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Study finds fish preserve DNA 'memories' far better than humans

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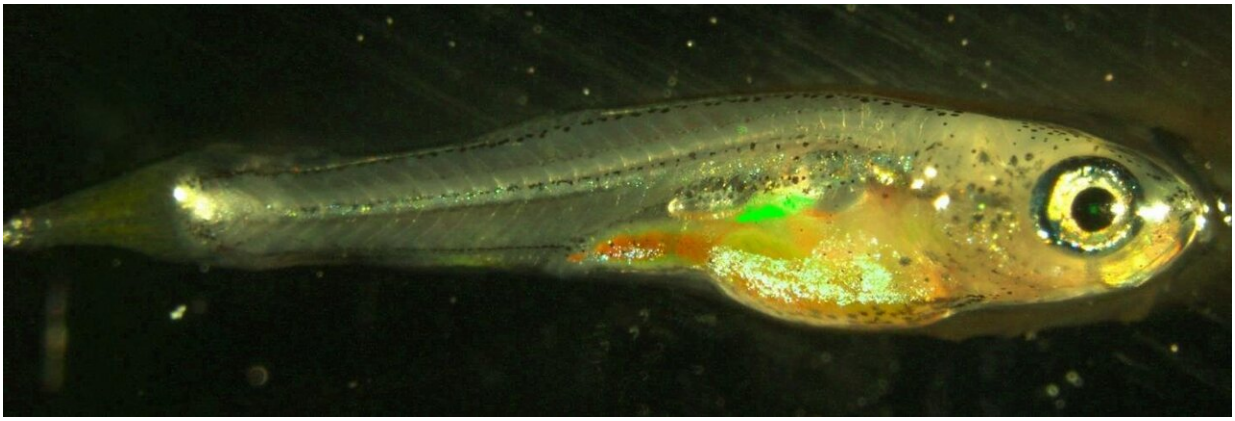

Cells transmitting information to the next generation in fish (highlighted green) do not erase memory attached to DNA as humans do. Credit: University of Otago

We are all familiar with the common myth that fish have poor memory, but it turns that their DNA has the capacity to hold much more memory than that of humans.

In a study published recently in the journal *Nature*, University of Otago researchers report that memory in the form of 'DNA methylation' is preserved between generations of fish, in contrast to humans where this is almost entirely erased.

DNA is often compared to a large book, with the words representing an instruction manual for life. DNA methylation encodes additional information that we are only starting to understand—a little like discovering handwritten notes in the margins of the book saying which pages are the most important, or recording newly acquired information. In humans, these notes are removed at each generation but this apparently does not occur in fish.

First author of the study, University of Otago Anatomy Ph.D. student Oscar Ortega elaborates; "Methylation sits on top of DNA and is used to control which genes are turned on and off. It also helps to define cellular identity and function. In humans and other mammals, DNA methylation is erased at each generation; however, we found that global erasure of DNA methylation memory does not occur at all in the fish we studied."

In recent years much attention has been paid to the idea that significant events such as war or famine can have a lasting effect on subsequent generations through the inheritance of altered DNA methylation patterns. While these 'transgenerational' DNA memory effects appear to be potentially important, because of DNA methylation erasure events during development, it is thought to be extremely rare in humans. However, because fish apparently do not have these erasure events, it seems possible they can transmit life experience through their DNA in the form of methylation.

Dr. Tim Hore, research team leader and Senior Lecturer, at Otago's Department of Anatomy, says the study's findings provide new avenues for scientists to study how the memory of events in one generation, can be passed on to the next.

"Mammalian biologists have searched long and hard to find reliable examples of where altered DNA methylation patterns are passed on to subsequent generations; yet only a handful have been verified in

repeated studies. However, unlike humans, DNA methylation is not erased at each generation in at least some fish. So, we think intergenerational memory transfer through DNA methylation could be much more common in fish," Dr. Hore says.

Also published in *Nature Communications* is a complementary study from the Garvin Institute (Australia), confirming the Otago observations. "It is really great to have immediate validation that our results are robust—they used different techniques and developmental samples, but came to the same conclusions as we did," Dr. Hore adds.

The researchers hope this new knowledge into DNA methylation inheritance will drive new understanding into what molecular secrets are passed from parents to their offspring, ultimately, rewriting the book of life as we know it.

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