The middle-age brain

ABSTRACT:

Background
Middle adulthood – the age between 40 and 60 – is characterised by many social, emotional, and health-related changes which mirror changes in brain and cognition. However, the neuroscience of the middle age brain is quite sparse, often due to the assumption that more informative brain changes are observed while growing up or ageing. However, identifying the roots of age-related changes earlier in adulthood may allow to minimise or prevent the cognitive, psychological and well-being issues that are often serious in late life.

Aims
To generate a novel, informed, and detailed profile of the middle-aged brain by studying the correlational and causal links between brain, cognitive functions, and well-being.

Method
A continuous measure of working memory performance as well as the source of errors typically affecting working memory was obtained in 179 adults across the life span (58 middle agers), in addition to information on well-being and cognitive reserve - a proxy for cognitive proficiency. In the same sample, data on parietal brain stimulation (tACS) in alpha, gamma, beta frequency or sham coupled with either the continuous working memory task or with a measure of time processing were also obtained. Electrophysiological (EEG) data were also collected, and analysed to identify resting state spectral power and the duration of burst events.

Results
Memory performance declined linearly with age, whereas changes in error rate peaked in middle age. At a physiological level, posterior alpha power – typically related to memory performance – as well as the ratio of long bursts within the upper alpha band changed linearly with age. In contrast, sensorimotor beta power and burst rate properties varied primarily non-linearly, with extrema during middle age. Hence, the initial increase in beta power and bursts during youth slowed in middle age reaching its maximum around the age of 60, and slowly decreased in older age. In parallel, memory performance following tACS to the posterior parietal regions changed non-linearly and was stimulation specific: there was a gamma-related working memory improvement in younger adults, a similar but alpha-related improvement in ageing participants, and a significant decline in middle agers following alpha-tACS. Time processing was instead specifically modulated by beta oscillations. Complementing these results, well-being indexes, and especially stress, were higher in middle agers and significantly reduced in those with higher cognitive reserve.

Conclusions
Ageing is characterized by distinct cognitive and well-being underlying patterns as well as different spatial and temporal brain dynamics, some critically arising or changing in middle age.

Keywords
Middle age, Ageing, Brain oscillations, Parietal lobe, Working memory, Time processing, Neurostimulation.

Published Work:

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