Researchers discover molecule that allows for controlling animal movements using light

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(Phys.org)— A diverse group of researchers from the U.S. and China has discovered a molecule that allows for controlling the movements of animals using only light. In their paper published in the journal *Nature Chemical Biology*, the team describes the exhaustive process they used to find a molecule that would allow for manipulating the actions of an animal, using only light—without having to resort to genetic engineering.

The molecule—the researchers call it optovin—was one of 10,000 different compounds the researchers created and applied to pre-hatched zebrafish held in a jar—it was the only one that caused a change in behavior of the fish when a light was shone on them. Encouraged by their success, the researchers applied the same compound to the ears of several mice and found that shining a light on the area afterwards, caused the mice to shake their heads.

Up till now, the only way to get animals to respond in desired ways when shone with a light (other than training them), was to use genetic modification of their skin cells, a process known as optogenetics. This new chemical, a drug-like compound, is able to pull off the same trick, though in less varied ways.

The researchers believe optovin causes a response in the animals tested, not because they see, perceive and then respond accordingly, but because it bonds directly with nerve cells in the skin—those that are involved in the perception of pain. Fish with their heads cut off, or made blind, continued to respond in the same manner. They believe the new

compound binds with a protein channel in nerve membranes, which are known to be the first responders in recognizing a painful experience. When a light was shone on the fish, all of them changed direction almost instantly, as if stung. It's not known of course, if the fish were experiencing actual pain, or if they were simply responding to a sudden stimulus. In either case, they also found that if they continued to stimulate the fish, or mice, that eventually both groups grew numb to the sensation and stopped responding.

The research group believes their discovery might prove useful for those studying pain and might even lead to ways to alleviate it due to the desensitizing that occurred after prolonged exposure to the light source.

More information: Photochemical activation of TRPA1 channels in neurons and animals, *Nature Chemical Biology* (2013) doi:10.1038/nchembio.1183

Abstract
Optogenetics is a powerful research tool because it enables high-resolution optical control of neuronal activity. However, current optogenetic approaches are limited to transgenic systems expressing microbial opsins and other exogenous photoreceptors. Here, we identify optovin, a small molecule that enables repeated photoactivation of motor behaviors in wild-type zebrafish and mice. To our surprise, optovin's behavioral effects are not visually mediated. Rather, photodetection is performed by sensory neurons expressing the cation channel TRPA1. TRPA1 is both necessary and sufficient for the optovin response. Optovin activates human TRPA1 via structure-dependent photochemical reactions with redox-sensitive cysteine residues. In animals with severed spinal cords, optovin treatment enables control of motor activity in the paralyzed extremities by localized illumination. These studies identify a light-based strategy for controlling endogenous TRPA1 receptors in vivo, with potential clinical and research applications in nontransgenic

animals, including humans.

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