Taking it all in: Revealing how we sense things

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McGill physiology research team sheds light on how the brain processes what we sense.

We rely on our senses in all aspects of our lives. Unfortunately, many people suffer from some kind of impaired sensory function. In Canada alone, 600,000 people are visually impaired while almost three million suffer from partial or total hearing loss. In a paper published this week in *The Journal of Neuroscience*, researchers from McGill University have

demonstrated for the first time that there are specific neurons that respond selectively to first and second order sensory attributes. In the visual system, for example, luminance is a first-order attribute, whereas contrast is second-order. These findings could pave the way to the development of novel therapies and improved prosthetics for those with sensory deficiencies.

The research team, led by physiology student Patrick McGillivray, recorded the responses to stimuli of midbrain electro-sensory neurons in the weakly electric fish. Based on these responses, the researchers were able to demonstrate that there are specific neurons that respond selectively to different attributes at the same time. Moreover, they uncovered the simple and generic neural circuits that enable this selectivity. These findings provide important clues about how the brain processes first and second order sensory attributes in audition (like pitch and timbre) and vision (like luminance and contrast).

"Uncovering these clues relies on identifying the attributes that we use to perceive stimuli, the computations performed by the brain, and the actual neural networks that implement these," explained Dr. Maurice Chacron, lead author and principal investigator at McGill's Computational Systems Neuroscience Lab. "Stimuli like speech and music are characterized by multiple attributes. For example, when listening to music, we can perceive both frequency (how low or high an instrument is playing), as well as timbre (the type of instrument playing)."

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