Study suggests that attention networks support changes in cortical organization and cognition during childhood

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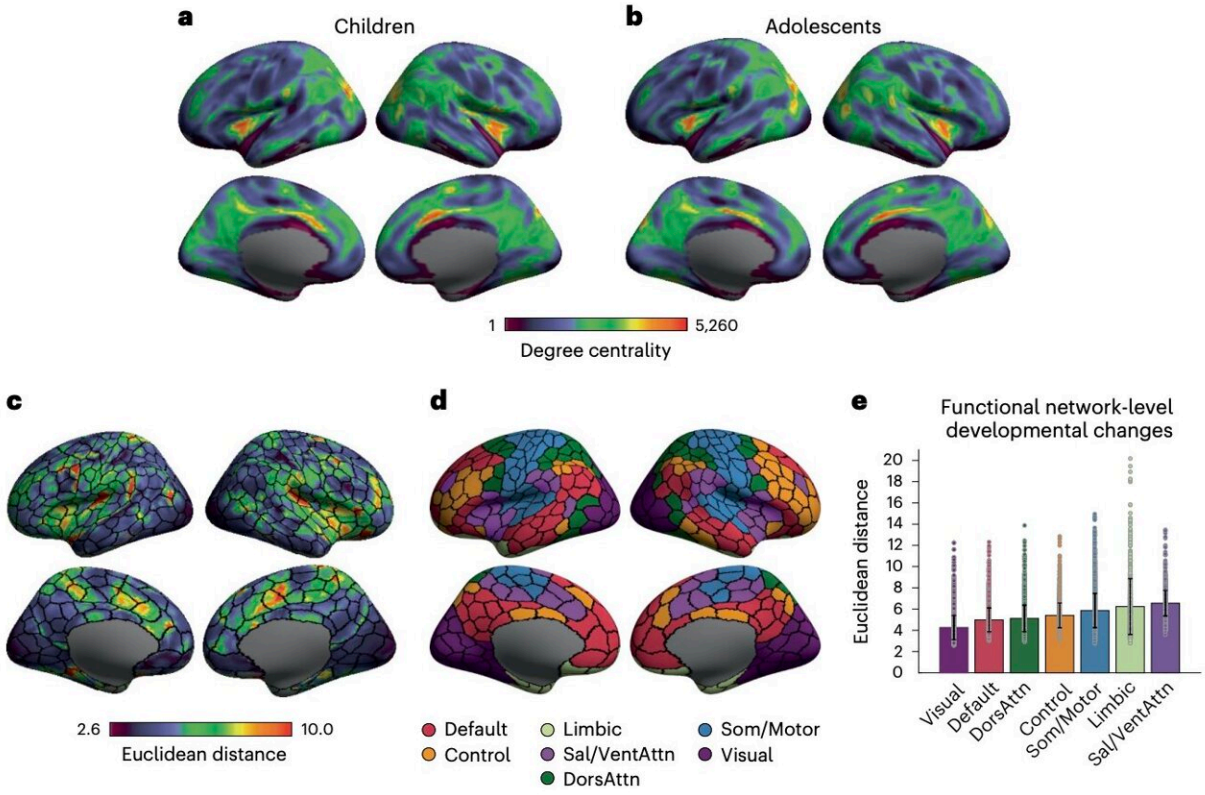

Ventral attention network areas demonstrate high population-level degree centrality but pronounced functional changes across development. Credit: *Nature Neuroscience* (2024). DOI: 10.1038/s41593-024-01736-x

Past neuroscience studies have consistently highlighted the profound changes that the human brain undergoes throughout childhood and adolescence. These efforts have uncovered various stages of development, during which the brain's organization evolves to support increasingly complex cognitive functions, gradually shifting from a focus on somatosensory/motor and visual processing to more advanced mental capabilities.

These stages of brain development and their underlying neurobiological processes have been closely studied and are now relatively well-understood. In contrast, the contributions of specific functional networks (i.e., interconnected brain regions that collectively serve specific functions) to the brain's maturation process remain poorly delineated.

Researchers at Yale University, National University of Singapore and Beijing Normal University carried out a study investigating the extent to which individual functional networks contribute to the maturation of the brain and the gradual acquisition of new cognitive abilities before adulthood.

Their findings, published in *Nature Neuroscience*, suggest that one of the primary functional networks responsible for directing attention to specific stimuli plays a role in the brain's re-organization and cognitive development during childhood and adolescence.

"The human brain experiences functional changes through childhood and adolescence, shifting from an organizational framework anchored within sensorimotor and visual regions into one that is balanced through interactions with later-maturing aspects of association cortex," Hao-Ming Dong, Xi-Han Zhang and their colleagues wrote in their paper.

"We link this profile of functional reorganization to the development of ventral attention network connectivity across independent datasets."

As part of their study, the researchers analyzed brain imaging data collected from children and adolescents over the course of their development. The two datasets they analyzed were gathered as part of the Chinese color nest project (CCNP) and the ABCD study, two distinct longitudinal research efforts that collected brain scans and cognition-related data from children and adolescents at regular intervals for a few years.

By analyzing these two datasets, the researchers first delineated cortical regions that exhibited the most pronounced changes as the children who participated in the CCNP and ABCD studies grew. They observed that significant developmental shifts occurred within an attention-related brain network known as the ventral attention network (VAN).

The VAN is a functional network that supports the ability of humans to detect external, unexpected and behaviorally relevant stimuli, redirecting their attention towards them. The team found that the changes observed in this network were correlated with the children's cortical maturation and cognitive development.

"We demonstrate that maturational changes in cortical organization link preferentially to within-network connectivity and heightened degree of centrality in the ventral attention network, whereas connectivity within network-linked vertices predicts cognitive ability," wrote Dong, Zhang and their colleagues.

"This connectivity is associated closely with maturational refinement of cortical organization. Children with low ventral attention network connectivity exhibit adolescent-like topographical profiles, suggesting that attentional systems may be relevant in understanding how brain functions are refined across development."

Overall, the findings gathered by this research team suggest that

attention-specialized functional networks, particularly the VAN, support the re-organization of the brain and cognitive maturation across childhood and adolescence.

These results could pave the way for additional studies aimed at further exploring the contribution of the VAN to neurodevelopment using other methods and longitudinal brain datasets.

More information: Hao-Ming Dong et al, Ventral attention network connectivity is linked to cortical maturation and cognitive ability in childhood, *Nature Neuroscience* (2024). DOI: 10.1038/s41593-024-01736-x