New discovery of alarm response in medaka fish furthers analysis of fear

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Yale-NUS Assistant Professor of Science Dr Ajay Mathuru has discovered that the medaka fish has an 'alarm response' to a type of semiochemical (message-bearing chemicals that carry information from one animal to another) released due to physical injuries sustained by another member of its kind. Since the 1970s, many scientists had considered this type of alarm behaviour to be unique to fishes of the superorder Ostariophysi. The medaka fish, a member of the Beloniformes order, is one of the few laboratory-friendly fish outside of the Ostariophysi superorder to similarly have a response to this type of semiochemical. With this discovery, it is now possible to perform non-invasive, comparative neural circuit analysis against the zebrafish, the species of the Ostariophysi superorder most commonly used in laboratories.

Dr Mathuru's research was published on 8 November 2016 in *Scientific Reports*, a leading international scientific journal.

Considered an anti-predator mechanism, this semiochemical - Schreckstoff - triggers fear in fish by warning it of a nearby danger. Unlike humans, fish do not wait for visual confirmation of predators, but use their keen sense of smell to detect them. Dr Mathuru has found that while the medaka fish also has an 'alarm response', it reacts in a different way from the zebrafish - by playing dead. Since both species of fish are laboratory-friendly to raise and possess characteristics such as a translucent skin and skull when young, researchers are able to study the activity of neurons in their brains by non-invasive methods of imaging

and compare their neural responses. Prior to this discovery, scientists were unable to use non-invasive methods to study fishes outside of the superorder Ostariophysi that exhibited an alarm response. Comparing the two types of fish that have a similar but distinctive alarm response will lend greater insight into how the brain processes information to generate behaviours when danger is felt.

Discussing the significance of the study, Dr Mathuru said, "It will be highly informative to look into the biochemistry of alarm cues and neural circuits operating in this way, in two species that shared a common ancestor approximately 110-160 million years ago. It will allow us to delve further into understanding how neural machinery orchestrates species-specific behaviours. It will also reveal if such a behaviour originated once in the course of evolution, or multiple times."

The discovery also has implications for improving our understanding of fear and panic in other animals, including humans. While the triggers for fear may be different for humans, the organisation of the fear circuitry could be similar. A greater understanding of such neural circuits may allow scientists to have a better understanding of uncontrolled fear in humans, such as those seen when panic disorders happen.

More information: Ajay S. Mathuru, Conspecific injury raises an alarm in medaka, *Scientific Reports* (2016). DOI: 10.1038/srep36615

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