Prefrontal plasticity underpinning resilience against cognitive ageing.

Results in Brief

Can we build resilient brains to mitigate cognitive decline?

Do stimulating activities change the structure of the brain and if so, would that help fend off the symptoms of dementia? The AGEING PLASTICITY project has some answers.

HEALTH

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Several studies have shown that right fronto-parietal networks in the brain may be critical for resilience to cognitive decline in ageing. Changes in structure of the brain acquired through learning and experience are referred to as 'brain plasticity processes'. New findings made by the AGEING PLASTICITY project suggest brain plasticity may be induced by enriched environments which could improve how older adults can concentrate and remember in their later years.

Given that the organisation Alzheimer Europe states the numbers of people with dementia in Europe will almost double by 2050, increasing to 14 298 671 in the European Union and 18 846 286 in the wider European region, the search is on for any mechanisms that can mitigate the effects of the condition.

"During my Marie Skłodowska-Curie Actions fellowship I explored whether enriched environments were associated with altered neuroanatomical, or structural,

properties of right hemisphere networks," notes Méadhbh Brosnan, principal investigator on the AGEING PLASTICITY project.

Brosnan, who conducted her research at the Oxford Department of Experimental Psychology, was building on her doctorate studies which brought together experts from Dublin, Copenhagen and Berlin.

Their work provided some of the first evidence to suggest that older adults with greater exposure to enriched environments, such as engagement with leisure, social, educational and professional activities, showed differences in how they used their right hemispheres.

The AGEING PLASTICITY project set out to determine whether such changes in use may be paralleled by structural differences.

Mapping changes in the right hemisphere of the brain

The project recruited 50 older adults aged 64-85, and looked at different aspects of their environments, behaviour and brain structure.

Researchers interviewed them about lifestyle factors including social, leisure, occupational and educational engagements using a validated, semi-structured interview, called the Cognitive Reserve Index questionnaire. The subjects' ability to pay attention was assessed using a computerised cognitive assessment, the Attention Network Test.

The team then looked at a specific part of the brains of the participants, called the superior longitudinal fasciculus (SLF) using magnetic resonance imaging. The SLF is a white matter pathway in the brain.

"White matter pathways can be described as analogous to train tracks. The physical state of train tracks across Europe, for example, will influence the efficiency of a transport network. Similarly, within the brain, the quality of these white matter pathways determines how well information is communicated and distributed throughout the brain," says Brosnan.

The project's findings were presented in a paper published in the journal 'Brain Communications'.

Brosnan explains: "The frontal areas of the brain are sometimes referred to as the 'conductor' of the brain and are critical for maintaining attention and focus. The results from our work suggest that environmental stimulation forces traffic through

this pathway – through the right SLF – and changes its structure to benefit attention in older adults."

Can activities be targeted to develop brain pathways?

The next goal is to explore the extent to which these effects are specific to the SLF, or to define whether other areas are structurally altered.

"If we can identify a pathway in the brain that is uniquely sensitive to the positive impact of enriched environments, we can pave the way towards developing a measurable marker of brain health. With this we could monitor the impact of new interventions, such as lifestyle, pharmacological, and others, aimed at preventing and redressing cognitive decline," Brosnan adds.

Challenges of working with older age groups in the COVID crisis

The fellowship started in Oxford in March 2020, a turbulent moment in time! As the project involved inviting many older adults, 65 years and over, into the lab, the impact of the coronavirus was challenging.

"Unfortunately, even during the intermittent opening of the University in between lockdowns, this older cohort were 'shielding' in the United Kingdom while we awaited vaccines. So, we had to get creative! I felt incredibly lucky to have a wonderful supportive network of colleagues and mentors.

"Thanks, in particular to Kia Nobre, head of the Brain & Cognition lab and director of the Oxford Centre for Human Brain Activity, who provided a lot of insights and ideas to help me redesign the project and gather meaningful data throughout the crisis."

Keywords

AGEING PLASTICITY | prefrontal plasticity | brain pathways | environmental stimulation | cognitive decline | dementia | brain plasticity

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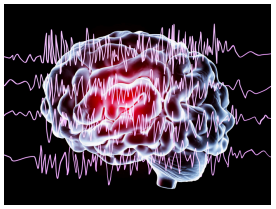

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