The wiser brain: Insights from healthy elders

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The archetype of old wise elders distinguished for their wisdom and sound judgement continues to inspire dreams of reaching a bright and enlightened old age. However, it is presently unclear how such elders are able to stop the natural cognitive decline associated with old ageing.

An international team of researchers recorded and analysed brain activity of 100 healthy older Portuguese adults with different levels of cognitive abilities and found distinct patterns of brain activity associated with better cognitive performance, according to a study led by Dr Joana

Cabral, Prof Dr Nuno Sousa, Prof Morten Kringelbach and Prof Gustavo Deco from the Universities of Oxford (UK), Minho (Portugal), Aarhus (Denmark) and Pompeu Fabra (Spain) published July 11, 2017 in the open-access journal *Scientific Reports* from the Nature publishing group.

The results demonstrate that the participants with better cognitive performance have different brain activity even when resting quietly inside the MRI scanner. The team developed a novel method to characterize the evolution of the brain Functional Connectome over time, consisting in the Leading Eigenvector Dynamics Analysis (LEiDA), which allows detecting recurrent patterns in brain network activity over large datasets. The Functional Connectomes of poor performers were found to switch more erratically between different network configurations, whereas good performers were found to form and hold specific connectivity patterns for longer times and follow more structured network re-configurations. These results provide new evidence linking the switching dynamics of the Functional Connectome with cognitive performance in later life, reinforcing the functional role of spontaneous brain activity for effective cognitive processing.

In a time where modern medicine pushes life expectancy to the limits of our body, one of the current challenges in neuroscience is to understand the root of cognitive decline and perhaps help dissociate it from the natural ageing process.

"Using this novel method we can efficiently characterize the repertoire of network states that the human brain explores during rest", says lead author Dr Joana Cabral. "Here, we were able to show for the first time that cognitive performance in later life relates to the dynamical landscape of brain network states, which may be shaped throughout life by factors such as education, socioeconomic status, engagement in cognitive demanding activities, or even mood."

Senior author Prof Kringelbach adds: "Overall, this study is helping us understand the dynamics of the healthy ageing brain and show significant differences between individuals who only differ in their cognitive ability. Longer term, we are hoping to characterize the evolution of these changes over the years in the same individuals, aiming at an early identification of those who may be in need of help. On the flip side, this might also help identify some of the cognitive abilities that constitute the wisdom of old age."

More information: Joana Cabral et al, Cognitive performance in healthy older adults relates to spontaneous switching between states of functional connectivity during rest, *Scientific Reports* (2017). DOI: 10.1038/s41598-017-05425-7