Bugs life: The nerve cells that make locusts 'gang up'

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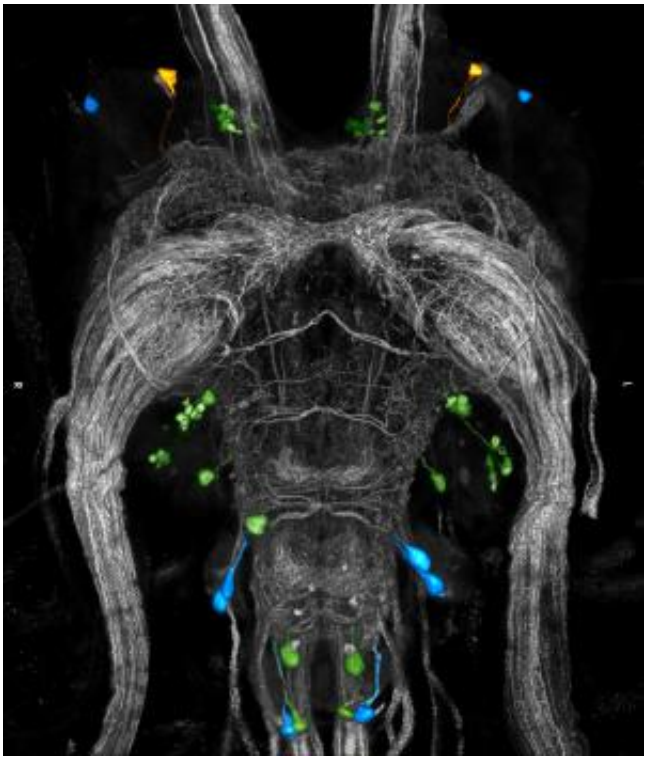

Computer reconstruction of nerve cells in a desert locust that produce the neurochemical serotonin. The colors indicate each cell's response to the social stimuli that cause gregarious behavior. The green cells contain less serotonin after a life-time of crowding with other locusts. The blue cells contain more serotonin after a locust has seen and smelled other locusts for just one hour. The yellow cells increase their serotonin content within an hour of exposing a locust to any of the social stimuli that induce gregarious behavior. Credit: University of Leicester

A team of biologists has identified a set of nerve cells in desert locusts that bring about 'gang-like' gregarious behaviour when they are forced into a crowd.

Dr Swidbert Ott from the University of Leicester's Department of Biology, working with Dr Steve Rogers at the University of Sydney, Australia, has published a study that reveals how newly identified nerve cells in locusts produce the neurochemical serotonin to initiate changes in their behaviour and lifestyle.

The findings demonstrate the importance of individual history for understanding how brain chemicals control behaviour, which may apply more broadly to humans also.

Locusts are normally shy, solitary animals that actively avoid the company of other locusts. But when they are forced into contact with other locusts, they undergo a radical change in behaviour - they enter a 'bolder' gregarious state where they are attracted to the company of other locusts. This is the critical first step towards the formation of the notorious locust swarms.

Dr Ott said: "Locusts only have a small number of nerve cells that can synthesise serotonin. Now we have found that of these, a very select few respond specifically when a locust is first forced to be with other locusts. Within an hour, they produce more serotonin.

"It is these few cells that we think are responsible for the transformation of a loner into a gang member. In the long run, however, many of the other serotonin-cells also change, albeit towards making less serotonin."

When a locust is first forced into contact with other locusts, a specific set of nerve cells that produce the neurochemical serotonin is responsible for reconfiguring its behaviour so that the previously solitary locust

becomes a member of the gang, which is known as 'gregarious' behaviour.

An entirely different set of its serotonin-producing nerve cells is then affected by life in the group in the long run.

Dr Ott added: "The key to our success was to look in locusts that have just become gregarious and that had never met another locust until an hour earlier. If we had looked only in solitary locusts and in locusts that had a life-long history of living in crowds, we would have missed the nerve cells that are the key players in the transformation.

"There is an important lesson here for understanding the mechanisms that drive changes in social behaviour in general, both in locusts and in humans. We have shown how important it is to look at what happens when a new social behaviour is first set up, not just at the long-term outcome.

"Research in insects can give us deep insights into how brains work in general, including our own."

Studies have previously shown that the change from solitary to gregarious behaviour is caused by serotonin.

The new study, which was funded by the Leverhulme Trust, the Biotechnology and Biological Sciences Research Council (BBSRC) and the Royal Society, has identified the individual serotonin-producing nerve cells that are responsible for the switch from solitary to gregarious behaviour.

The scientists used a fluorescent stain that reveals the serotonin-producing nerve cells under the microscope. This allowed them to measure the amount of serotonin in individual nerve cells—the brighter

a nerve cell lights up, the more serotonin it contains. The newly identified cells were much brighter in locusts that had just been forcedly crowded with other locusts. Moreover, the same cells were also brighter in locusts that had their hind legs tickled by the researchers for an hour—which is sufficient to make the locusts behave gregariously.

Serotonin has important roles in the brains of all animals that include the regulation of moods and social interactions.

In humans, there are strong links between changes in serotonin and mental disorders such as depression and anxiety.

- Study shows 'swarm' mentality in locusts is a result of specific nerve cells that produce the brain chemical serotonin
- Serotonin in humans is known to affect mood and behaviour such as aggression and anxiety
- Research in insects can give us deep insights into how brains work in general, including the human brain

More information: The paper, 'Differential activation of serotonergic neurons during short- and long-term gregarization of desert locusts', published in the academic journal *Proceedings of the Royal Society B*: Biological Sciences, can be found here: rspb.royalsocietypublishing.or … nt/282/1800/20142062

Provided by University of Leicester