From strangers to mates in 15 minutes

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Drosophila sp fly. Credit: Muhammad Mahdi Karim / Wikipedia. GNU Free Documentation License, Version 1.2

Ah, to be a fruit fly. No meddling matchmakers, creepy dates or frog kissing. Females process the sights, smell, sounds and touch of love to choose Mr. Right in 15 minutes. Researchers at Case Western Reserve University discovered the neural circuitry that allows females to make this decision. The work was published in the journal *PLoS Biology* and is featured on the cover of its October issue.

That's just one finding from the first-ever map of the brain circuits involved—an effort more than 40 years in the making.

The mapping enabled the scientists to identify the single gene responsible for the network and the neurotransmitter that mediates the "yes" or "no" response—and confirm a 50-year-old hypothesis on decision-making.

By the way, humans have the same gene, but whether it works in us the same way is unclear.

A female's choice of mate is a key factor in the survival or evolution of a species. She is deciding which traits will be passed on to the next generation.

"It's a complex decision, "said Rui Sousa-Neves, a research professor in the department of genetics and genomic sciences, who led the research and is senior author of the study published in the online journal *PLoS Biology*.

During courtship, "the female fruit fly is listening to love songs from the male and taking in the color of his eyes, how he dances and smells, and she's getting cues from the way he touches her abdomen," he said.

Sousa-Neves worked with PhD student Joseph Moeller Schinaman; biology and Spanish major Rachel Lynn Giesey, who graduated in May; and assistant biology professor Claudia Mieko Mizutani from Case Western Reserve; and University of California at Irvine researcher Tamas Lukacsovich.

Scientists have been working with fruit flies for more than 100 years. The University of Tennessee's Benjamin Hochman isolated mutations on the fly's fourth chromosome, a tiny chromosome compared to its three

others, more than 40 years ago.

But the resource sat on a shelf because no one could link mutations to genes, Sousa-Neves said.

To link the mutation to a gene, Sousa-Neves previously developed a series of tools to molecularly map it and more recently developed a method to generate mutant neurons using a fluorescent color code.

They showed that the gene datilografo (dati), a transcription factor, is essential to organizing and maintaining the neural circuitry in the central brain that enables a female to accept a mate.

The gene is required in an excitatory circuit involving just a few neurons in the olfactory lobe, the first entry point for odor processing in the brain. The neurons express acetylcholine as their neurotransmitter.

In addition, dati is required in two other brain centers: a region where olfaction and other senses are integrated; and a novel region.

Monitoring females that were being courted "provides the first evidence for a hypothesis made 50 years ago," Sousa-Neves said. "To make decisions we don't balance all options like a computer does…. Here females made decisions based on a sum of stimuli that came from outside."

Further testing showed that if they removed the dati gene, female flies made no decisions and never accepted to mate with males.

"Genes similar to dati are not only found in flies," said Sousa-Neves. "It's a conserved gene present in marine arthropods to humans."

Does the gene play the same role in humans? Do humans actually make

such a decision in 15 minutes?

"Nobody knows,"Sousa-Neves said. Finding the answers will take time.

But, now that they've discovered the players involved, "it opens up investigating decision-making at a brand new level," he said.

The researchers are looking further into how dati establishes the circuits for decision-making in flies and what decision-making involves.

More information: Schinaman JM, Giesey RL, Mizutani CM, Lukacsovich T, Sousa-Neves R (2014) "The KRÜPPEL-Like Transcription Factor DATILÓGRAFO Is Required in Specific Cholinergic Neurons for Sexual Receptivity in Drosophila Females." *PLoS Biol* 12(10): e1001964. DOI: 10.1371/journal.pbio.1001964

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