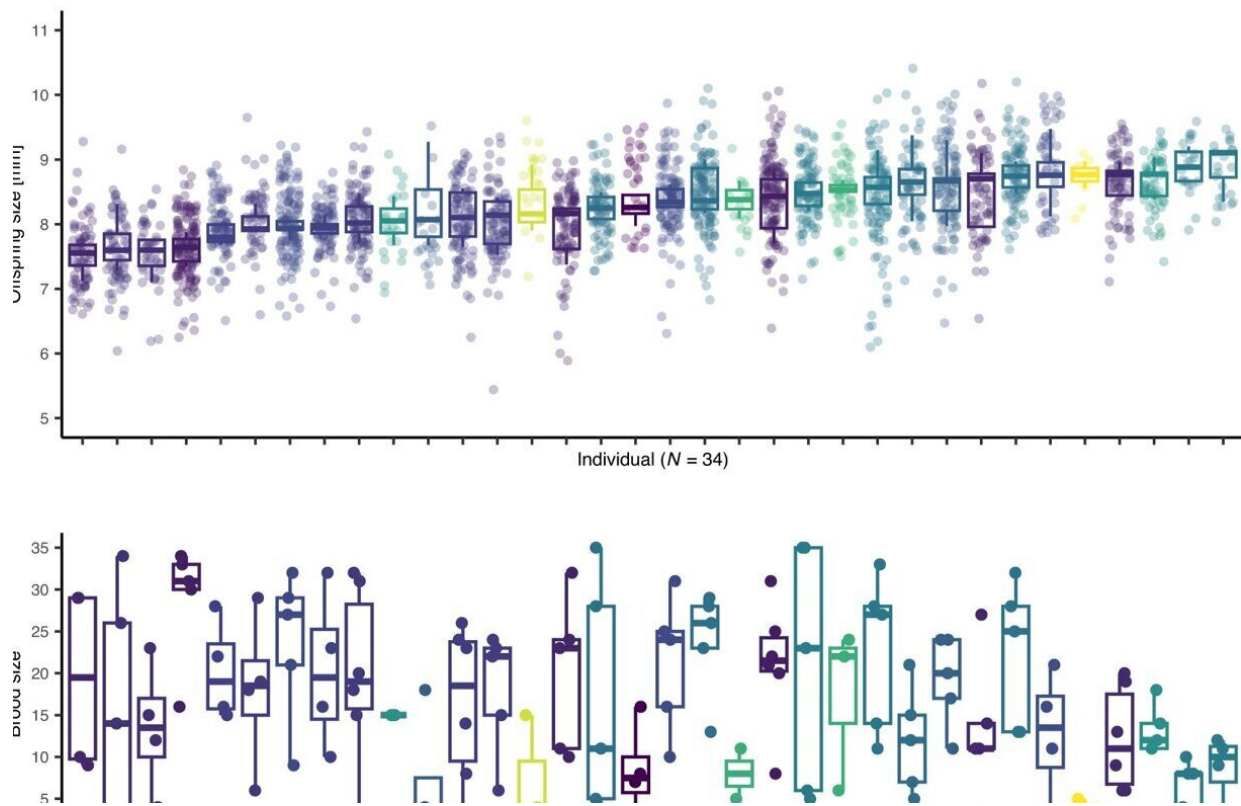


# Clonal fish: Same genes, same environment, different fitness levels

November 28 2023



Reproductive individuality. Credit: *Nature Communications* (2023). DOI: [10.1038/s41467-023-43069-6](https://doi.org/10.1038/s41467-023-43069-6)

According to current knowledge, individuality is determined by either differences in genome or in the apparent environmental conditions.

However, studies show, the paradigm of twin research is currently crumbling.

A research team from the Leibniz Institute of Freshwater Ecology and Inland Fisheries (IGB) and the Cluster of Excellence "Science of Intelligence" (SCIOI) has now found that clonal [fish](#)—i.e., fish with identical genetic material—that are reared under nearly identical, highly standardized environments systematically differ in the number and size of [offspring](#) per reproduction cycle, two crucial indicators of biological fitness. The study is [published](#) in the journal *Nature Communications*.

The researchers studied the behavior and reproductive profiles of 34 Amazon mollies (*Poecilia formosa*) over a period of 280 days. These fish naturally reproduce clonally, and all offspring is therefore genetically identical to the mother, with the species only consisting of females, and reproduction (i.e. cloning of the mother) occurring through activation through sperm of males from similar species. The fish are born alive and there is no brood care after birth. They can therefore be kept under identical, highly standardized conditions from day one.

With the help of an automated high-resolution video tracking system, the researchers recorded activity and [food intake](#) during the first month of life. They then characterized the reproductive profile of each individual, i.e. reproductive onset, brood size and offspring size. These are indicators of life history productivity and, ultimately, biological fitness. The team studied 2,522 offspring from 152 broods.

## **Individual differences in activity and food intake**

As shown in a [previous study](#) ("The emergence and development of behavioral individuality in clonal fish," also published in *Nature Communications*), the individual fish differed systematically in their activity patterns and food intake.

"Our experiment confirms that behavioral individuality develops at a very early stage even without genetic and obvious environmental variation," said Max Wolf, leader of the study and researcher at IGB and in the Cluster of Excellence SCIoI.

## **Individual differences in reproductive profiles and productivity**

The researchers studied an average of four broods per individual and found that individuals consistently differed in how large their offspring were and how many offspring they produced per brood. In other words, individuals differed in how productive they were.

"This is the first evidence that genetically identical animals growing up under near-identical environmental conditions differ quite substantially in their biological fitness," said Ulrike Scherer, lead author of the study and researcher in the Cluster of Excellence SCIoI and guest scientist at IGB.

There is a reason for that: It was found that the fish that spent more time feeding grew larger, and larger fish produced larger offspring, though those fish started reproducing later. However, food intake seemed to have no effect on [brood](#) size, and there was no correlation between individual activity levels and reproduction.

"Our study also reveals, how little we understand so far about the emergence of individuality and the possible role of epigenetics, stochasticity and micro-environmental differences," said Ulrike Scherer.

**More information:** Ulrike Scherer et al, Reproductive individuality of clonal fish raised in near-identical environments and its link to early-life behavioral individuality, *Nature Communications* (2023). [DOI:](#)

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Provided by Technical University of Berlin

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