From the General to the Specific: The Maturation Pattern of the Hippocampus Drives Human Memory Development

Position paper outlines new avenues for memory research

Berlin, July 23, 2018 – Neuroscientific and cognitive psychological research casts a fresh light on memory development in childhood and adolescence. The hippocampus plays a more important role than previously thought. Researchers from the Max Planck Institute for Human Development and Temple University present their latest findings in the journal Trends in Cognitive Sciences.

Parents know one of the paradoxes of human development well: Toddlers seem to acquire knowledge about their world effortlessly, but at the same time they often do not remember specific events. They learn that tigers have stripes, but forget their trip to the zoo—who they went with, what they ate, what they wore, and so on. Children's better memory for the generalizable than for the specific persists, albeit in a weaker form, up until pre-school and even primary school age.

Differences in the maturation of the regions of the hippocampus may explain this developmental paradox. Researchers from the Max Planck Institute for Human Development in Berlin and Temple University in Philadelphia have collaborated to review these findings in an article in the journal Trends in Cognitive Sciences.

The hippocampus is located deep in the brain and plays an important role in processes of learning and memory. Different areas within it prioritize generalization versus details. “Generalizing first allows small children to get their bearings in the world,” says first author Attila Keresztes from the Max Planck Institute for Human Development. “Building up stable notions of repeating events and language acquisition are part of the ability to generalize. On this basis, children become increasingly better at separating the specific from the general and at remembering details as well,” adds Keresztes.

The processes enabling this developmental trajectory are called pattern completion and pattern separation. Pattern completion extracts the generalizable across different experiences, whereas pattern separation identifies the differences between events and thereby allows memory for details. The Berlin team’s high-resolution brain imaging data show that the regions of the hippocampus responsible for pattern completion and pattern separation mature at different rates. The researchers regard this coordinated maturation of specialized areas of the hippocampus as being the cause of the observed development trend from the general to the specific.

“Last year we realized that we had arrived at the same conclusions in independent studies. So we decided to write a position paper together with our Berlin colleagues,” says Nora Newcombe, Professor at Temple University in Philadelphia. She regards the approach developed together as a pivotal reorientation in the study of human memory development. So far, the assumption was...
that the hippocampus was more or less mature by the age of six years and further memory development was only dependent on the maturation of the neocortex, explains Nora Newcombe. Now it is clear that maturation of the hippocampus continues into adolescence. “The textbooks need to be rewritten,” says Newcombe.

The details of hippocampal maturation and its links with neocortical maturation will be examined in further experiments and longitudinal studies, using behavioral assessment, neuroimaging, and computer models of the interactions between pattern completion and pattern separation.

Original studies


Max Planck Institute for Human Development
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