Signal variability and cognitive performance in the aging human brain

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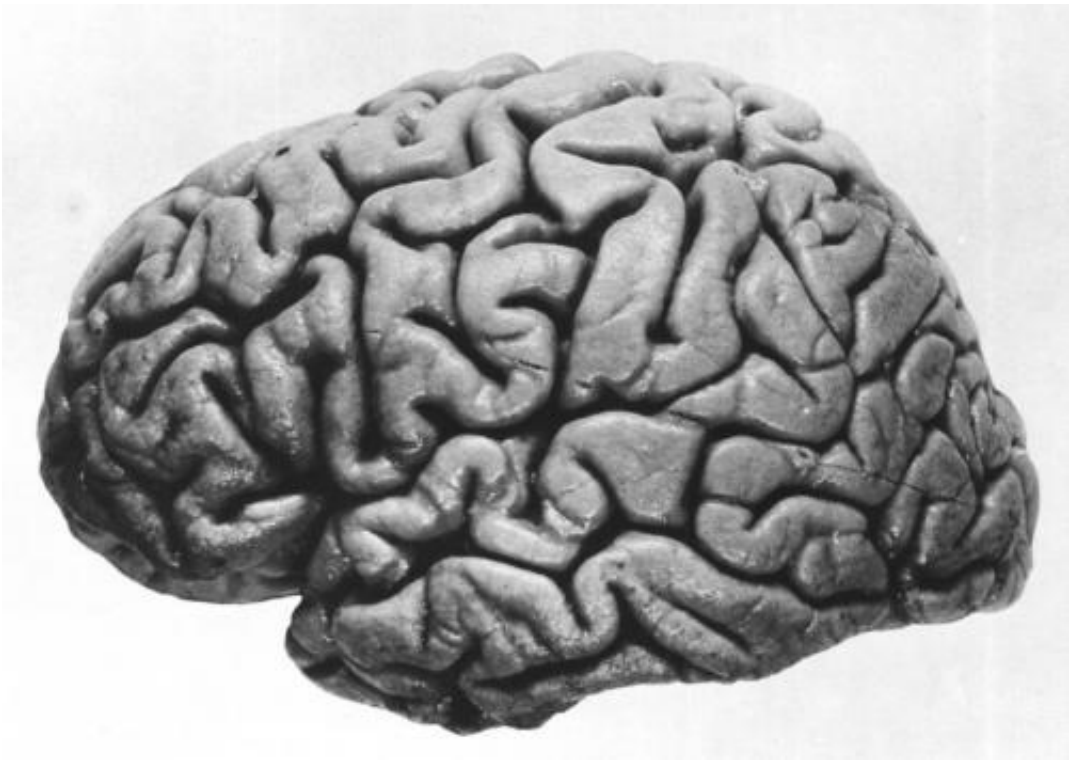

Left hemisphere of J. Piłsudski's brain, lateral view. Credit: public domain

As we age, the physical make up of our brains changes. This includes changes in neural processing in grey matter, but also in the deterioration of structural connections in the brain, which allow communication between distinct brain regions, so the brain is able to work as a well-wired network system.

Researchers at the Lifelong Brain and Cognition Lab at the Beckman Institute for Advanced Science and Technology at the University of Illinois have utilized the magnetic resonance imaging (MRI) facilities available in Beckman's Biomedical Imaging Center to measure the moment-to-moment variability in brain activity, more specifically in the blood oxygenation level-dependent (BOLD) signal.

In recent years, researchers have observed that this variability in the BOLD signal in the function of certain brain regions may be a good thing, linked to younger age and better cognitive performance. Greater variability may reflect more flexible or adaptive information processing.

However, the association between BOLD variability and structural brain connectivity is not well understood. Also unknown is the association between brain signal variability and cognitive performance on various tasks such as memory, reasoning, speed, vocabulary, and semantic knowledge. Beckman researchers collected functional and structural MRI and looked at cognitive performance in 91 elderly, non-demented adults. They found that older adults who had greater variability in neural activity in specific brain regions performed better on fluid ability and memory tasks, and also had better quality of structural white matter connections in the brain.

Their paper, "White matter integrity supports BOLD signal variability and cognitive performance in the aging brain," is published in *PLOS ONE*.

"Our study is important as it explores the relationships between moment-to-moment variability in spontaneous brain activity and broadly defined cognitive performance in older adults," said Agnieszka Burzynska, postdoctoral researcher in the Lifelong Brain and Cognition Lab and author of the study. "We think that greater variability in brain function in certain regions allows better processing of information, especially

during highly demanding memory and reasoning tasks, which require someone to remember information, form associations, or perform abstract mental operations. We believe that variability in the brain activity reflects the dynamic use of different brain networks. In the aging research, there are mixed findings on whether aging is associated with increased or decreased amplitude of neural activity, and looking into variability of the signal gives us a new type of information on how the aging brain works."

More information: *PLOS ONE*, journals.plos.org/plosone/arti … journal.pone.0120315

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