Neural, demographic and lifestyle correlates of aggregate cognitive performance and successful cognitive ageing

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Introduction

Age-related changes in performance in most cognitive domains are well-documented, but our understanding of the various causes of the different ageing trajectories is still limited (Rowe and Kahn, 1997).

Identifying the neural, demographic and lifestyle correlates of successful cognitive ageing is an important step toward devising better intervention strategies for maintaining cognitive health in older age (Grady, 2012). The present study aimed to identify factors that enhance cognitive performance in adulthood and use that index to uncover neural, demographic and lifestyle correlates of good overall cognitive performance and successful cognitive ageing.

Method

Participants

A population-based sample (N=476, 25-85 years, M=54.5, SD=16.9) was recruited as part of Cambridge Centre for Ageing & Neuroscience (Cam-CAN) project (Shafto et al., 2014).

Cognitive measures

12 scores from 11 cognitive tasks from Cam-CAN were used, tapping into a diverse set of cognitive abilities including reasoning, attention, language, memory and motor function.

- Emotion Recognition (Ekman faces)
- Face Recognition (Benton faces)
- Fluid Intelligence (Cattell culture fair)
- Motor Reaction Time (speed & coefficient of variation)
- Multitasking (Hotel task)
- Picture Naming
- Sentence Recognition (grammatical correctness)
- Crystalised intelligence (Spot the Word task)
- Story Recall (delayed verbal memory)
- Verbal Fluency (phonemic and semantic tasks)
- Visual Short-Term Memory

Cognitive Health Index (CHI) measure

Aggregate cognitive health (CHI) was measured as the 1st principal component (PC) across the 12 cognitive scores, after controlling for age. Thus CHI represents a general cognitive ability of the individuals compared to their age-matched peers.

Statistical tests

Correlations were controlled for age and gender. Neural measures were additionally controlled for the squared term of age, due to the known accelerated decline with age. For each set of correlation tests, p-values were FDR corrected to reduce multiple comparison effects.

Results

Neural correlates

CHI related strongly to all examined measures of global brain health: total grey matter (TGM) and total white matter (TWM) integrity and mean fractional anisotropy (mFA). Total intracranial volume (TIV) also correlated strongly with CHI and explained some of the relationship with the above neural measures.

While voxel-based morphometry (VBM) analysis of grey matter concentration (GMC) found large parts of the prefrontal, temporal and parietal cortices to relate positively to CHI, controlling for TIV removed these regional effects. Integrity (FA) of several major white-matter tracts, however, remained highly correlated to CHI, even after controlling for TIV.

Demographic & lifestyle correlates

Both education and social class related strongly to CHI in the middle- and older-age groups, while they did not relate significantly in younger adults.

Similarly, both the amount of daily reading and television watching time correlated strongly with CHI for middle and older adults, with CHI and TV watching having a strong negative relation. These lifestyle variables seemed to have a lesser effect on younger adults.

All three measures of social engagement (contact with relatives and friends, and overall social activity) correlated positively with CHI in the middle-aged group. For the younger adults, however, a negative correlation was found between two of the social measures and CHI.

The level of anxiety (HADS) was negatively related to CHI across the whole age range, but it became a significantly strong predictor for older adults only.

Conclusions

- A diverse set of cognitive abilities shared a single underlying factor (CHI).
- Older people increasingly relied on this common factor.
- While overall cognitive skills strongly related to both GM and WM integrity globally, only specific WM tracts, but not GM regions, showed correlation after accounting for head size (TIV).
- We found that maintenance of overall cognitive abilities relate increasingly to several demographic and lifestyle factors, such as education, amount of reading and TV watching, social engagement and general anxiety level.
- Further work is needed to identify functional correlates of general cognitive abilities.

References