

Impact of family income on children's learning shaped by hippocampus

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A new study by a team of researchers from the University of Toronto (U of T) has identified the region of the brain's hippocampus that links low income with decreased memory and language ability in children.

Previous research has shown that [children](#) from lower [income](#) families

on average score lower in memory and language abilities than their higher income peers.

It is also known that a brain region that supports these abilities—called the hippocampus—is sensitive to the [chronic stress](#) that can be associated with lower socioeconomic status and that it is smaller in volume in children from lower income families.

Surprisingly, previous research had failed to show that the hippocampus underlies income-related gaps in cognition.

"What we found—and what makes this result novel—is that it's the anterior hippocampus that is associated with differences in cognition related to income," says Alexandra Decker, lead author of a study published today in *Nature Communications*.

Decker is a Ph.D. candidate in the Department of Psychology in the Faculty of Arts & Science at U of T. Her co-authors are professors from the department and include co-senior-author Amy Finn, Katherine Duncan and Donald J. Mabbott who is also with The Hospital for Sick Children (SickKids) in Toronto.

Decker and her colleagues arrived at their result by analyzing data previously gathered from a diverse sample of over 700 children, adolescents and young adults that included assessments of memory and vocabulary, as well as annual [family](#) income. They also studied MRI scans of participants.

Stresses and availability of resources associated with low socioeconomic status

The hippocampus is located in the brain's temporal lobe. As part of the

limbic system, it plays a vital role in learning and memory.

Previous research linked socioeconomic status and decreased levels of cognition but did not identify the hippocampus as the underlying cause, in part because the hippocampus was viewed as a single, homogeneous structure.

The result produced by Decker and her colleagues was based on growing evidence that the hippocampus comprises two distinct regions—the posterior and anterior. According to Decker, "These regions develop differently and play different roles in cognition—and they have different sensitivities to stress."

The researchers found that lower socioeconomic status was associated with reduced size of the anterior hippocampus but not the posterior or whole hippocampus.

Although the data used in the study was limited to family income, Decker and her colleagues describe factors associated with socioeconomic status that could play a role in the effect—including stress and the availability of material and non-material resources.

"Parents from families with higher incomes are more able to take time off work and are less likely to be working multiple jobs," says Decker. "They're also generally able to consistently afford enrollment in enriching programs and nutritious meals."

What's more, she says, children from lower socioeconomic backgrounds can experience a range of stressors. "For example, the stress borne by their parents about being able to make rent, pay bills and afford groceries."

Insight for researchers, educators and policy makers

In addition, the researchers found that increases in income benefited brain development only up to a certain threshold.

"The relationship between income and the anterior hippocampus seems to be significant up to about an annual family income of about \$75,000," says Decker. "There appear to be diminishing benefits at higher levels—which raises the question, why?"

"More research needs to be done to answer this," she says. "But it could be that at around \$75,000, particular needs have been met."

The researchers say the finding may be helpful to researchers, educators, and policy makers interested in promoting brain and cognitive health in children from families with lower incomes. It may also provide insight into the types of cognitive processes that require more support in these children.

According to Finn, who is head of the Learning and Neural Development Lab at U of T, "These findings can help us understand how children from lower income backgrounds are uniquely disadvantaged compared to their peers from higher-income families on measures of cognitive ability.

"Understanding how these factors interact," she says, "is central to designing means to boost cognitive performance in children from lower income backgrounds, with implications for social mobility, reducing achievement gaps and much more."

"It raises the possibility," adds Decker, "that we may eventually be able to prevent—at least to some extent—these negative effects on the brain. It suggests how we might be able to make a difference."

More information: Alexandra L. Decker et al, Children's family

income is associated with cognitive function and volume of anterior not posterior hippocampus, *Nature Communications* (2020). [DOI: 10.1038/s41467-020-17854-6](https://doi.org/10.1038/s41467-020-17854-6)

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