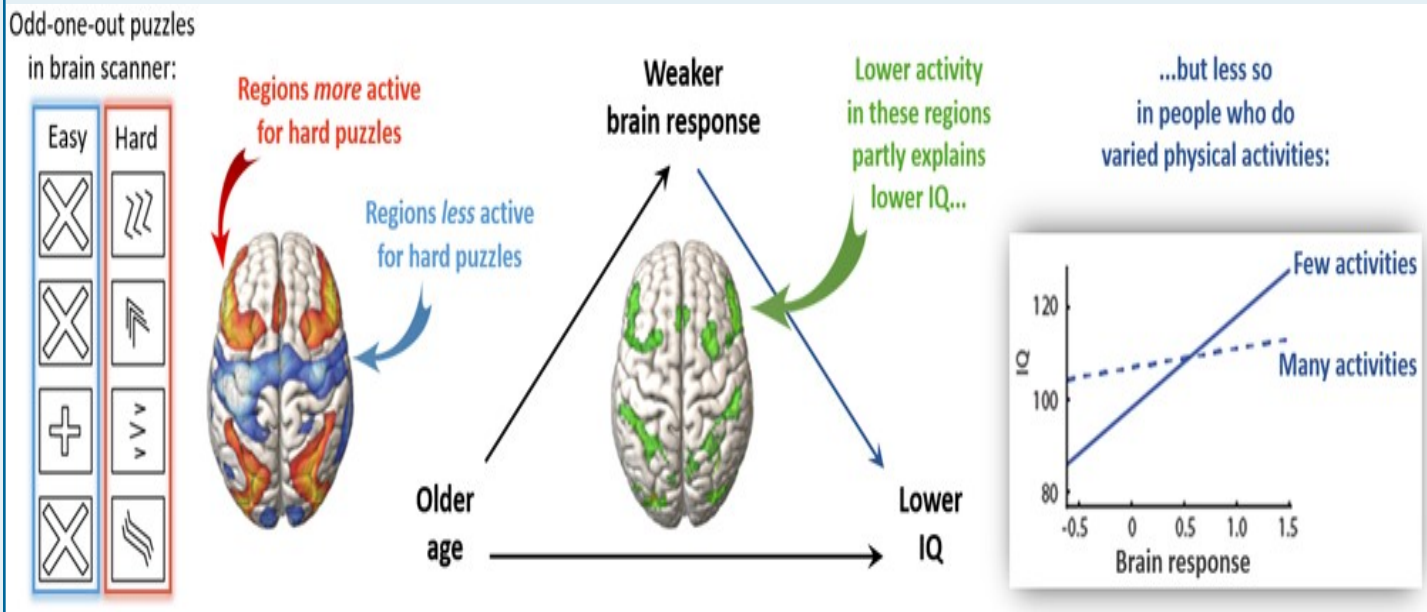
Cam-CAN Newsletter 2024

Reduced speed of reasoning with increased age is linked to weaker brain activity... ...but a varied lifestyle might help

Daniel Mitchell

The ability to reason about novel problems—or what is sometimes called "fluid intelligence" or IQ – is essential for effective behaviour, but declines steeply with age. Using an "odd-one-out" puzzle task, we found that this age-related decline is partly explained by reduced activity in "frontoparietal" brain regions that are more active when the problems are harder. We were also interested in whether these findings might help to identify potential strategies to maintain fluid intelligence in old age. As one example, we investigated whether the link between reduced brain activity and poorer performance on the task depended on individual differences in physical activity. This association was weaker in people who reported more varied, regular, physical activities. Interestingly, the frequency or duration of any one activity seemed less important than their variety. Mental activities that were largely non-physical seemed to be less important. These results suggest that varied physical exercise could be a widely applicable lifestyle strategy that might buffer age-related cognitive decline, and so help to promote successful aging.



Reference: Mitchell D.J., Mousley A.L.S., Shafto M.A. & Duncan J. (2023). Neural contributions to reduced fluid intelligence across the adult lifespan Journal of Neuroscience 43 (2), 293-307 https://www.jneurosci.org/content/43/2/293

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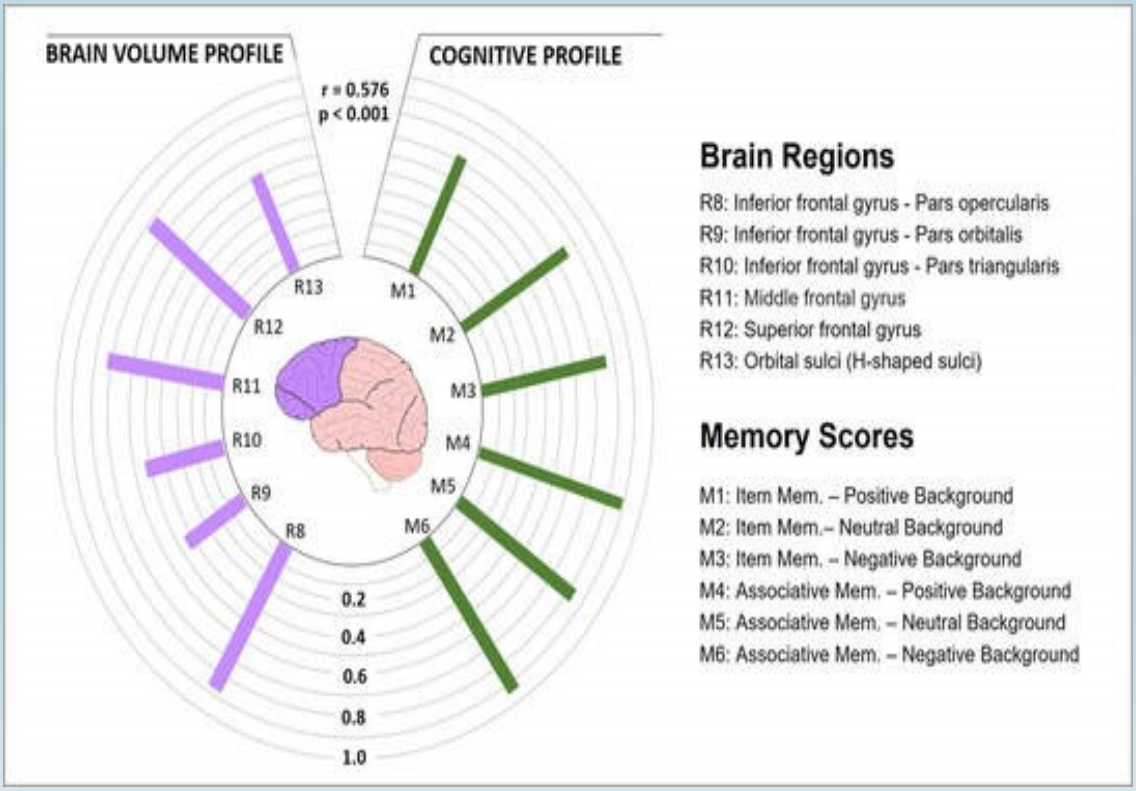
Frontal Lobes Critical for Associative Memory

Karen Campbell

Memory for events (like what you did yesterday or that time you fell out of the canoe) is referred to as 'episodic memory'. Episodic memory tends to decline with age, but it remains unclear what is causing this decline. Some work suggests that age-related differences in episodic memory may be due to a reduced ability to form the new associations that link the different parts of a memory together (e.g., remembering that the canoe incident happened at your friend's cottage). In the brain, these associations rely on regions of the medial temporal lobe (such as the hippocampus), but also the frontal lobes which control where attention is directed. Although age-related declines in associative memory have been linked to grey matter volume loss in these brain regions, results from previous studies have been mixed, possibly because they focused on a limited set of regions. In this study, we evaluated the relationship between grey matter volume within substructures of the medial temporal and frontal lobes, and differences in associative memory performance across the adult lifespan.



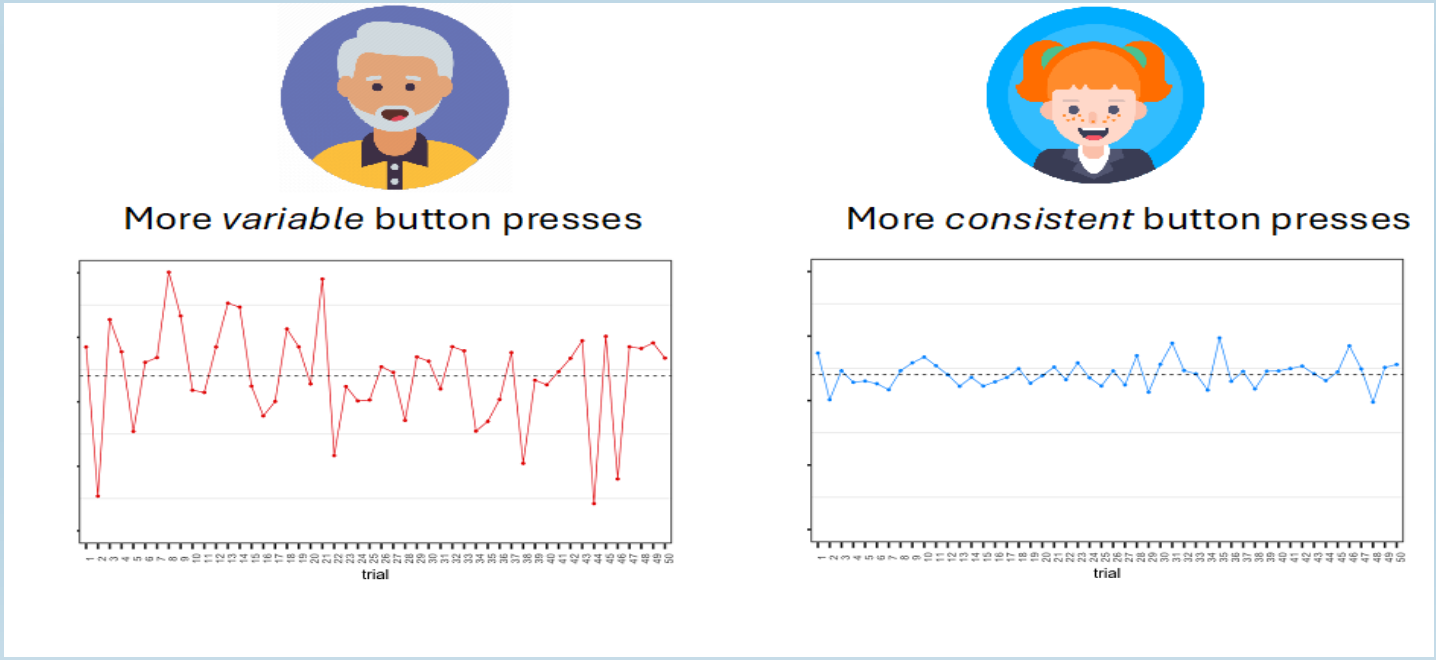
We used data from over 300 individuals uniformly spread across the adult lifespan (18-87 years). Our results indicated that age was associated with reduced grey matter volume in the medial temporal and frontal lobes, and similar age differences were observed in both men and women. Memory performance also declined with age, but these declines were more pronounced in men. We also found that the structures of the frontal lobes alone predicted memory performance better than either the medial temporal lobe alone, or both lobes combined. These findings suggest that age-related differences in associative memory are due to grey matter loss in the frontal lobes and, as a result, a reduced ability to control attention. So if you want to remember something, it's best to minimize distraction so you can really focus your attention.

Reference: Associative memory is more strongly predicted by age-related differences in the prefrontal cortex than medial temporal lobes: Tiago Guardia, Negar Mazloum-Farzaghi, Rosanna K. Olsen, Kamen A. Tsvetanov, Karen L. Campbell

Why does our performance change from moment to moment? Your brain connections may be (part of) the answer

Rogier Kievit

As we age, we tend to respond a bit slower than when we are young. For instance, if we ask people to press a button as fast as they can when a light flashes, young people on average do so more quickly than older people. We can also study something else about these responses, namely how consistent they are. We find that in addition to being a bit quicker, young people also respond more consistently – if they repeat the same button press task 100 times, each press will be quite similar, whereas older people (as well as young children) will vary more, with a greater range of faster and slower presses. We call this 'cognitive variability'. You can see an example in the figure – these two people (one younger, one older) respond just as quickly on average – but the older person has more 'ups and downs' of both slow and fast button presses.



Understanding why some people have more of these ups and downs is important because this consistency tells us something valuable about day-to-day performance—not just whether you can, for instance, drive safely today, but whether you can also drive safely tomorrow, or in a few hours. In this study we wanted to test one possible explanation of such 'inconsistency' in performance: the connections between brain areas. We found that that if the wiring between different brain regions (known as axons) is stronger, people were able to respond more consistently. This is like when a good internet connection allows you to hear someone clearly all the time, or a well paved road allows fast driving without too many bumps or potholes in the way. This research has helped us better understand cognitive variability, or why older people may sometimes have more ups and downs in their abilities than younger people.

Reference: McCormick, E. M., & Kievit, R. A. (2023). Poorer white matter microstructure predicts slower and more variable reaction time performance: evidence for a neural noise hypothesis in a large lifespan cohort. Journal of Neuroscience, 43(19), 3557-3566.

In 2023-2024, we recruited over 150 CamCAN volunteers for our latest Rescan Phase. We tested and scanned volunteers aged 33-96 which provided us with extremely valuable longitudinal data. So a big thank you to all of you who took part, we greatly appreciate your continued participation!

Call for volunteers who have not been scanned in the past few years

Tina Emery

If you have previously had an MRI scan with us at the CBU—but not for our most recent "Rescan Phase" in 2023-2024—and would like to volunteer again, please get in contact, because we are still recruiting.

Participation would involve completing some cognitive tasks at home, either online or on paper. Once this has been completed, I will telephone you to assess your eligibility for brain scanning and, if appropriate, you will be invited to 2 separate scanning sessions: one MRI and one MEG. Each appointment will last approximately 2 hours and upon completion, you will be paid £30 for each visit plus £3 travel expenses each time i.e. up to £66. If you complete the MRI session, you will also be given a picture of your brain to take home with you.

If you are interested in completing only the cognitive tasks, but do not wish to be scanned, this is also a possibility too, but unfortunately we would not be able to pay you.

If you have any questions or would like further information, please get in contact using any of the methods below, and I will be happy to answer any questions.

Please do keep in touch

If your contact details have changed, or you do not want to participate in further studies, please let us know via:

E-mail: camcan-admin@mrc-cbu.cam.ac.uk

Tel: 01223 769442

Post: Cam-CAN, Medical Research Council Cognition and Brain Sciences Unit, University of Cambridge, 15 Chaucer Road, Cambridge, CB2 7EF