Zebrafish testing identifies a gene potentially at the root of domestication

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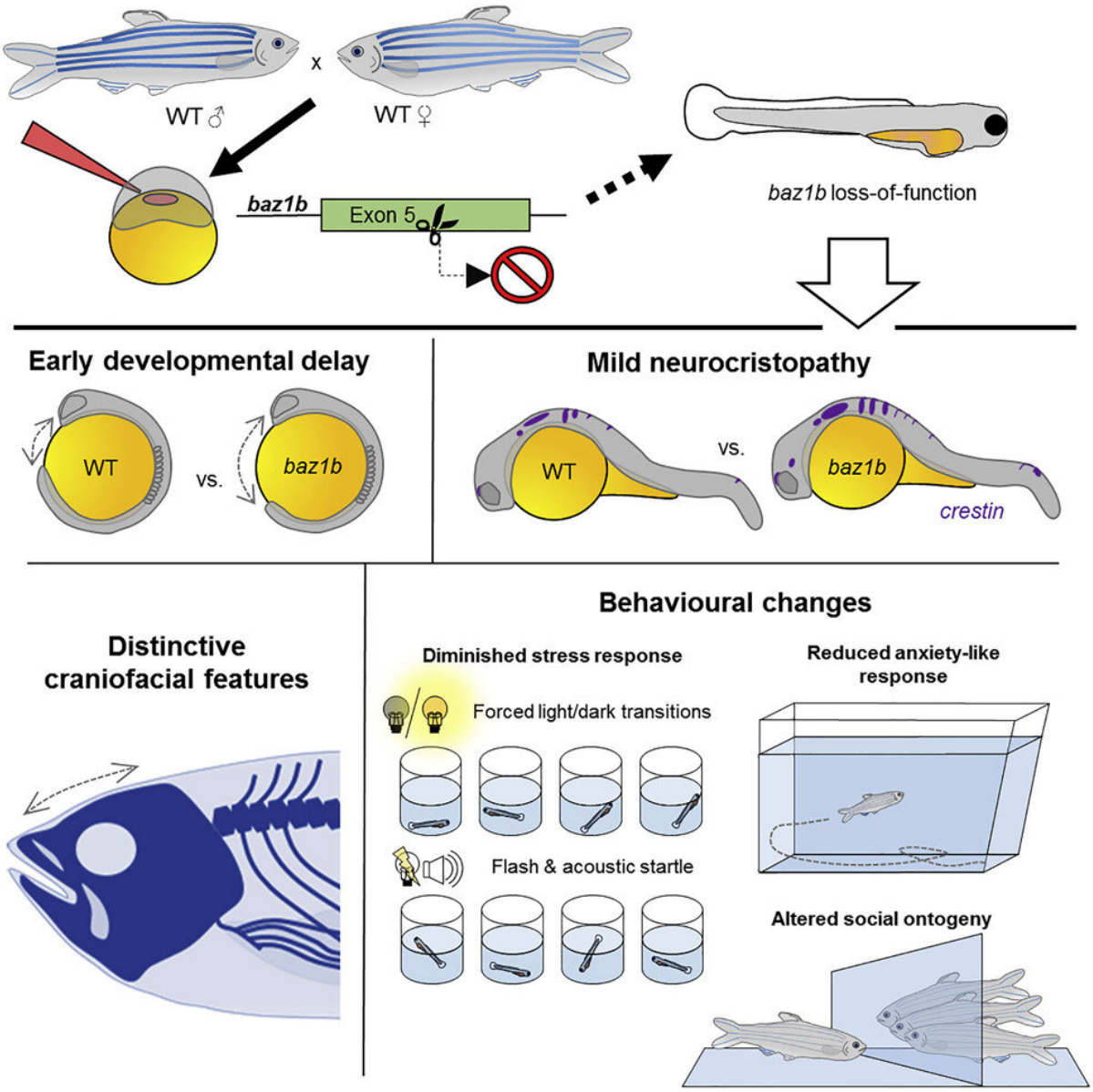

Graphical abstract. Credit: *iScience* (2022). DOI: 10.1016/j.isci.2022.105704

Researchers at Queen Mary University of London have shown that zebrafish can provide genetic clues to the evolution of social behaviors in humans and domesticated species.

The research, published in *iScience*, looked at genetically modified zebrafish that fail to make the baz1b protein. The results suggest the gene is not only at the cornerstone of physical and behavioral changes in the fish and other domesticated species, but potentially also human beings' social relationships.

Domesticated species—such as dogs and cats—show genetic differences compared to their wild type counterparts, including variation in the baz1b gene. These genetic changes correlate with physical and behavioral traits including smaller facial features such as skulls and teeth, as well as being more sociopositive, less aggressive, and having less fear.

However, studies have also suggested that modern humans domesticated themselves after they split from their extinct relatives, Neanderthals and Denisovans. In doing so, we experienced similar physical and behavioral changes.

Those changes have all been linked to the fact that domesticated animals have fewer of a certain type of stem cell, called neural crest stem cells.

The research led by the Queen Mary team builds on this by studying the impact of removing baz1b gene function, and the impact of doing so on neural crest development and social behavior.

The mutant zebrafish studied were found to be more socially prone than their counterparts with functional baz1b. They showed an increased tendency to interact with members of the same species, although the differences between the two types of zebrafish were no longer observable once the fish were three weeks old.

As well as being more sociable, the mutant zebrafish showed distinctive facial changes in later life. These included altered eye length and width, a protruding forehead, and a shorter snout. This was accompanied by reduced anxiety-associated behaviors.

To measure this, the researchers examined the zebrafish's response to a brief flash of light, specifically the distance traveled over a five-minute period following the flash, as well as their response to an acoustic startle and their response when exposed to a new environment. In all cases, the mutant zebrafish recovered more quickly following a change in condition, indicating less fear-related reactivity.

The mutant zebrafish also showed mild under-development of the neural crest at larval stages.

The research determined that in zebrafish the baz1b gene impacts both morphological and behavioral characteristics associated with the domestication syndrome in other species.

Jose Vicente Torres Perez, co-author from Queen Mary University of London and the University of Valencia, said, "Since the process of self-domestication, which allowed modern humans to form larger social groups, among other characteristics, is similar to the process of domestication in other 'domesticated' species, our research has the potential to help us unravel the biological roots governing these behaviors.

"Our research backs up the existing hypothesis that behavioral and morphological changes that came with domestication in animals and humans can be traced to under-development of neural crest stem cells."

Professor Caroline Brennan, lead author and Professor of Molecular Genetics at Queen Mary University of London added, "This study offers an interesting perspective into the origins of how we interact with others. While carrying the conclusions from zebrafish over to other vertebrates might be challenging, comparative studies such as these give insight into the evolution of human cognition."

Zebrafish were partly chosen for the research because about 80% of genes associated with human diseases have a corresponding orthologue—a gene in a different species that evolved from a common ancestor—making zebrafish an ideal model in which to study the genetics and neuronal circuitry underlying behavior.

More information: Jose V. Torres-Pérez et al, baz1b loss-of-function in zebrafish produces phenotypic alterations consistent with the domestication syndrome, *iScience* (2022). DOI: 10.1016/j.isci.2022.105704

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