Effects of cognitive training in aging in MRI/fMRI studies

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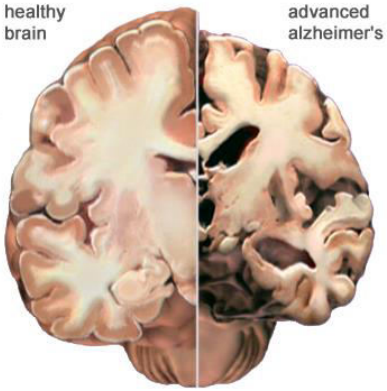
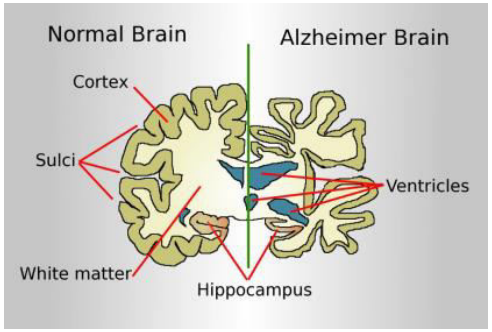
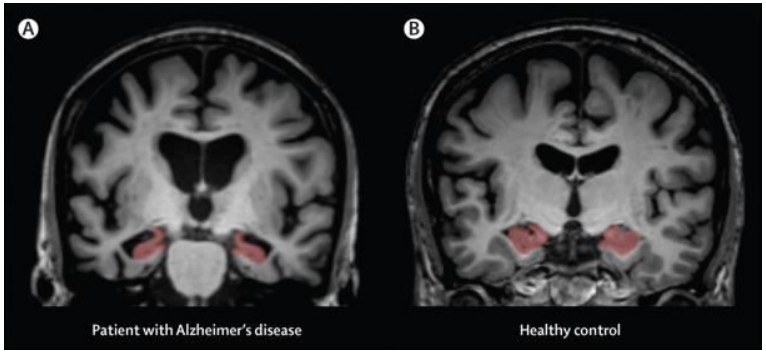
Hippocampus
brain area critical for learning and memory
especially vulnerable to damage
in early stages of dementia and Alzheimer's disease



Credit: Alzheimer's Association



Credit: Wikimedia Commons



Teipel et al. Multimodal imaging in Alzheimer's disease:
validity and usefulness for early detection. Lancet, 2015, 14, 1037–1053.

Engvig A, et al. Effects of cognitive training on gray matter volumes in memory clinic patients with subjective memory impairment. J Alzheimers Dis, 2014, 41, 779–791.

Subjects

Mean age 61 years, subjective memory impairment (SMI, n=19),
healthy controls (HC, n=42), groups: SMI-training, HC-training, HC-no training.

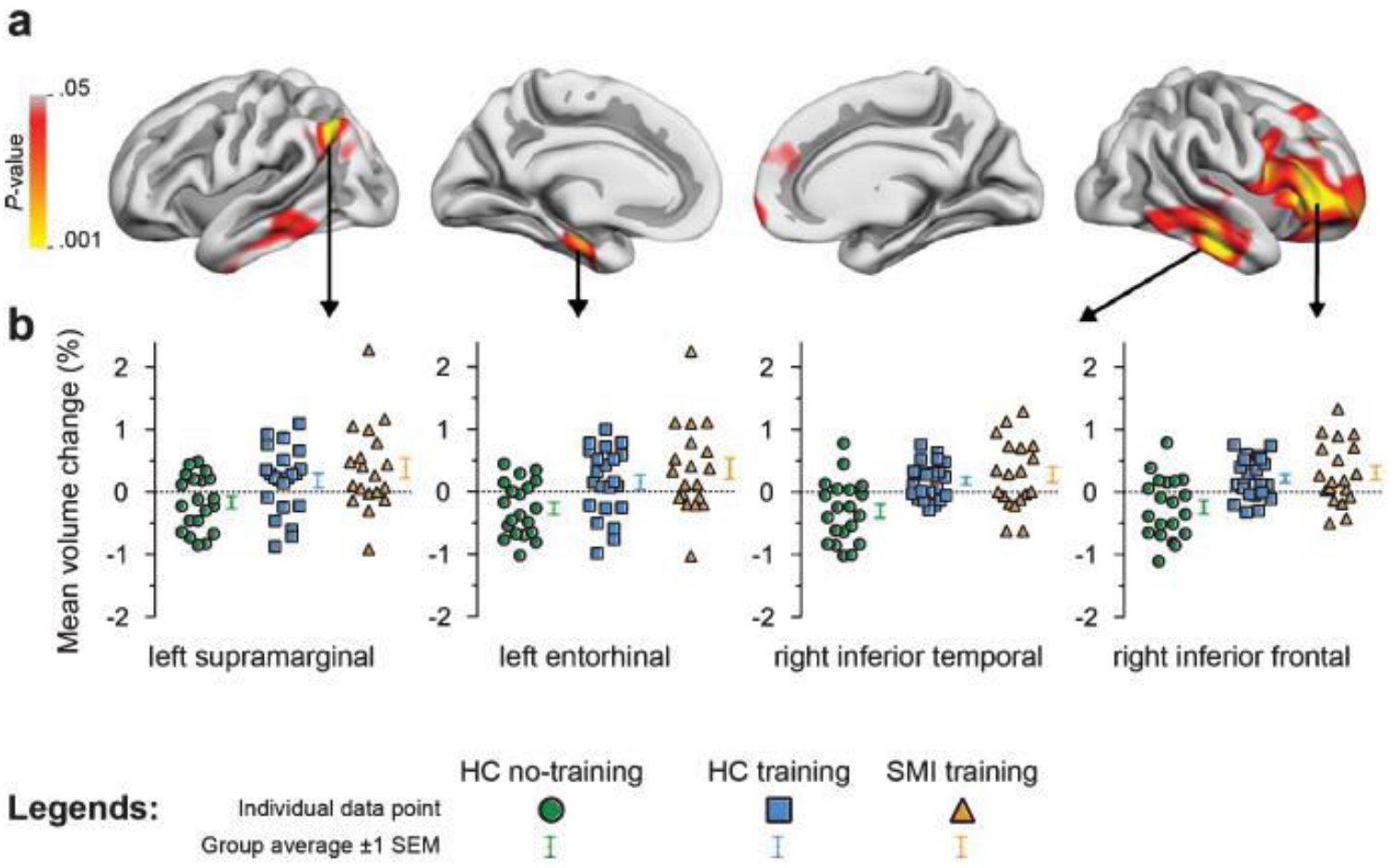
Training

8 weeks, 1/week, 90-min supervised class sessions (verbal recall memory),
5 weekly homework assignments (25-30 min).

Measures

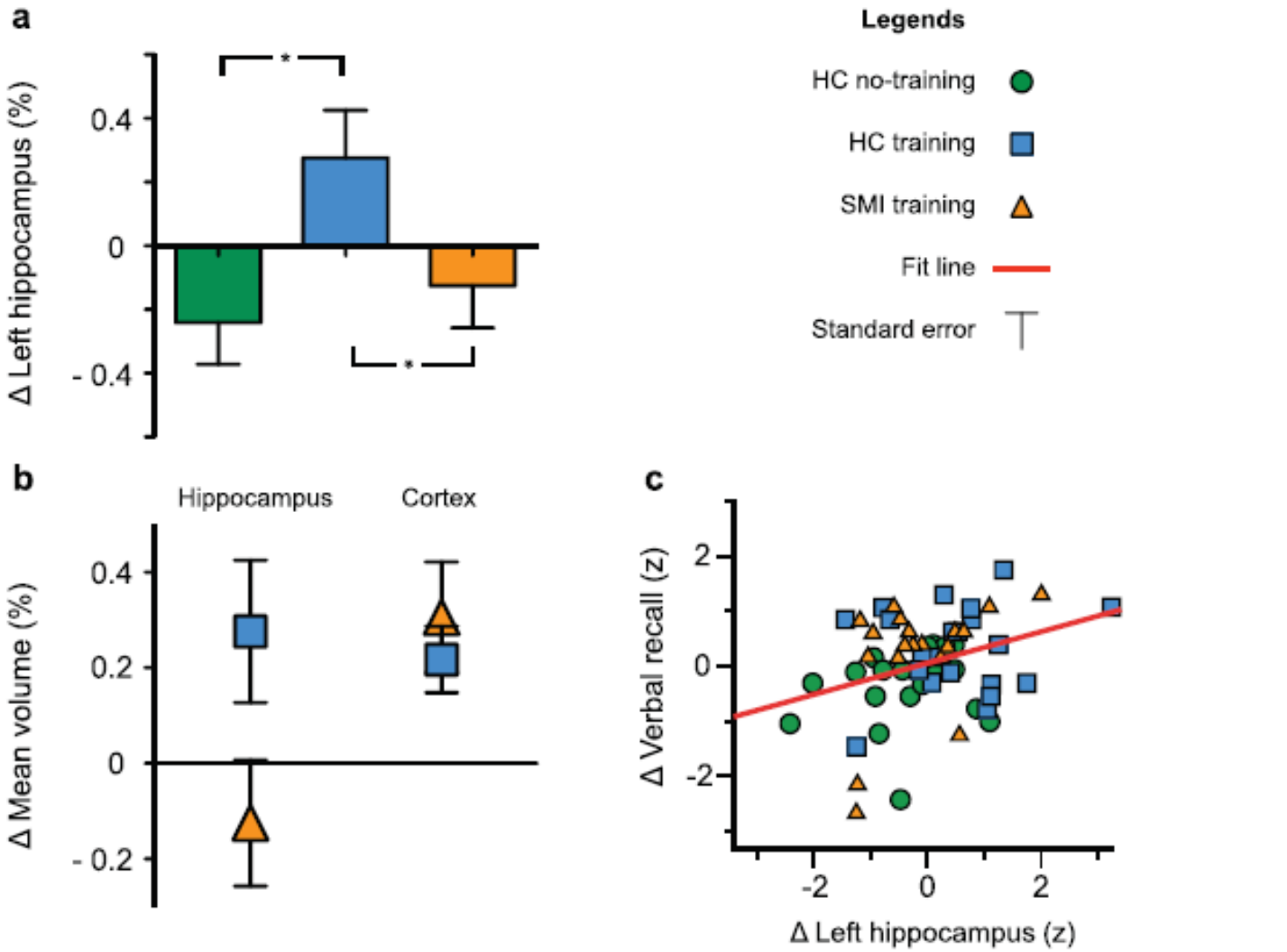
One week before and after training (approx. 65 days apart).

Longitudinal increases in cortical volume in SMI- and HC-training groups following training



Engvig et al., 2014

Memory training was associated with increased hippocampal volume in HC-training group (but not in SMI-training)



Engvig et al., 2014

Maffei L. et al. Randomized trial on the effects of a combined physical/cognitive training in aged MCI subjects: the Train the Brain study. Sci Rep, 2017, 7, 39471.

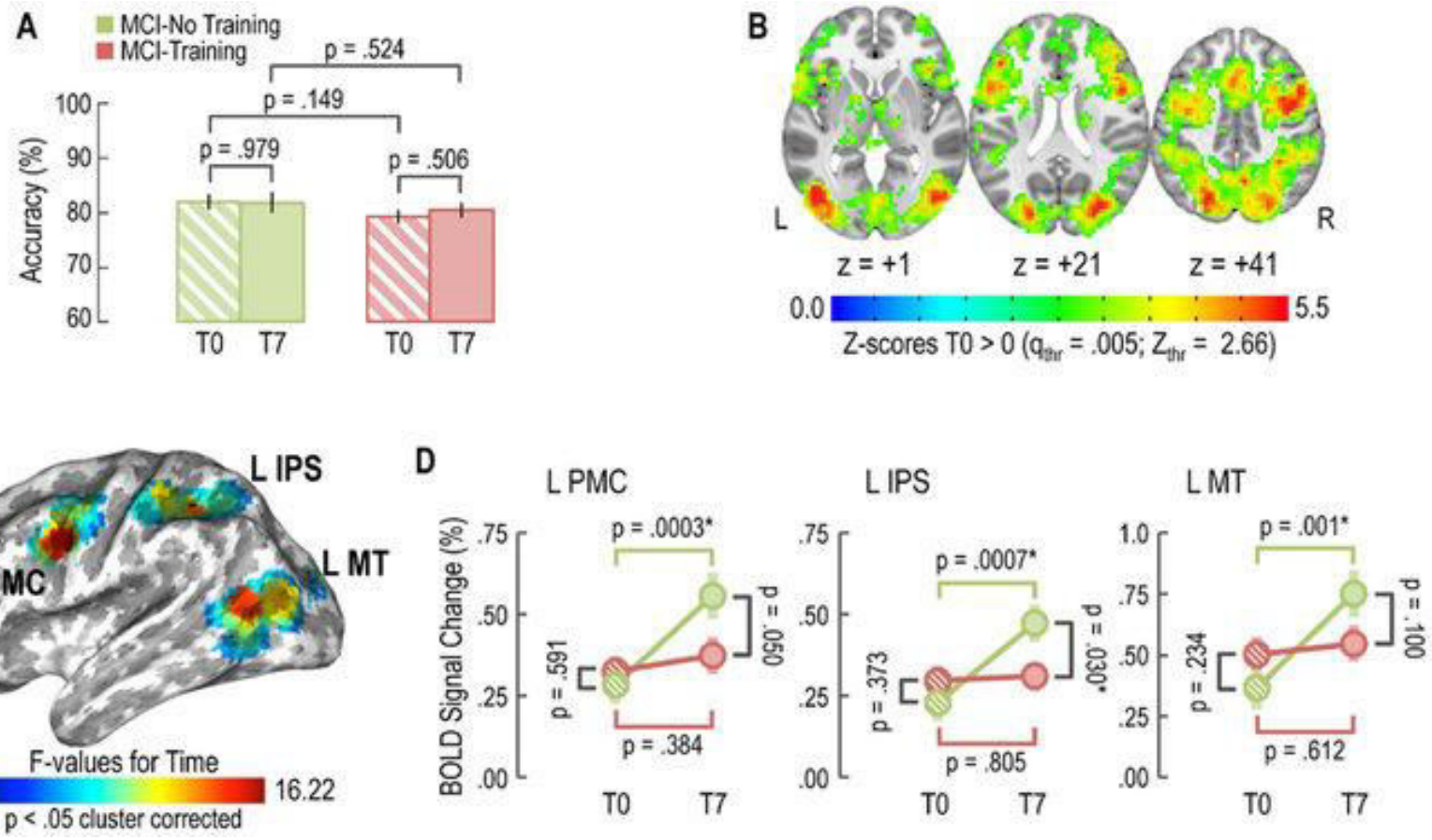
Subjects
Aged 65-89 years, mild cognitive impairment (MCI),
groups: training (n=55, n=38 fMRI), no training (n=58, n=25 fMRI).

Training
Multi-domain cognitive training + physical exercises + music therapy,
classes of 7-10 subjects, 7 months, 3/week,
cognitive training 2 x 60-min sessions, physical training 60 min in a gym,
music therapy 1/week, film 1/month;
cognitive sessions - stimulating acoustic and visual attention,
various forms of memory, imagination, orientation, etc.

M**easures**
Before training (T0) and at the end of 7 months after training or usual life (T7).

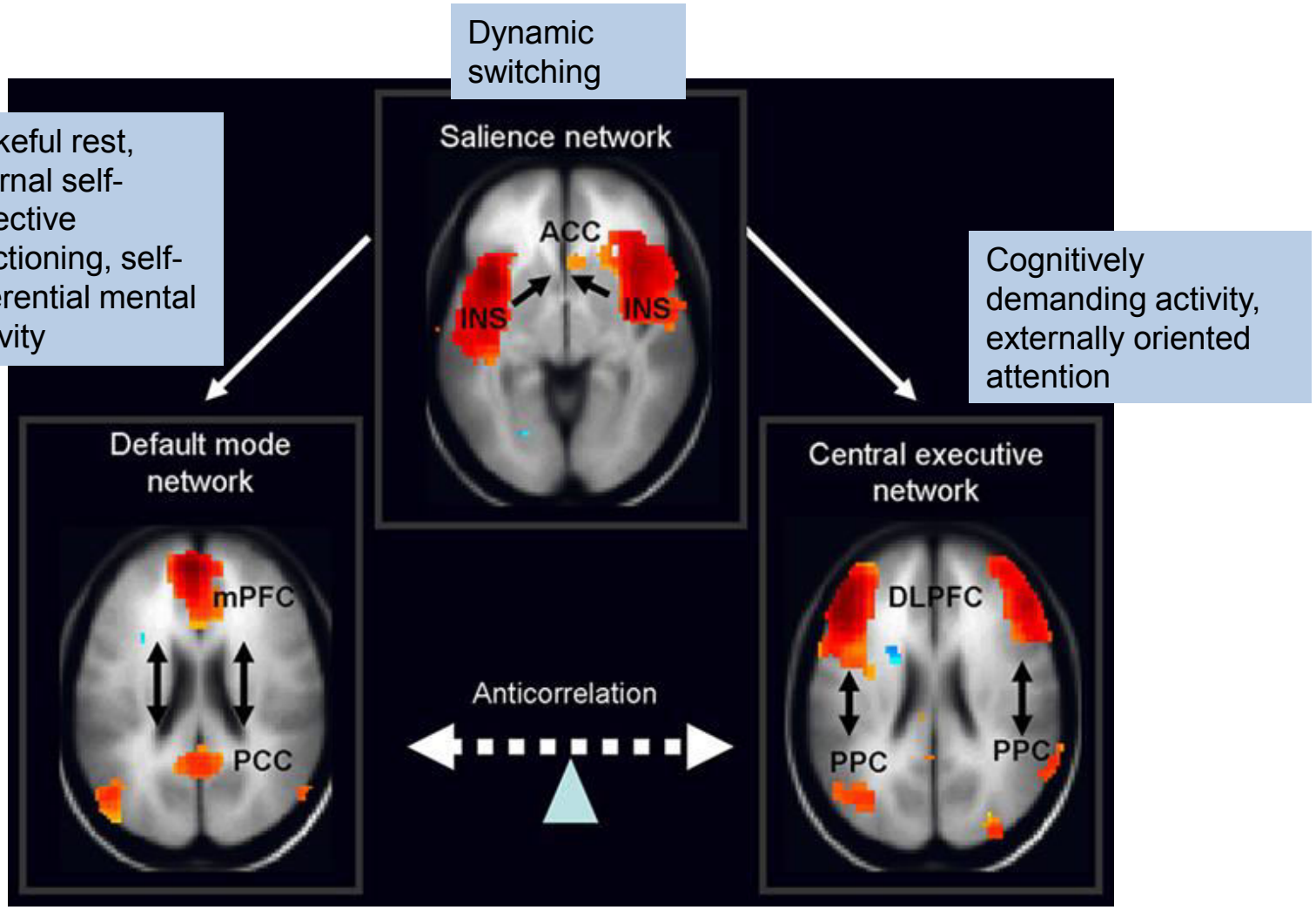
Training maintained neural efficiency as measured by task-related fMRI

L MT, left middle temporal motion-related region; L IPS, left intraparietal sulcus; L PMC, left premotor cortex



Maffei, L. et al

Major functional networks in the human brain



Nekovarova T, et al. Bridging disparate symptoms of schizophrenia: a triple network dysfunction theory. Front Behav Neurosci, 2014, 8, art.171.

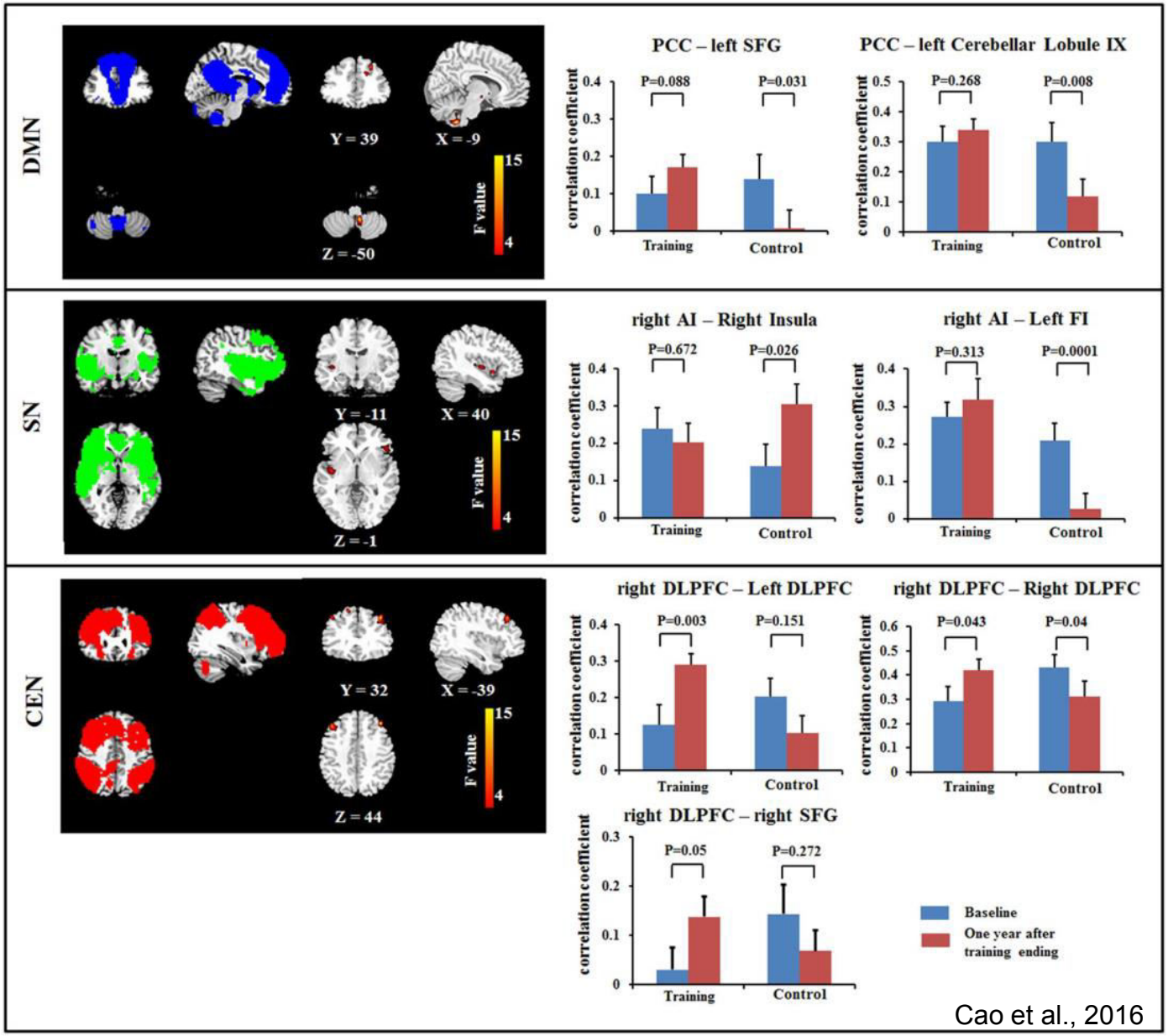
Cao W, et al. Effects of cognitive training on resting-state functional connectivity of default mode, salience, and central executive networks. Front Aging Neurosci, 2016, 8, 70.

Subjects
Healthy adults, age 65-75 years, training group (n=23), no training group (n=17).

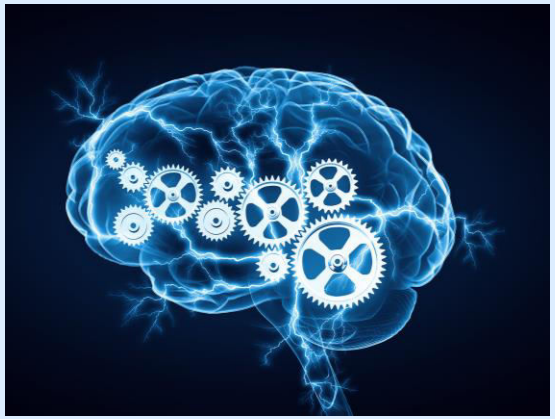
Training
Supervised multi-domain cognitive training, 3 months, 2/week, 60-min session; training targeted: memory, reasoning, problem-solving, handcraft-making, healthy living, etc.

Measures
Baseline before training and at 1 year after training ended (fMRI).

Resting-state functional connections within the three networks were increased or maintained after training (and decreased in the control group)



Cao et al., 2016



Credit: NeuroPlusBrainSupplement.org

Conclusion

Multi-cognitive training in older adults can mitigate age-related structural and functional alternations in the brain, thereby helping to reduce or delay age-related cognitive decline, which in turn supports accomplishments of everyday tasks and independent living.