Mechanisms of sound and gravity sensation of the *Drosophila* brain

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Thanks to the advanced molecular-genetic techniques of the fruit fly, *Drosophila melanogaster*, it is easy to label specific subsets of neurons and to monitor and manipulate their functions. Here we report the analysis of the neural substrates underlying sound and gravity perception of this organism. Whereas human senses sound and gravity using different sensory organs in our inner ear, the flies detect these stimuli with a single system, the Johnston's organ (JO). The JO houses clusters of mechanosensory neurons that monitor antennal movements. Detailed anatomical analysis revealed that the JO neurons could be classified into several groups, each of which terminates in a specific zone of the primary sensory center in the brain. By expressing calcium-dependent fluorescent proteins to monitor neural activities and tetanus toxin proteins to block synaptic transmission, we found that information about vibration and static deflection of the antennae were received by specific subsets of JO neurons, sent to difference zones of the primary center, and utilized specifically to the behaviors in response to sound and gravity, respectively. The characteristic organizations of the secondary neurons arising from these sound- and gravity-associated centers showed surprising similarity with the vestibular and auditory pathways in our brain.