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Experiments with fruit flies suggest learning differences might involve more than just nature versus nurture

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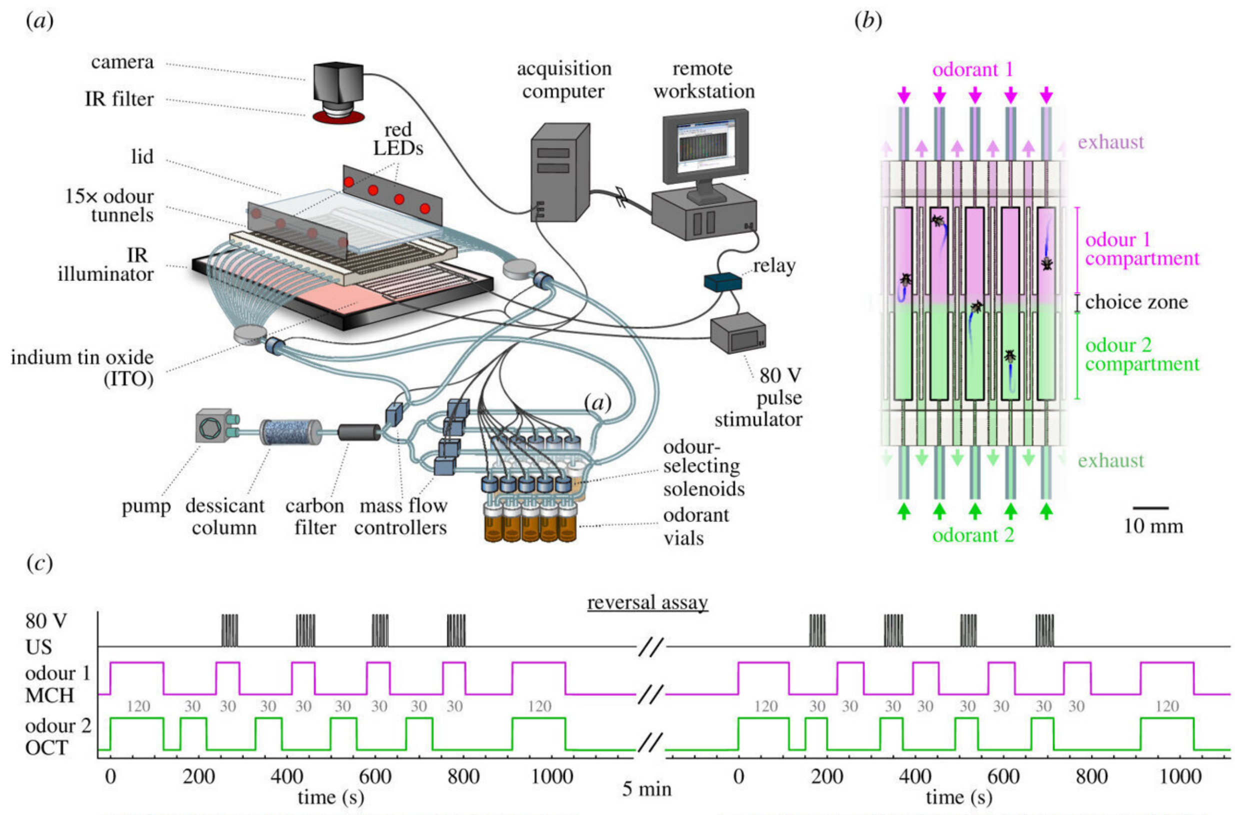

Figure 1. Individuality in associative learning. (a) Schematic of the reversal assay. (b) Zoom-in view of the linear behavioral arenas, with odorant flowing into each half. (c) Diagram of training protocol (top). Gray numbers indicate the length in seconds of each stimulus phase. Note that the timing of US delivery differs in the classical and reversal phases. Position in the arena versus time kymographs of three specific flies undergoing conditioning. Magenta and green

shading indicate the portions of each arena that are filled with OCT and MCH, respectively. (d) Octanol preference of flies before and after training with MCH as the CS+ (left) and with OCT as the CS+ (right). Points are individual flies. Coloued examples correspond to the individual flies highlighted in (c). p-values reflect paired t-tests. Thick black line represents the mean. (e) Scatterplot of individuals' learning responses for reversal versus classical conditioning trials ($r = 0.31$; $p = 0.02$; $n = 53$). Points are individual flies. Line is the best linear fit and shaded region is the 95% CI of the best-fit line. Credit: DOI: 10.1098/rsbl.2021.0424

A team of researchers from Harvard University, the Ann and Robert H. Lurie Children's Hospital of Chicago and the Howard Hughes Medical Institute reports evidence that certain learning differences between individuals of the same species might involve factors beyond genetic or nurturing experiences. In their paper published in the journal *Biology Letters*, the group describes learning experiments they conducted with fruit flies.

For many years, scientists and laypeople alike have debated the impact of nature versus nurture on children as they learn and grow to adulthood, without much consensus. Now, it appears that there may be a third factor that has not been recognized—random brain growth differences.

In this new effort, the researchers wondered if randomness may occur in the brains of developing fruit flies. To find out if that might be the case, they conducted experiments with one-week old fruit flies. The experiments involved genetically modifying the flies to make them very nearly genetically identical. All of the test flies were housed in the same container and fed the same diet. The researchers placed them individually into a testing device consisting of a small container with two tunnels, each of which had been treated with materials to make them smell different. At the outset of the experiment, traveling through one of the tunnels resulted in receiving a small electric shock or food that had a bitter taste. The next day, the researchers swapped the tunnels, which meant the flies had to relearn which tunnel would result in which outcome.

The researchers found that the flies did not respond identically to the training sessions—some relearned quickly; others took longer. They also found that those that learned quickly to avoid the bitter taste on the second trial were the same flies that learned quickly to avoid the electric shock. The researchers noted that the flies also demonstrated physical differences in their responses to the changes they encountered.

The researchers suggest that there may be some degree of randomness introduced during brain development that plays a role in how flies, and possibly people, learn.

More information: Matthew A.-Y. Smith et al, Idiosyncratic learning performance in flies, *Biology Letters* (2022). DOI: 10.1098/rsbl.2021.0424