether noise levels might even be genetically tuned to make animals behave differently from one another. "Changes in gene expression may affect the strength of constant neural fluctuations and, consequently, influence behavior," said the researchers. Noisy fluctuations have been observed in the nervous systems of many species, including humans. Therefore, by making predictions for how neural dynamics are sculpted by these fluctuations, this study provides general insights into basic

nervous system function, and, by extension, may inform our understanding of human behavioral disorders.

More information: Andrea Maesani et al. Fluctuation-Driven Neural Dynamics Reproduce Drosophila Locomotor Patterns, *PLOS Computational Biology* (2015). DOI: 10.1371/journal.pcbi.1004577

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