# When food is scarce, a smaller brain will do

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A new study explains how young brains are protected when nutrition is poor. The findings, published on March 7th in *Cell Reports*, a Cell Press publication, reveal a coping strategy for producing a fully functional, if smaller, brain. The discovery, which was made in larval flies, shows the brain as an incredibly adaptable organ and may have implications for understanding the developing human brain as well, the researchers say.

The key is a carefully timed developmental system that ultimately ensures neural diversity at the expense of neural numbers.

"In essence, this study reveals an adaptive strategy allowing the reduction of the number of neurons produced in the face of sub-optimal nutritional conditions, while preserving their diversity," said Cedric Maurange of Aix-Marseille Université in France. "This is a survival strategy permitting the developing brain to produce the minimal set of neurons necessary to be functional, at the minimum energetic cost."

Most of the neurons in the human brain are produced well before birth, as the developing fetus grows and changes in the womb. But how the young brain copes with adversity is an unresolved question. If a mother doesn't have enough food to eat, what happens to the brain of her baby?

To find out, Maurange and his colleagues looked to the fruit fly, a workhorse of biology. The much shorter lifespan of fruit flies means that they reach the equivalent of toddlerhood in just four days' time.

Their developmental studies in the fly visual system reveal an early sensitivity to the availability of amino acids, ingredients that are the building blocks of proteins. They found that a fly with all the amino acids it needs ends up with a larger pool of neural stem cells than one lacking those nutrients. Later, when those neural stem cells start to produce the many different types of neurons, that nutrient sensitivity goes away. The end result is a brain that is functional but smaller. In some flies, the optic lobe contained 40 percent fewer neurons and still worked.

"We were surprised to realize that the optic lobe can have such a drastically reduced number of neurons under dietary restriction and yet remains functional," Maurange said.

The findings may help to explain well-documented patterns of brain growth in humans. The human brain is protected over other organs when nutrients are lacking late in fetal development, producing a brain that is large relative to organs such as the pancreas or intestine. But when nutrients are limited early in larval development, the brain remains small along with the rest of the body. Those growth patterns are known as asymmetric and symmetric intrauterine growth restriction (IUGR), respectively.

"Our work suggests new avenues to investigate how early nutrient restriction affects mammalian brain development and may help in understanding the mechanisms underlying symmetric and asymmetric IUGR in humans," Maurange said.

**More information:** *Cell Reports*, Lanet et al.: "Protection of neuronal diversity at the expense of neuronal numbers during nutrient restriction in the Drosophila visual system."
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