Male and female brains are not so different, fruit flies' sex acts tell us

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While males and females might sometimes act as though they come from different planets, a new study in flies suggests they are both equipped with a largely unisex brain.

Remote control of fruit flies' sexual behaviour has revealed that male courtship tricks lie dormant in the female brain.

Male fruit flies 'sing' to attract females, vibrating one wing to produce a distinctive sound which females react to by allowing copulation. Professor Gero Miesenböck of Oxford University has shown that female fruit flies can be made to 'sing' too, using a revolutionary technique that he developed whilst at Yale which allows the remote control of brain circuits with light.

'You might expect that the brains of the two sexes would be built differently, but that does not seem to be the case,' says Miesenböck. 'Instead, it appears there is a largely bisexual or "unisex brain" with a few critical switches that make the difference between male and female behaviour.'

Miesenböck and colleagues had previously pioneered a powerful new research method that allowed them to trigger certain actions in flies from a distance by shining a laser beam on them. The flies were genetically engineered so that only the neurons of interest were made responsive to light. When the laser flashed it activated these neurons, thus provoking certain behaviours, such as jumping, walking, and flying away. In the recent research, Miesenböck and colleagues used the technique to investigate the 'singing' courtship behaviour. The set of neurons that control this behaviour make the products of the fru (or 'fruitless') gene – a key sex-determining factor in the nervous system. Using the laser method, the researchers could 'switch on' the specific neuronal circuits responsible for this courtship behaviour (the fru neurons) and cause the males to go about their wooing.

Miesenböck was interested to see whether they could do the same in females. If they could, it would show that the neuronal circuitry for male behaviour exists in female brains and simply lies dormant. The researchers could indeed produce the behaviour in females – although the 'song' was not quite as good as the males'.

'The fact that we could make females vibrate one wing to produce a courtship song – a behaviour never before seen in female flies – shows that the brain circuits for this male behaviour are present in the female brain, even though they are never used for that purpose,' says Miesenböck. 'One obvious question is why females possess this brain circuitry at all. It's possible that the circuitry overlaps with circuitry used for other behaviours.

'But the mystery at the root of our study is the neuronal basis of differences in male and female behaviour. Anatomically, the differences are subtle. How is it that the neural equipment is so similar, but the sexes behave so differently?

'Our findings suggest that flies must harbour key nodes or "master switches" that set the whole system to the male or female mode. Our next goal is to find those controls.' In an earlier study in mice, other researchers found that females took on masculine behaviours when a particular pheromonal cue was blocked, suggesting that male behaviour is actively repressed in the rodents.

‘In flies, you don’t see a spontaneous emergence of male behaviour when you block pheromonal cues,’ Miesenböck says. ‘Rather, it requires an artificial trigger. Female flies have the program, but they seem to lack the activating command. Either way, the principle is the same in flies and mice: male and female brains are not as different as you might think.’

Source: Oxford University