



**The Science of Mental Vitality:
Can We Slow the Aging Process?**

Denise C Park

University Distinguished Chair of Brain Science

Regents Research Scholar

Center for Vital Longevity

University of Texas at Dallas



All research funded by the
National Institute on Aging

The Scientific Challenge of the 21st Century

- Developing interventions to slow the rate that the mind ages.
- Right now someone develops Alzheimer's disease every 72 seconds in the U.S. By 2050, there will be a million cases a year and a case diagnosed every 33 seconds.
- By the age of 85, the risk of A.D., is nearly 50%.
- Yearly treatment costs are three times more per year than other illnesses of people the same age.

Preserving Cognitive Function

“For every dollar spent now on research, taxpayer would receive a tremendous return in future saving on Medicare and Medicaid: 12 to 1 by 2015 and 30 to 1 by 2025.”

Sheldon Goldberg, President Alzheimer’s Association

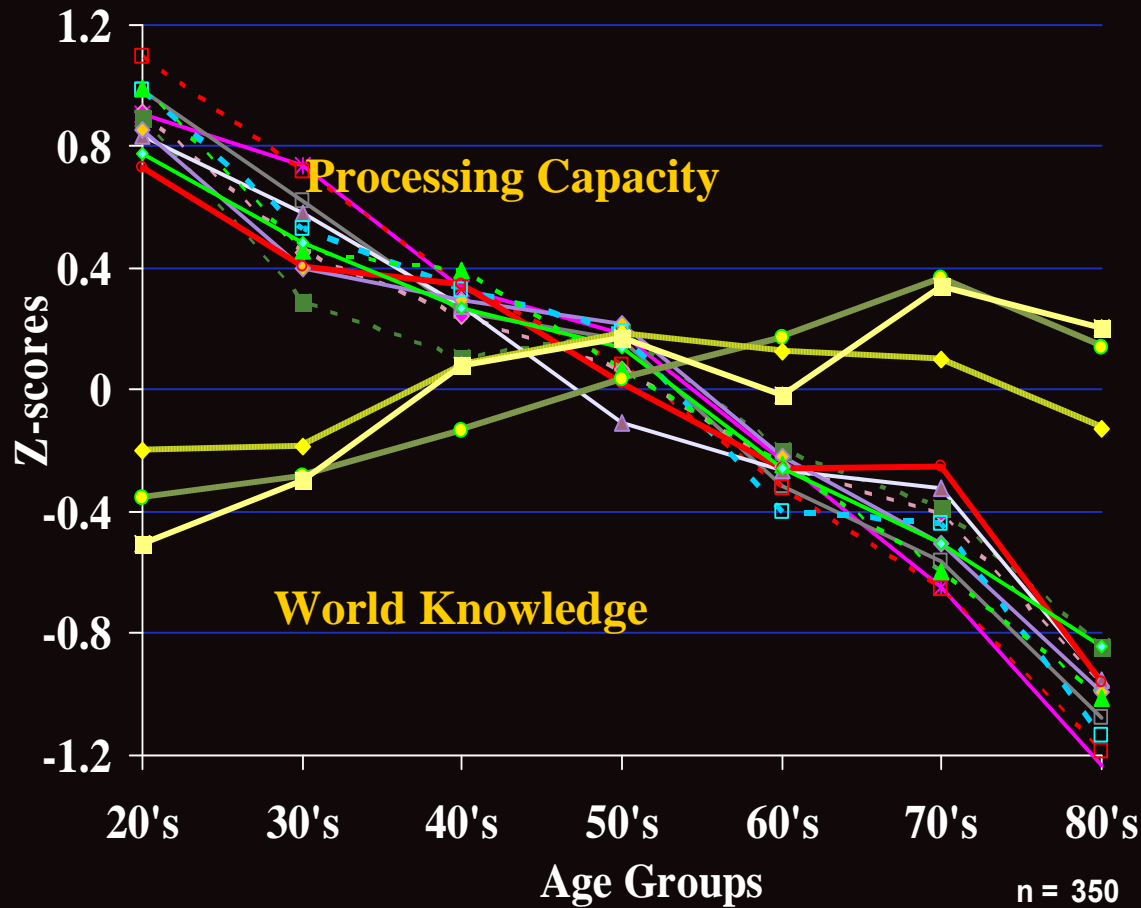
“A research advance that delayed the onset of Alzheimer's by just five years would translate by 2050 into a 5.3 million (40%) reduction in disease prevalence and roughly \$515 billion (44%) in annual savings for Medicare & Medicaid.”

The Lewin Group

Goals for Tonight's Talk

- What happens to the mind with age?
- How does the mind adapt to the aging process?
- Is it possible to protect your mind from some of the negative consequences of aging? How ?

The Aging Mind

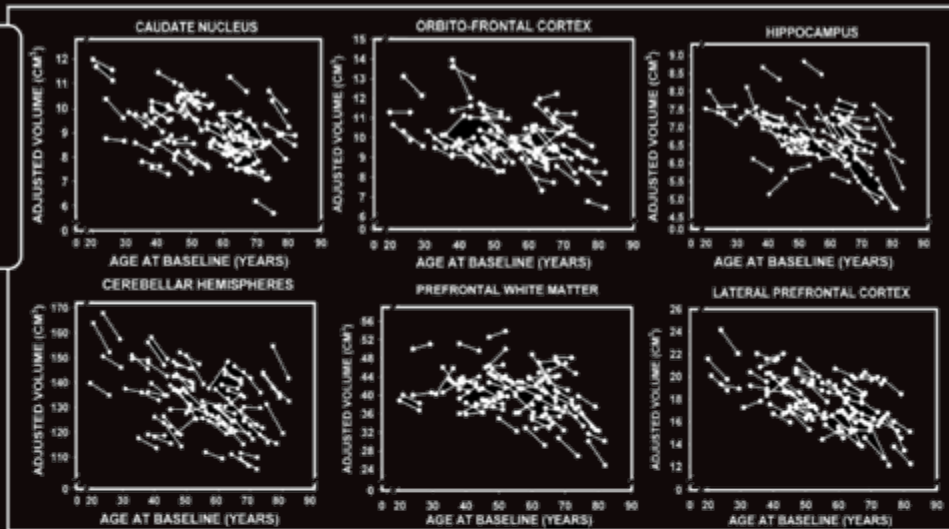


- ✱ Digit Symbol
- Letter Comparison
- Pattern Comparison
- ◇- Letter Rotation
- Line Span
- △- Computation Span
- ◇- Reading Span
- Benton
- ▲- Rey
- Cued Recall
- ◆- Free Recall
- Shipley Vocabulary
- ◇- Antonym Vocabulary
- Synonym Vocabulary

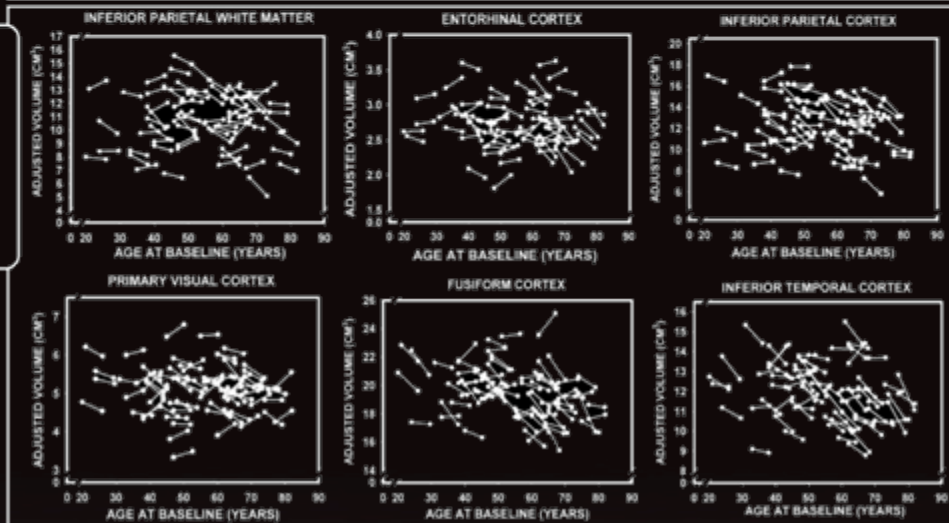
Park, Lautenschlager, Hedden, Davidson, Smith & Smith,
2002. Psychology and Aging

Brain Shrinkage Occurs with Age

Brain regions
that reduce
in volume
with age



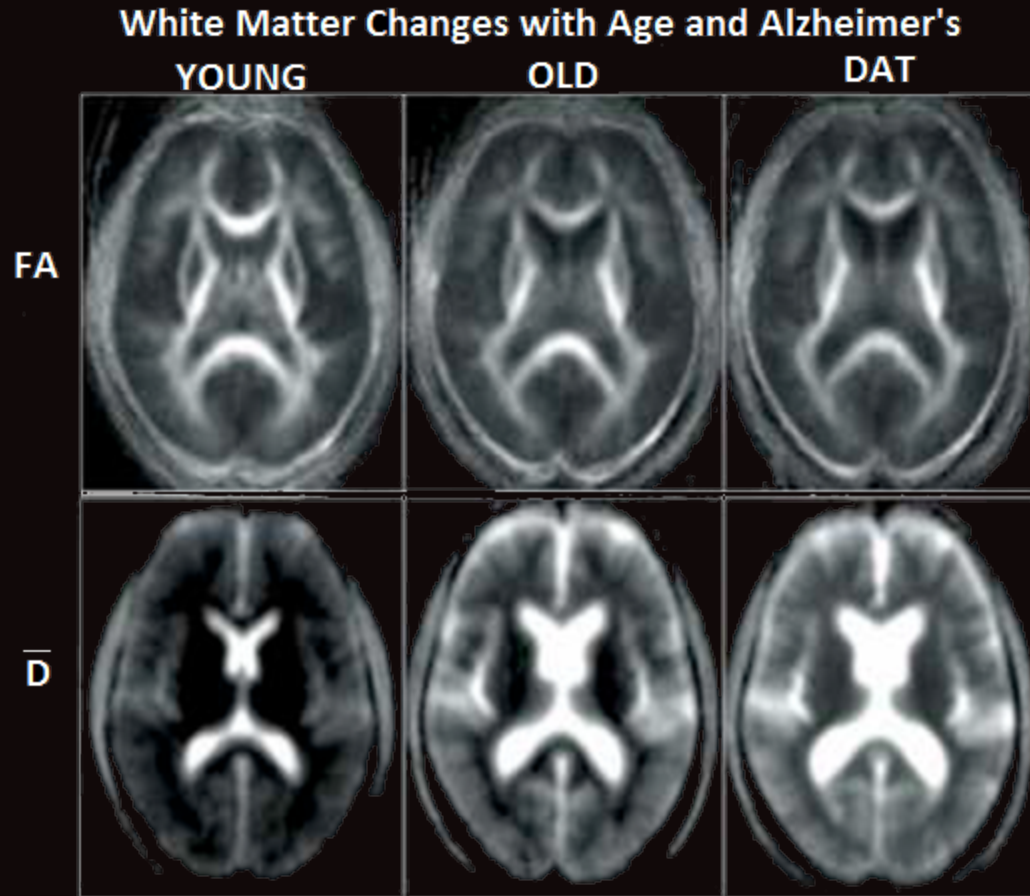
Brain regions
that are
preserved
with age



Raz, Lindenberger,
Rodrigue, Kennedy,
Head, et al, 2005

Cerebral Cortex

The White Matter Becomes More Porous

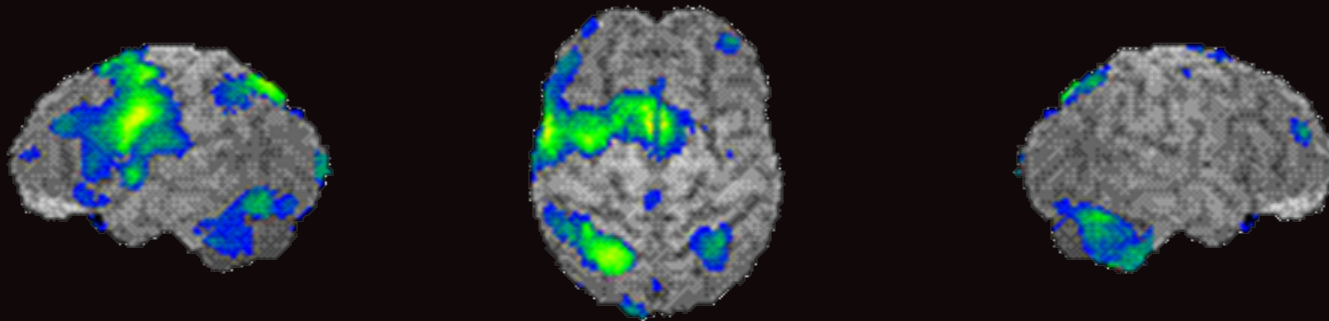


Head et al., 2004

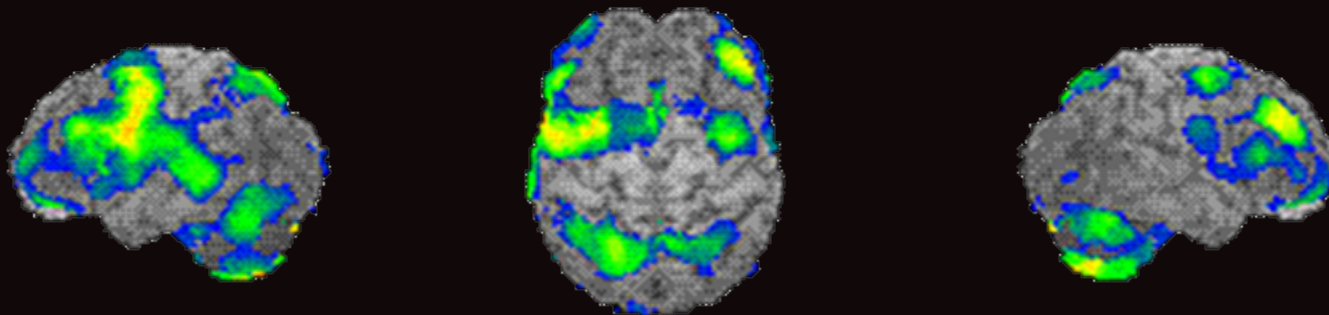
The Brain's Response to Neural Aging

- The use of functional magnetic resonance imaging
- Allows us to see how the brain's function changes in response to the neural degradation that occurs.

Young - Verbal WM



Seniors - Verbal WM



Left Lateral

Superior

Right Lateral

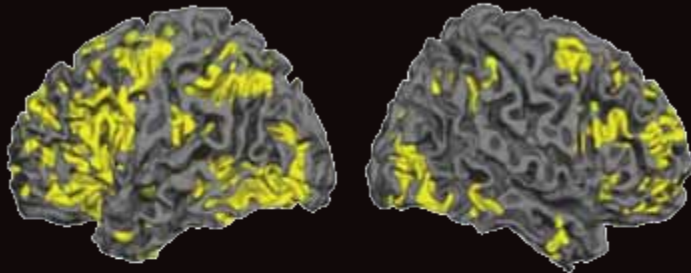
Reuter-Lorenz, et al., *Journal of Cognitive Neuroscience*, 2001

Imaging Boone Pickens' Brain

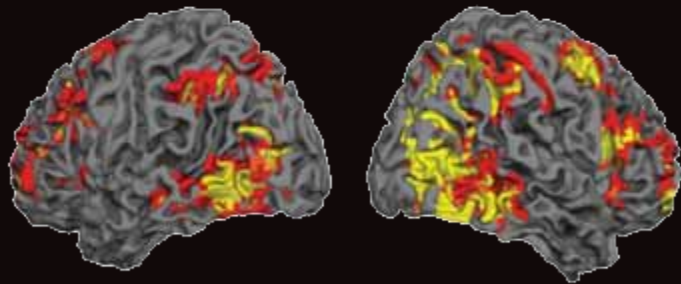
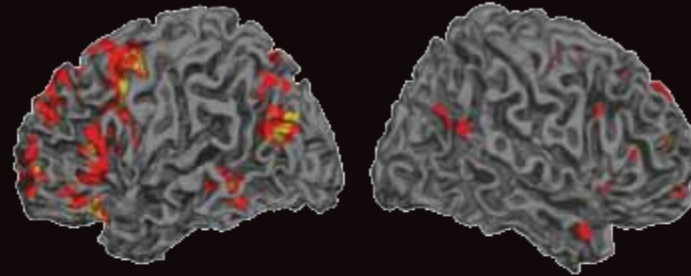


A Map of Boone's Brain

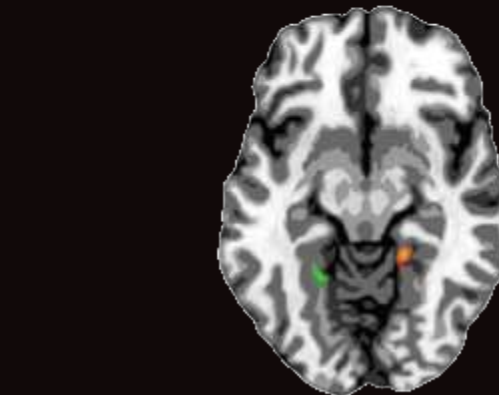
Easy Verbal Judgment Task



Hard Verbal Judgment Task

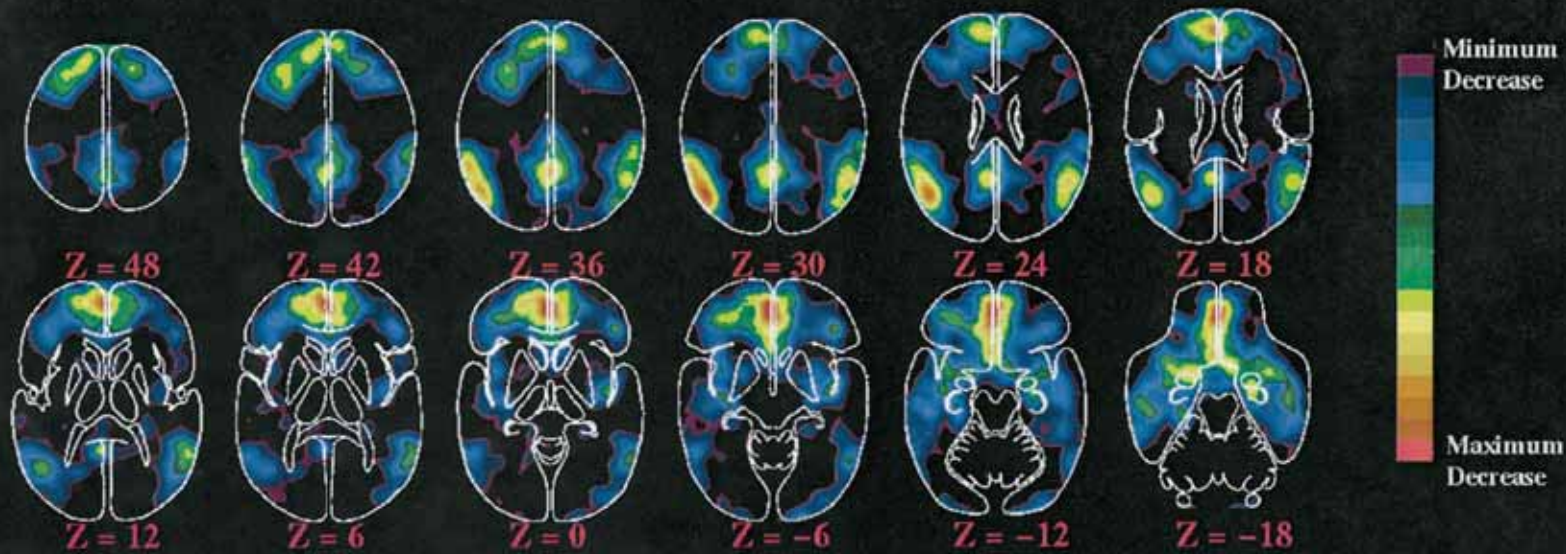


Spatial Judgment Task



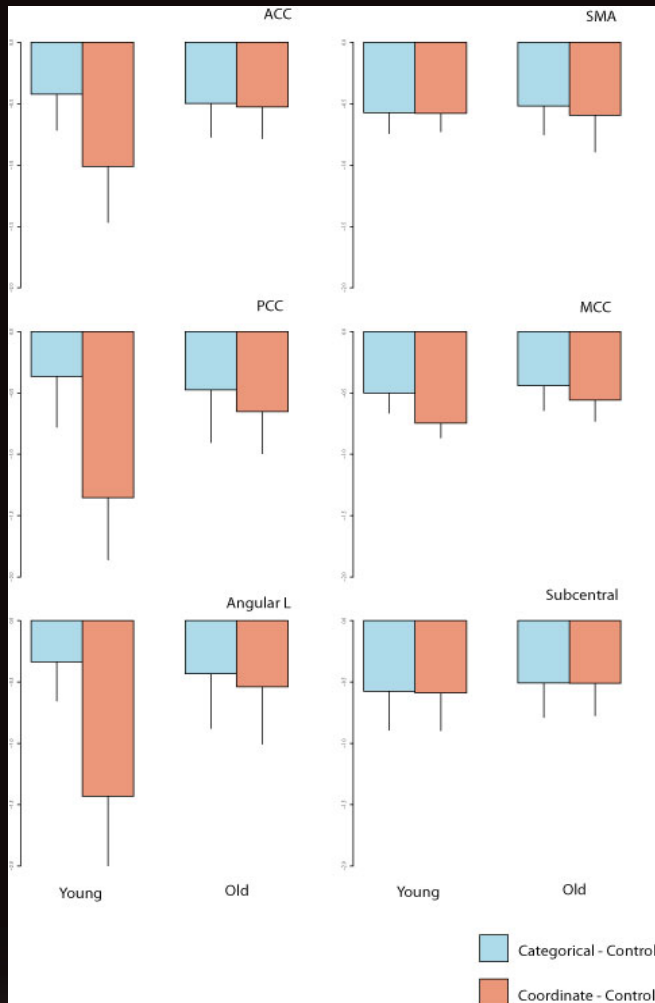
Specialized Face and Place Areas

The Brain at Rest: The Default Network



Raichle et al., 2001

Suppression of the Resting State When the Brain Is Challenged



What We Know So Far

BAD NEWS

Speed of processing, working memory, long term memory decline with age

The brain shrinks!

White matter becomes porous.

Difficulty switching out of resting/daydreaming state.

GOOD NEWS

Knowledge is preserved

Frontal activation compensates for neural decline in other areas.

The brain is capable of remodeling itself.

Scaffolding Theory of Cognitive Aging

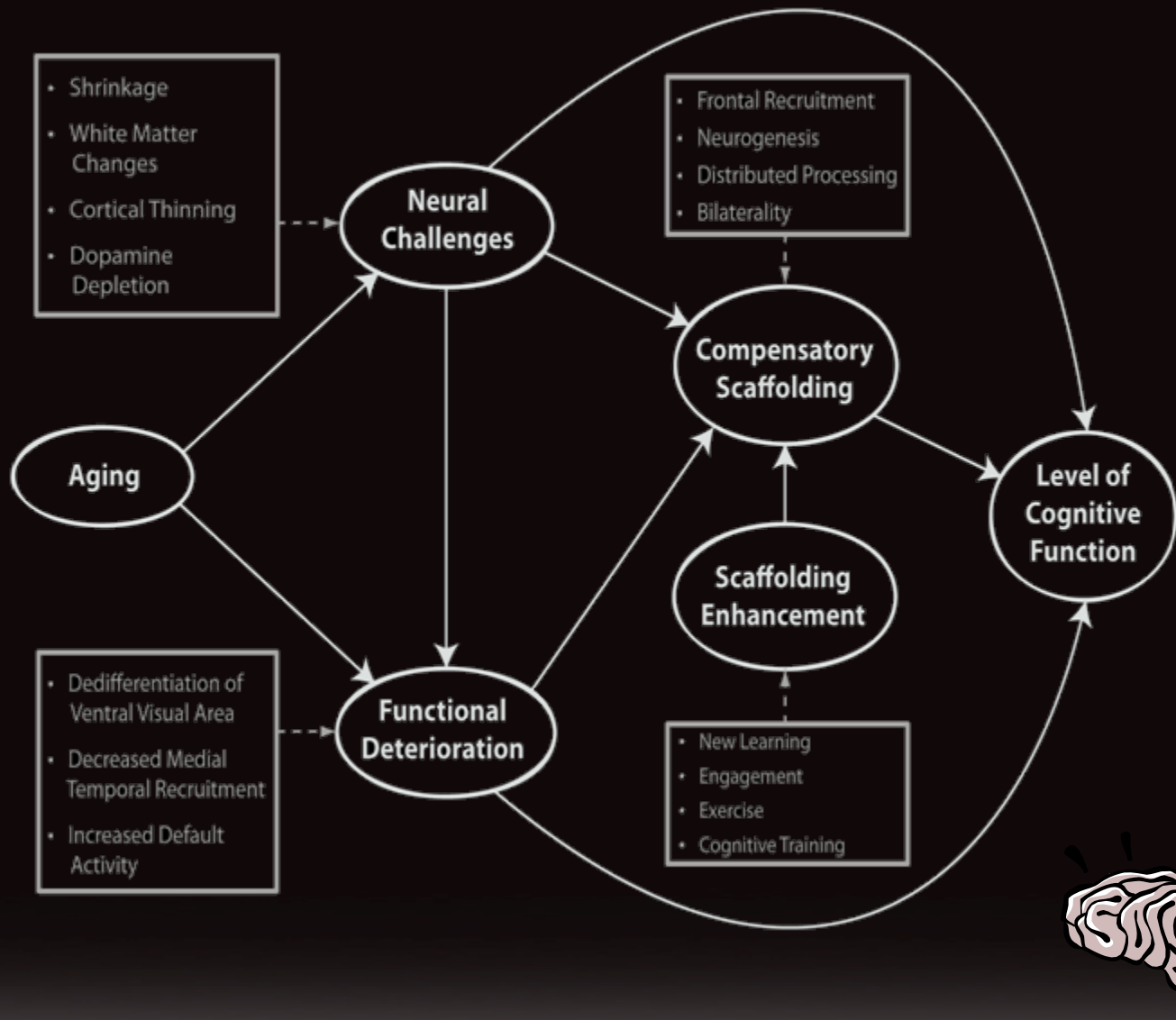
Proposed by Park & Reuter-Lorenz, 2009, Annual
Review of Psychology

What Is a Scaffold?

- According to Encarta: It is a “supportive structure”
- According to Park & Reuter-Lorenz, neural scaffolds can be developed that protect the mind from the neural insults of aging.



THE STAC MODEL

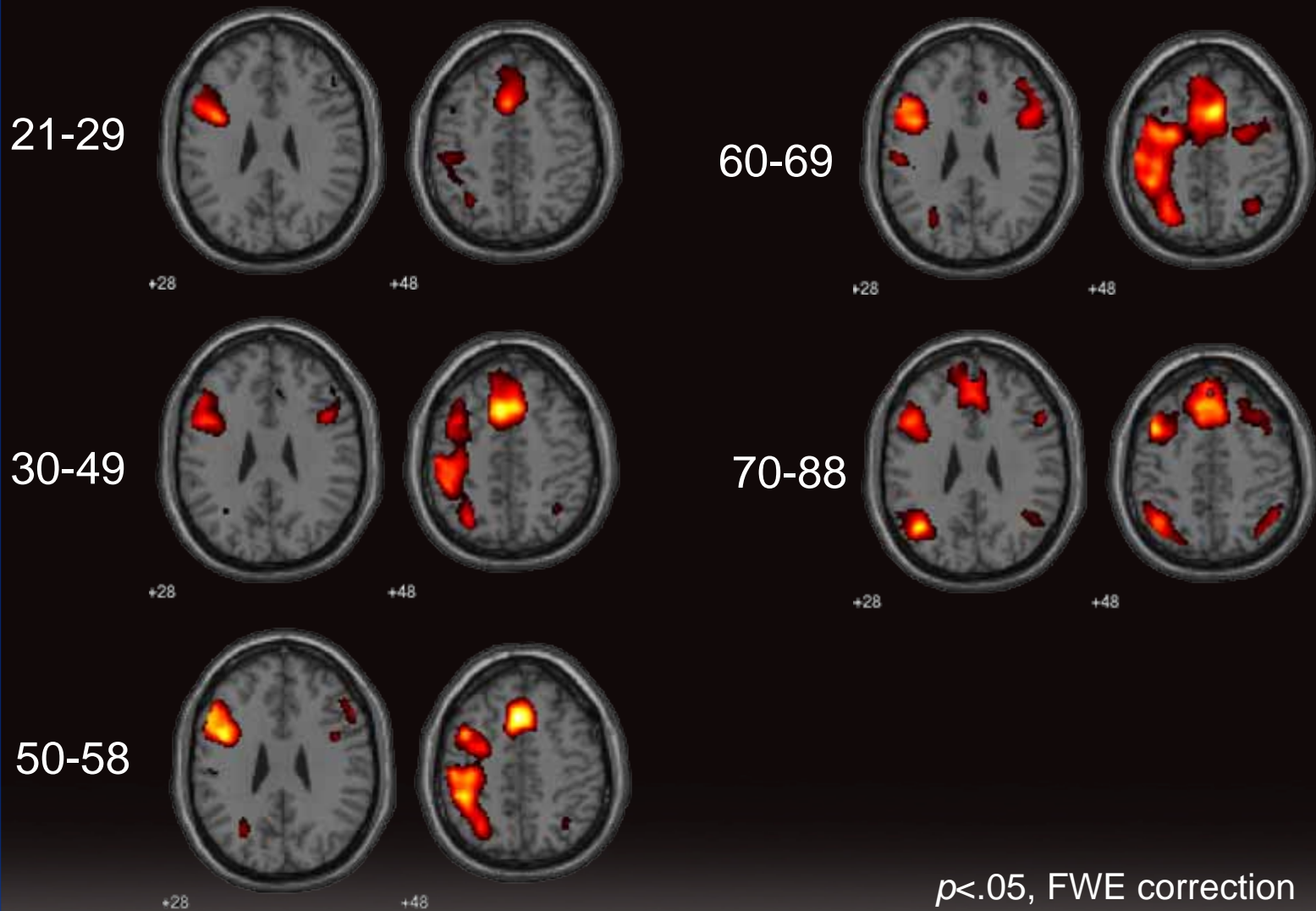


An Example of Scaffolding in a word judgment task.

Is this word...

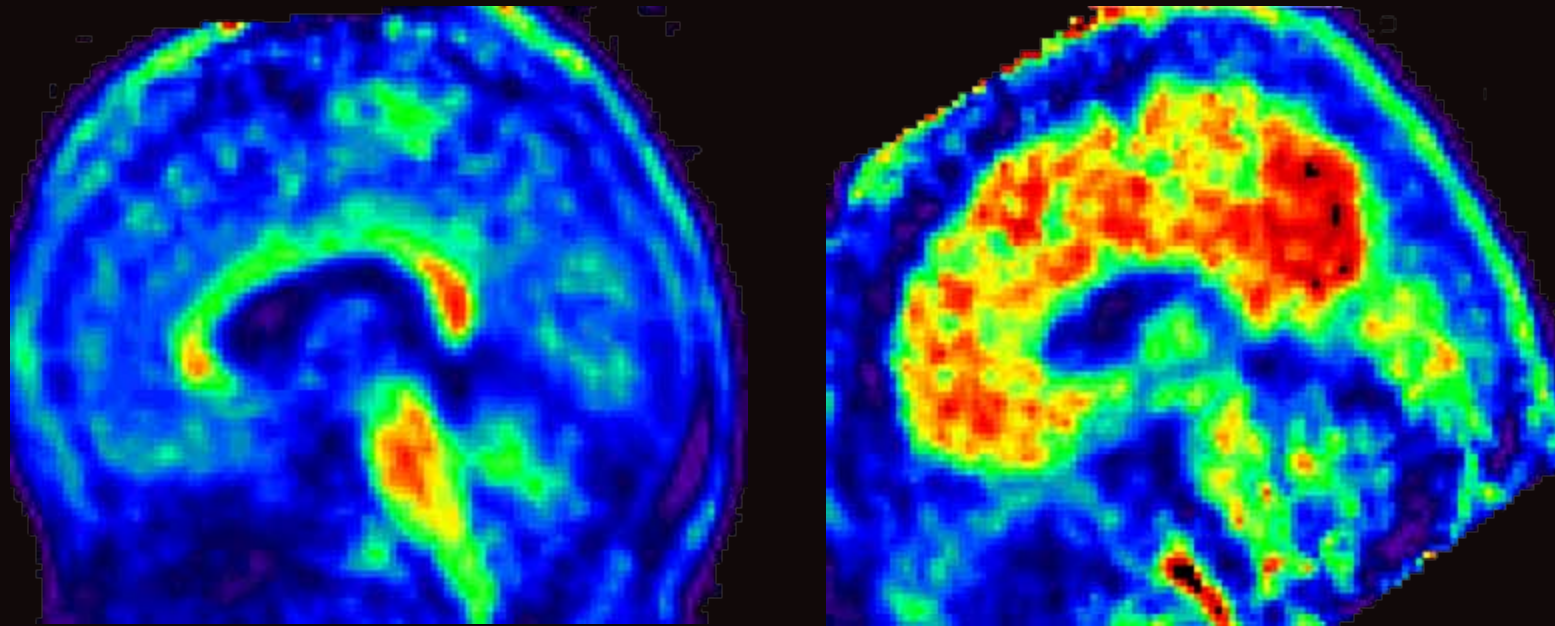
- Living or nonliving?
- Ghost
- Virus
- Sponge

Age Differences in Brain Patterns when Judging a Word



$p < .05$, FWE correction

A-beta plaques detected with PET

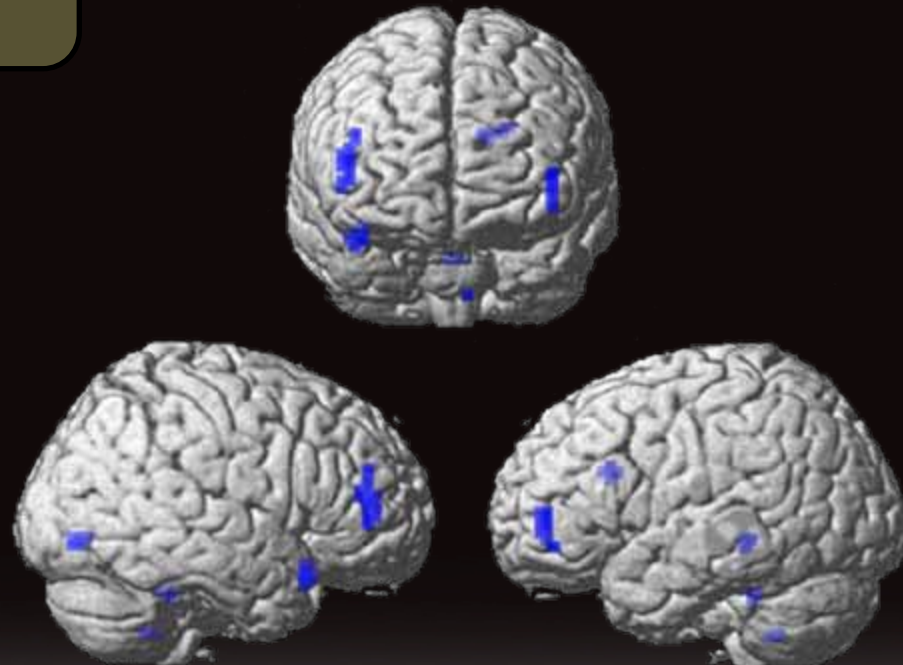
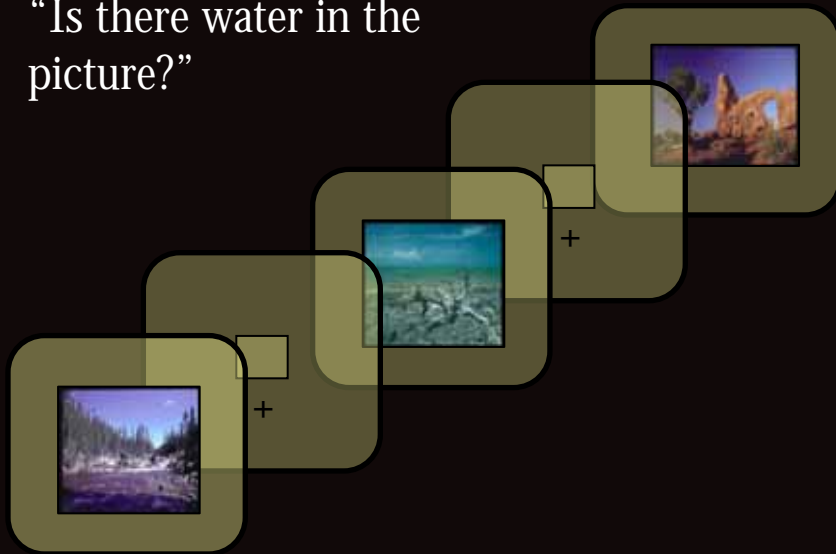


Individual levels of A-beta vary dramatically among individuals

Warmer colors indicate greater levels of A-beta counts

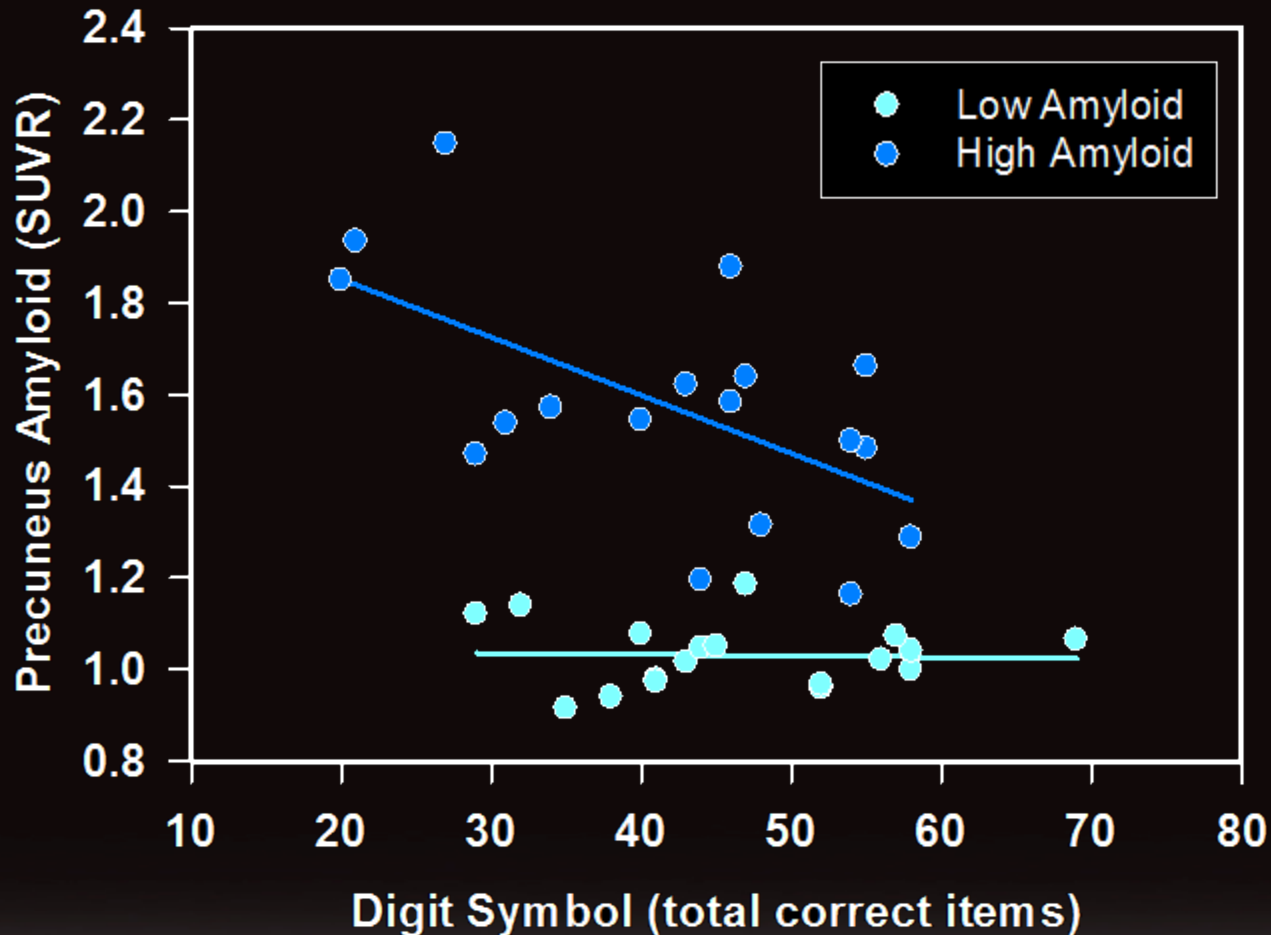
Greater precuneus $A\beta$ is associated with decreased prefrontal activation

“Is there water in the picture?”



A β amount associated with cognitive performance in healthy adults

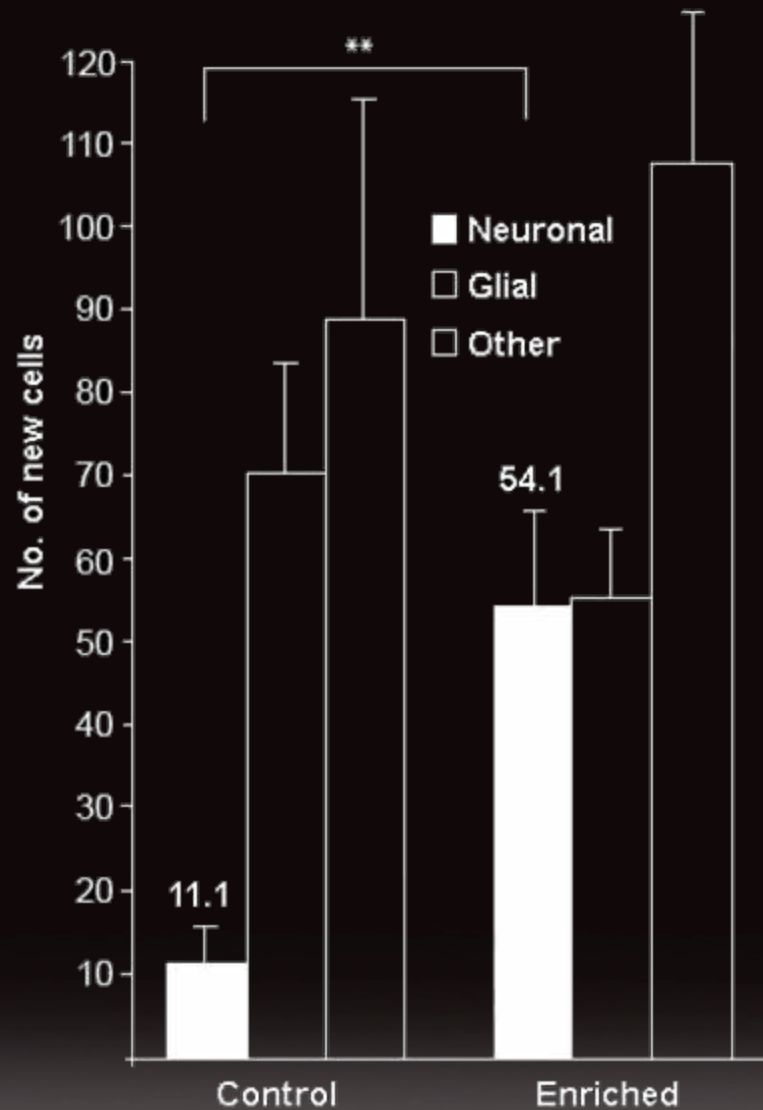
High Amyloid Burden in Precuneus Predicts Slower Mental Speed



Scaffolding Enhancement Is Promoted by Training and Cognitive Activity

- What evidence is there that you can change your own brain function through various activities?

Neurogenesis in senescent rats



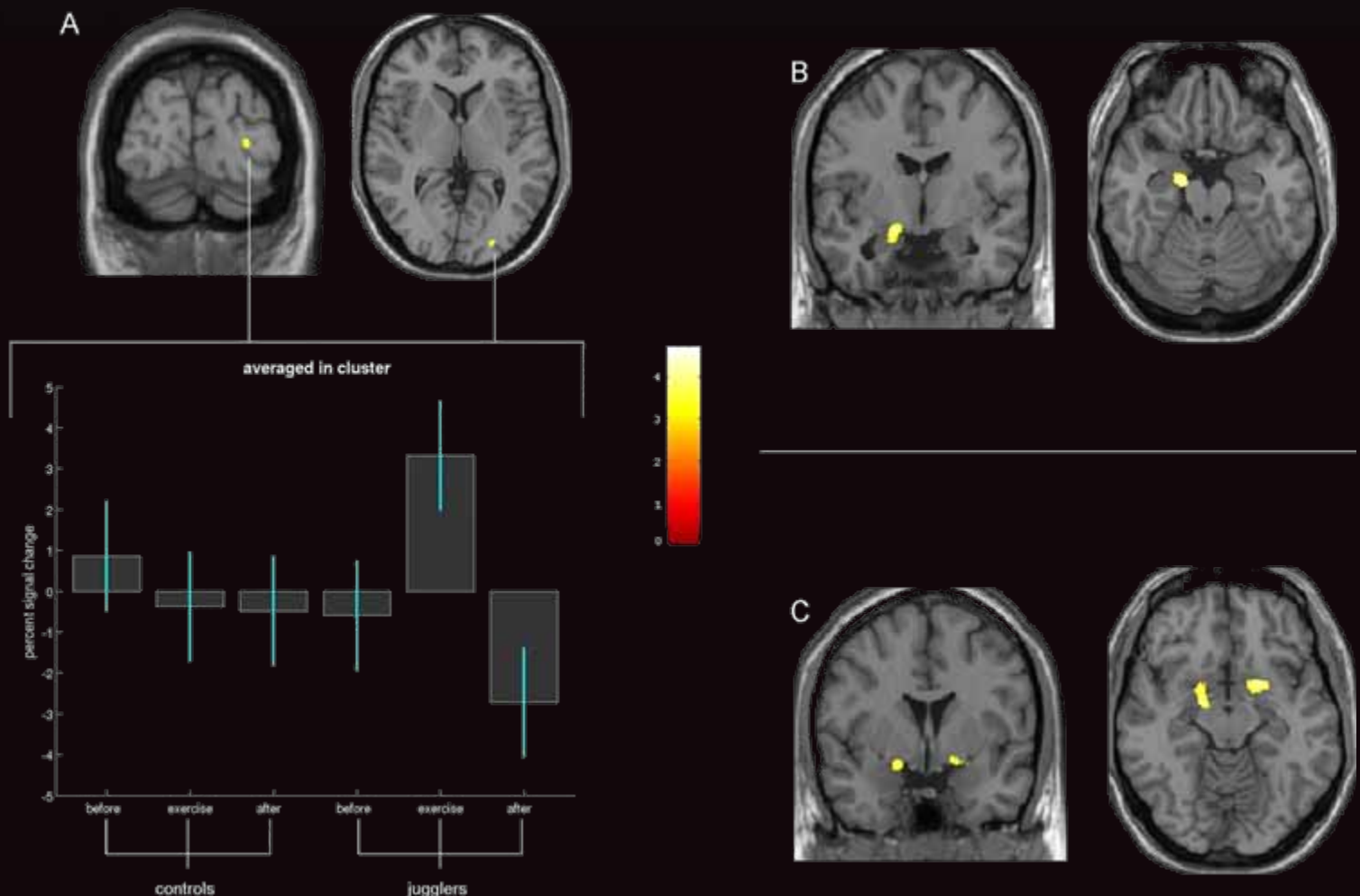
The Juggling Study

- Scan the brain before training
- Learn to juggle over 90 days
- Another scan was performed at the end of juggling.
- A third scan was performed three months later after nonpractice of juggling.
 - Boyke, Driemeyer, Gaiser, Buchel, May (JON, 2008)



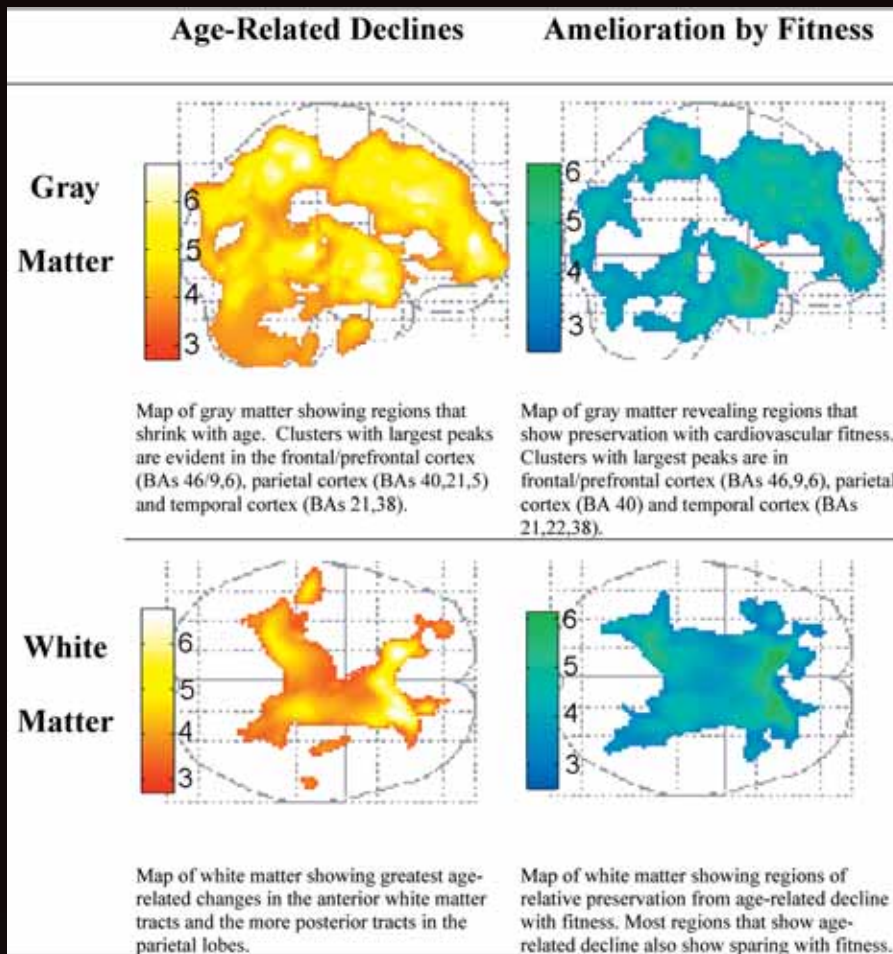


Figure 2. Time point (before intervention, after intervention) by group (jugglers, controls) interaction analysis, testing for greater changes in the jugglers group



Boyke, J. et al. *J. Neurosci.* 2008;28:7031-7035

Exercise and Aging



Colcombe et al., 2003

The Synapse! Program

- Attempts to create a “scaffolding environment” to promote maintenance of cognitive health.
- Synapse!: Engagement for 15 hours of week for three months.
- Learning to quilt: visuospatial, motor, memory, social stimulation
- Learning digital photography:
- Combination group
- Addition of exercise conditions

Learning To Quilt



Building a Neural Scaffold



Practical Advice for Maintaining a Healthy Mind

- Maintain a regular program of cardiovascular fitness.
- Prevent brain shrinkage and white matter lesions: get prompt treatment for diabetes, depression, and any source of frailty that limits mental, physical, or cognitive activity.
- Stay Engaged....

Continuously Challenge Your Mind

- Learn new and different things
 - Language, piano, dancing
 - Unsupported travel to a foreign country



- The critical importance of variety and constant challenge

- Move to a new environment



What about Brain Software?

- Does it help?
 - Maybe
- Video games and Wii
 - Importance of staying outside your comfort zone.



Do Not Underestimate Social Engagement

- A partner as neuroprotective
- The cognitive demands of socializing and meeting new people



Work!...

The role of work in preserving the mind is poorly understood but the possibility that it is neuroprotective should be considered



Stay on Top of New Technology

“Gadgets” offer tremendous cognitive and physical support.

Provide mechanisms of neurocognitive engagement and support for everyday tasks.

Stay gadget-literate and be open to new technology .

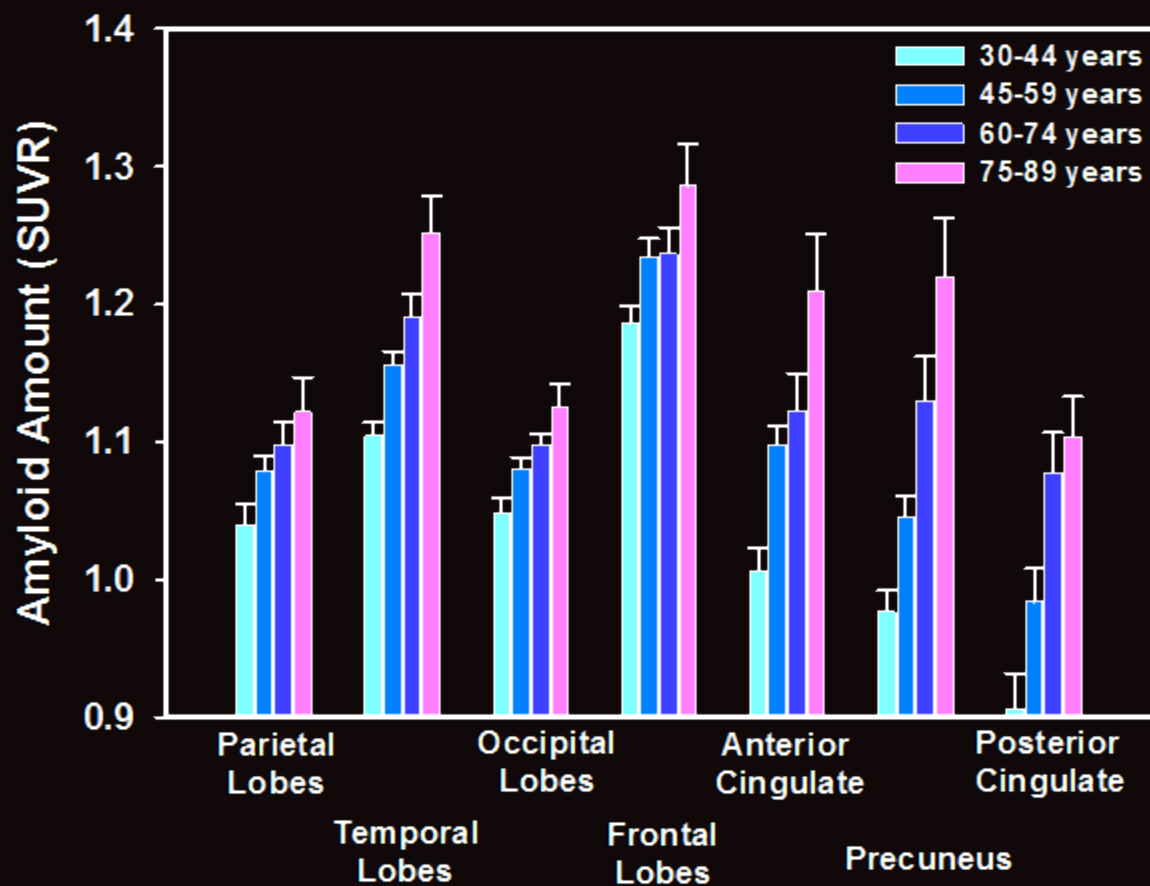
The 21st Century

- A period of unprecedented challenge and risk that has long been predicted by demographers and other gerontologists.
- Phenomenon is global and will hit East Asian countries even harder than western countries.
- The triple threat of increased longevity, increasing prevalence of Alzheimer's, and increased medical care costs needs to be managed.
- Need to move from older adults as threat to older adults as resource and learn how to extend the working life of the aging mind.

The Center for Vital Brain Aging



Amyloid Deposits Vary Across Brain Region and Age Group

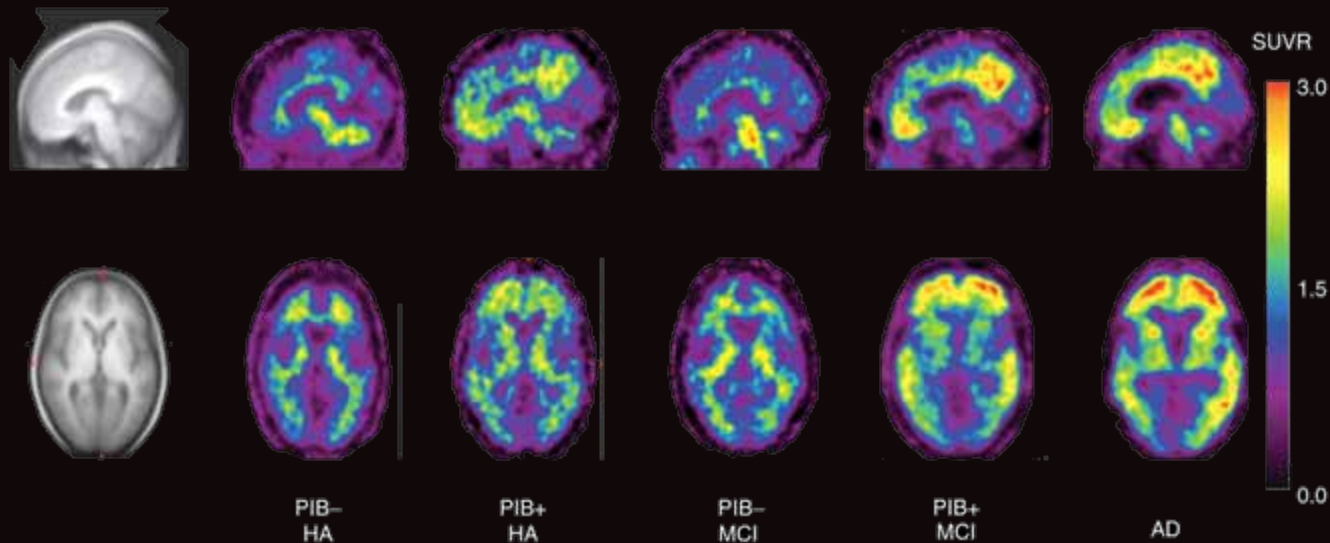


Findings

- Reported significant increase in volume in right h/MT/V5, left hippocampus, and left and right nucleus acumbens.
- These effects disappeared after three months.

Amyloid Deposition Occurs

Typical mid sagittal and transverse ^{11}C -PIB PET images



Pike, K. E. et al. *Brain* 2007 130:2837-2844; doi:10.1093/brain/awm238

BRAIN A JOURNAL OF NEUROLOGY

UT DALLAS