Smell and behavior: The scents of taking action

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Invasive sea lampreys, subject of research at Michigan State University. Credit: Daymon J. Hartley

In all animals, including humans, smell—the oldest of the five senses—plays a predominant role in many behaviors essential for survival and reproduction. It has been known since ancient times that animals react to odours.

Yet researchers are just beginning to elucidate the neural pathways and

mechanisms responsible for odour-induced behavior. . A first step was made by showing the existence of a neural pathway connecting the olfactory and motor centers of the brain in invertebrates with the worm C. elegans and in vertebrates with the lamprey, a primitive, eel-like fish native to the Atlantic Ocean.

In a new study published in *PLoS Biology*, scientists at Université de Montréal, in Quebec, and the University of Windsor, in Ontario, show that an inhibitory circuit that releases the neurotransmitter GABA into the olfactory bulb strongly modulates behaviouralresponses to odours in lampreys. The study of these modulatory mechanisms allowed the researchers to discover a new pathway linking together olfactory and motor centers in the brain.

This discovery demonstrates that odourscan activate locomotor centers via two distinct brain pathways," said lead author Gheylen Daghfous, a researcher in the laboratory of UdeM neuroscience associate professor Réjean Dubuc, also a professor at Université du Québec à Montréal. "This work shed snew light on the evolution of the olfactory systems in vertebrates."

He added: "It is well-known that animals are attracted to odors, whether it be a dog tracking its prey or a shark attracted to blood. On the other hand, we are only beginning to understand how the brain uses odors to produce behavior. Our study revealed a new brain highway dedicated to transmitting smell information to the regions controlling movements."

Funded by the Great Lakes Fishery Commission (GLFC), with the Canadian Institutes of Health Research (CIHR) and the Natural Sciences Research Council of Canada (NSERC), the study is the result of a long-standing collaboration between Dubuc and Windsor's Barbara Zielinski.

"Our purpose was to identify the neural circuitry linking olfaction to

locomotion in lampreys," a parasitic type of fish that attach themselves to other fish and suck their blood, leaving a gaping wound, said Dubuc. "Lampreys invaded the Great Lakes decades ago and have decimated large populations of fish, with major commercial impact. The GLFC is looking for new means to control lamprey populations, and attracting them using olfactory stimuli is one such avenue."

More information: Gheylen Daghfous et al, GABAergic modulation of olfactomotor transmission in lampreys, *PLOS Biology* (2018). DOI: 10.1371/journal.pbio.2005512

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