



*A Better Future in Mind™*

# Building a Fit Brain: Role of Sleep

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# New Discoveries in Neuroscience



## Modifiable factors that alter the size of the hippocampus with ageing

*Majid Fotuhi, David Do and Clifford Jack*

**Abstract** | The hippocampus is particularly vulnerable to the neurotoxic effects of obesity, diabetes mellitus, hypertension, hypoxic brain injury, obstructive sleep apnoea, bipolar disorder, clinical depression and head trauma. Patients with these conditions often have smaller hippocampi and experience a greater degree of cognitive decline than individuals without these comorbidities. Moreover, hippocampal atrophy is an established indicator for conversion from the normal ageing process to developing mild cognitive impairment and dementia. As such, an important aim is to ascertain which modifiable factors can have a positive effect on the size of the hippocampus throughout life. Observational studies and preliminary clinical trials have raised the possibility that physical exercise, cognitive stimulation and treatment of general medical conditions can reverse age-related atrophy in the hippocampus, or even expand its size. An emerging concept—the dynamic polygon hypothesis—suggests that treatment of modifiable risk factors can increase the volume or prevent atrophy of the hippocampus. According to this hypothesis, a multidisciplinary approach, which involves strategies to both reduce neurotoxicity and increase neurogenesis, is likely to be successful in delaying the onset of cognitive impairment with ageing. Further research on the constellation of interventions that could be most effective is needed before recommendations can be made for implementing preventive and therapeutic strategies.

Fotuhi, M. et al. *Nat. Rev. Neurol.* 8, 189–202 (2012); published online 13 March 2012; doi:10.1038/nrneuro.2012.27

## Changing perspectives regarding late-life dementia

*Majid Fotuhi, Vladimir Hachinski and Peter J. Whitehouse*

**Abstract** | Individuals over 80 years of age represent the most rapidly growing segment of the population, and late-life dementia has become a major public health concern worldwide. Development of effective preventive and treatment strategies for late-life dementia relies on a deep understanding of all the processes involved. In the centuries since the Greek philosopher Pythagoras described the inevitable loss of higher cognitive functions with advanced age, various theories regarding the potential culprits have dominated the field, ranging from demonic possession, through 'hardening of blood vessels', to Alzheimer disease (AD). Recent studies suggest that atrophy in the cortex and hippocampus—now considered to be the best determinant of cognitive decline with aging—results from a combination of AD pathology, inflammation, Lewy bodies, and vascular lesions. A specific constellation of genetic and environmental factors (including apolipoprotein E genotype, obesity, diabetes, hypertension, head trauma, systemic illnesses, and obstructive sleep apnea) contributes to late-life brain atrophy and dementia in each individual. Only a small percentage of people beyond the age of 80 years have 'pure AD' or 'pure vascular dementia'. These concepts, formulated as the dynamic polygon hypothesis, have major implications for clinical trials, as any given drug might not be ideal for all elderly people with dementia.

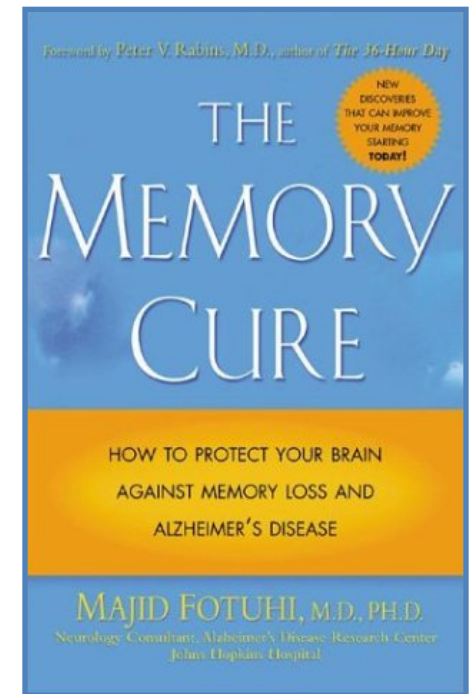
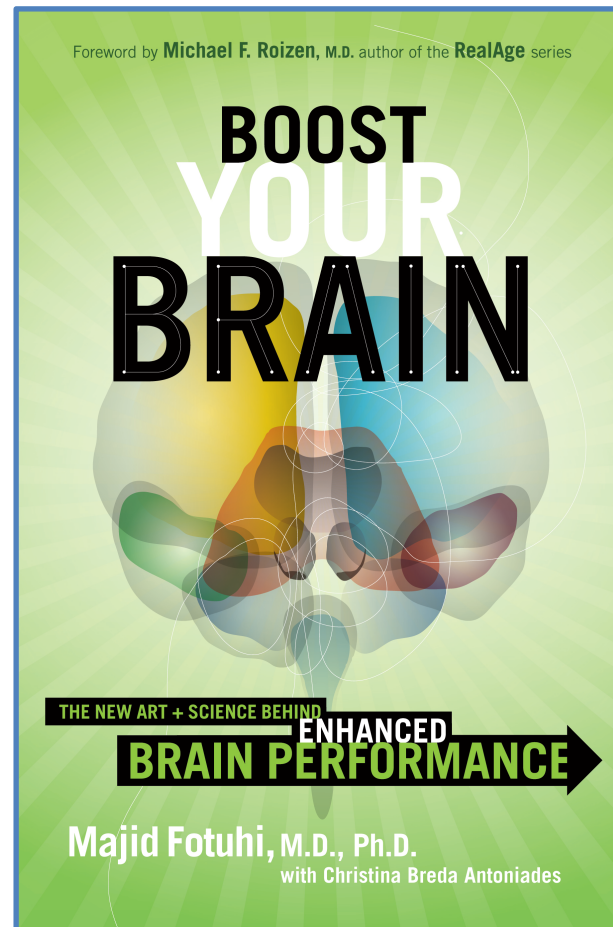
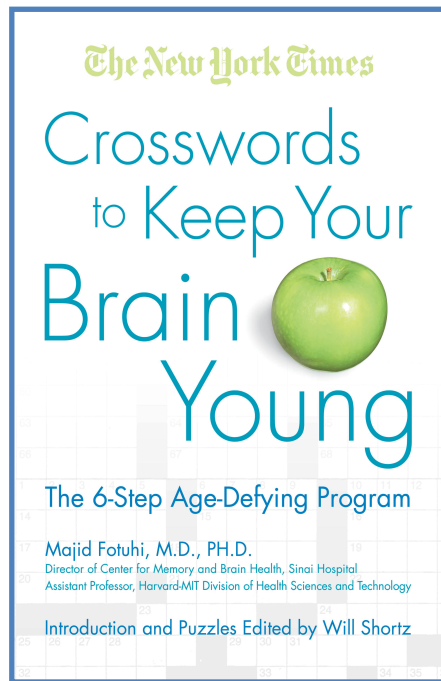
Fotuhi, M. et al. *Nat. Rev. Neurol.* 5, 649–658 (2009); published online 17 November 2009; doi:10.1038/nrneuro.2009.175



“This book may be the most important you’ll ever read.  
Certainly, what Dr. Fotuhi teaches in this book has changed *my*  
life.”

Michael Roizen, M.D.

*Chairman of the Wellness Institute- The Cleveland Clinic*



“Dr. Fotuhi has summarized the latest discoveries that show how we can grow our brains bigger and stronger...”

Mehmet Oz, M.D.



Forbes



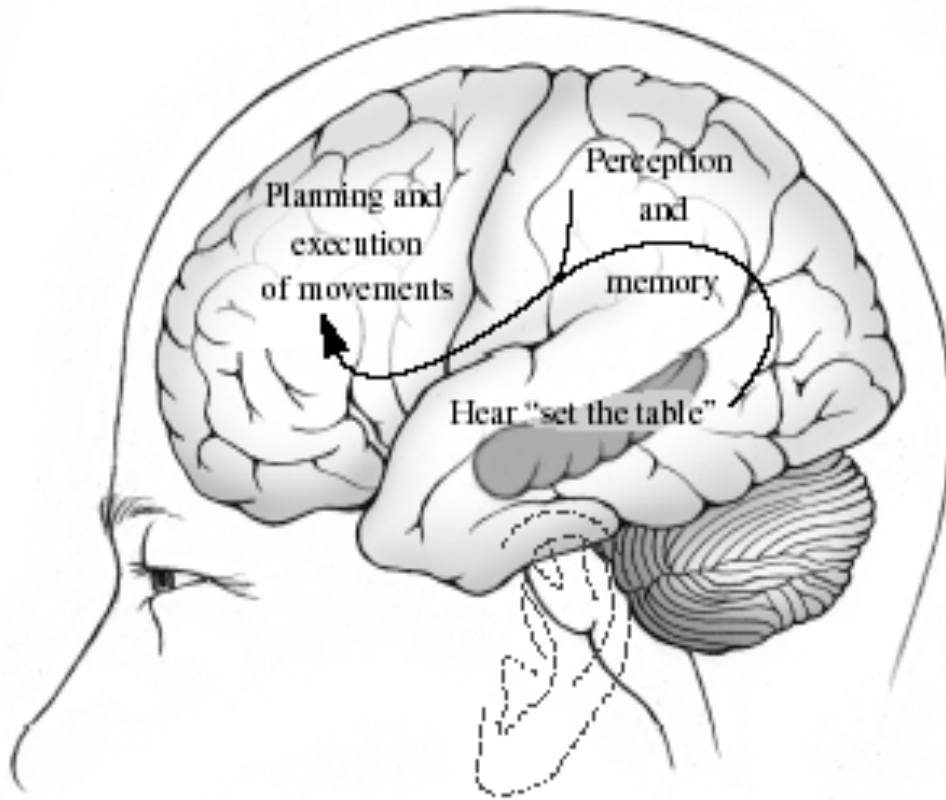
The Dr. Oz Show



# Objectives

- How does our brain work?
- What happens to our brain when we don't sleep enough?
- How can we treat insomnia?
- How can we treat sleep apnea?
- Brain Fitness Program

# Cognitive Function: Cortex and Hippocampus



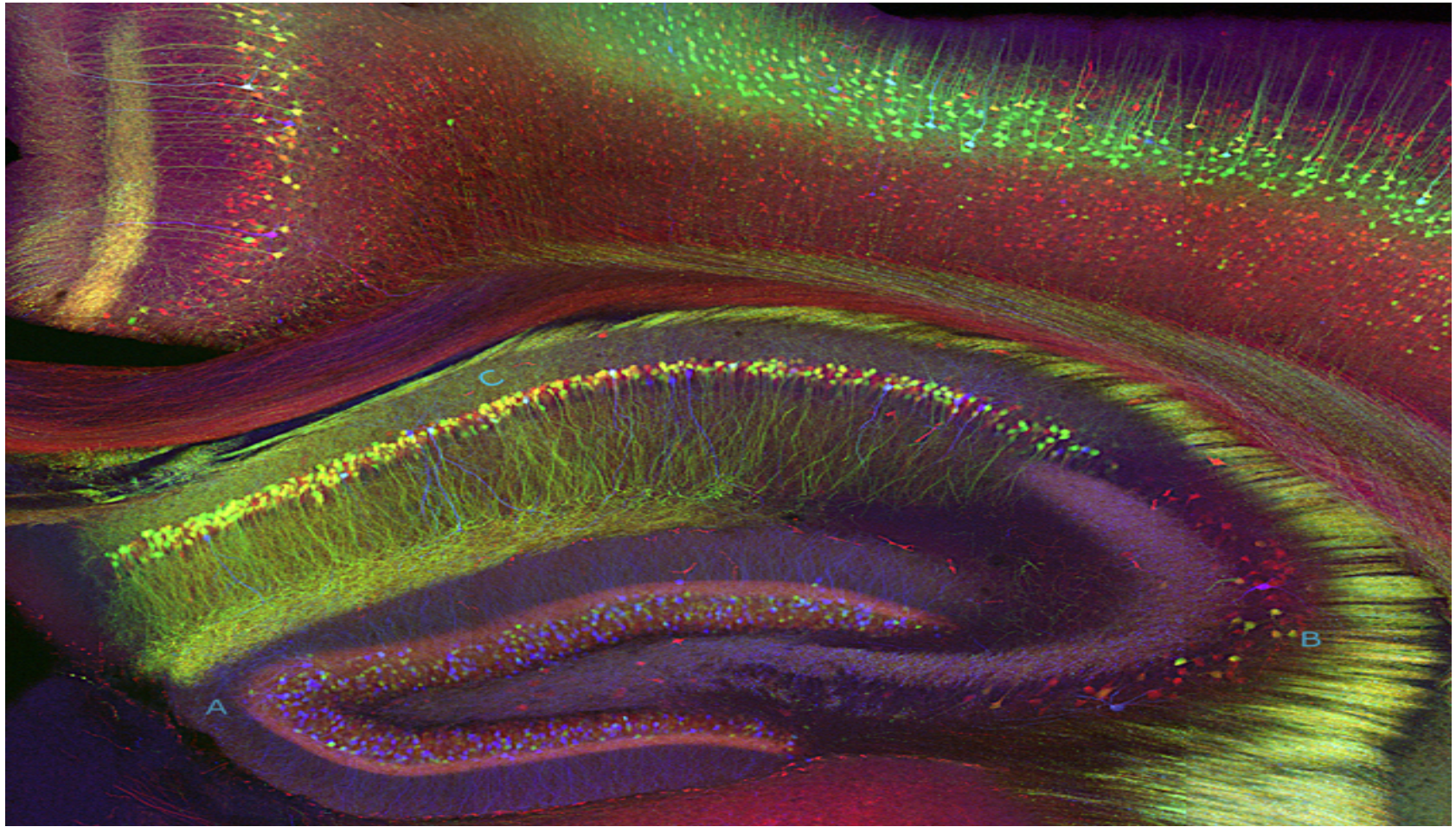
- Learning & Memory
- Language
- Orientation
- Calculation
- Recognizing faces and objects
- Executive functions

# Hippocampus





# Beautiful Neurons in Hippocampus





# With Aging, Hippocampus Atrophies Faster than the Rest of the Brain

- Hippocampus shrinks by about 0.5% per year after age 50
- That is the reason memory lapses become more frequent after age 50



# What Causes Atrophy in Hippocampus?

**Insomnia**

**Sleep Apnea**

**Obesity**

**Stroke**

**Diabetes**

**Stress**

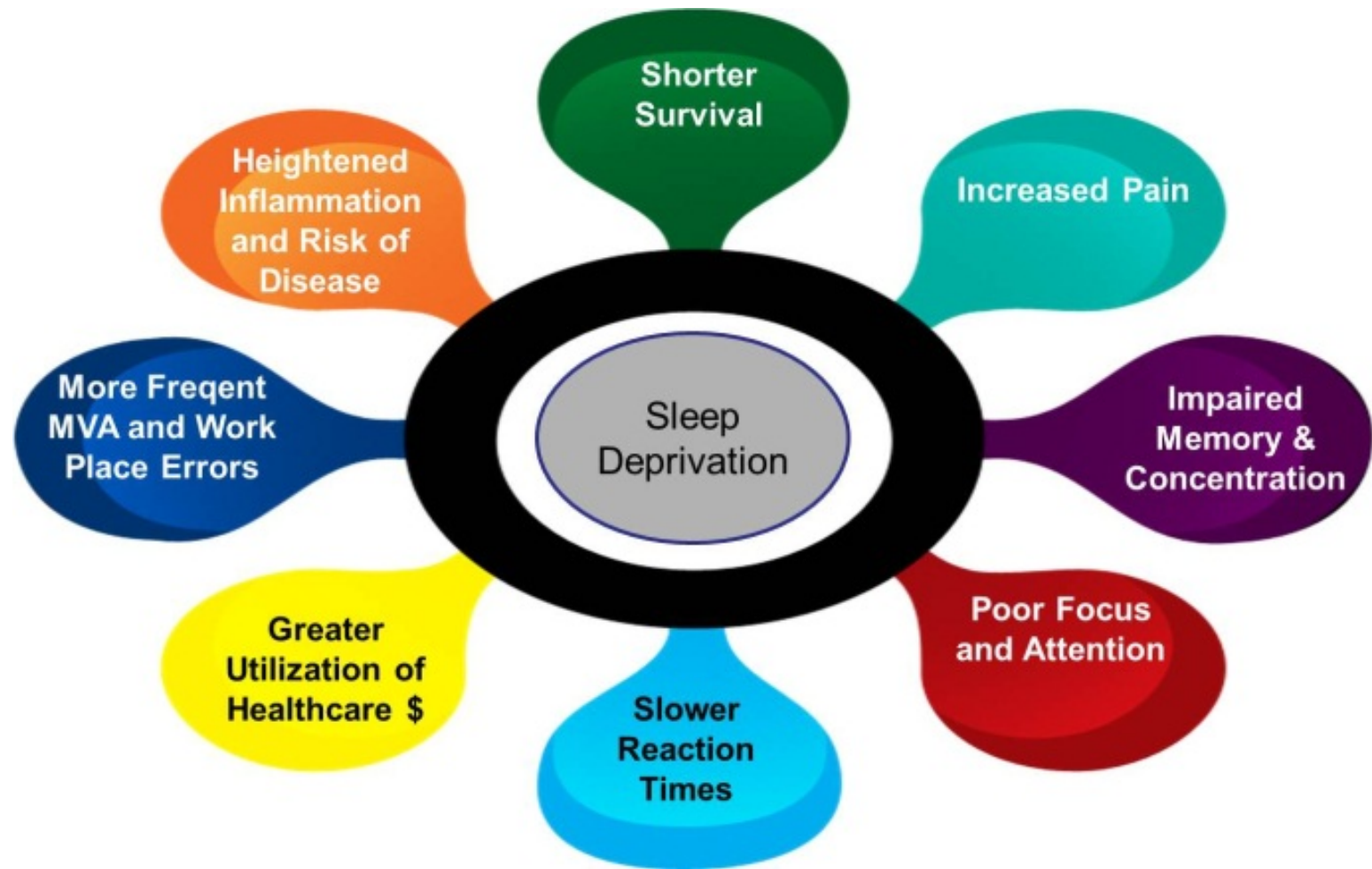
**Concussion**

**Alzheimer's**

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# Effects of Sleep Deprivation



<http://nutritionistclinic.blogspot.com/2014/03/dangers-of-sleep-deprivation.html>



# Why Do We Sleep?



During sleep, we:

- repair and reconstruct the highways in our brain
- clear waste material from our brain
- consolidate our memories

# Our Internal Clock: Circadian Rhythm

- The biological clock resides in the brain.
- It helps regulate when we feel sleepy and when we are alert.
- It works in tandem with light and dark, and our body temperature and hormones.



# What Causes Poor Sleep?

## ■ Medical Conditions:

- Pain (DJD, neuropathy)
- Cardiac Disease
  - Angina, CHF, arrhythmia
- Pulmonary Disease
- Reflux disorder
- Endocrine: thyroid, menopause, DM polyuria

## ■ Medications:

- Side-effects can impair sleep
- Drug-drug interactions
- Dependence of sleep medications

## ■ Neuropsychological Impairments:

- Depression
- Stress & Anxiety
- Neurodegeneration

## ■ Primary Sleep Disorders:

- Insomnia
- Sleep apnea
- Restless Leg Syndrome

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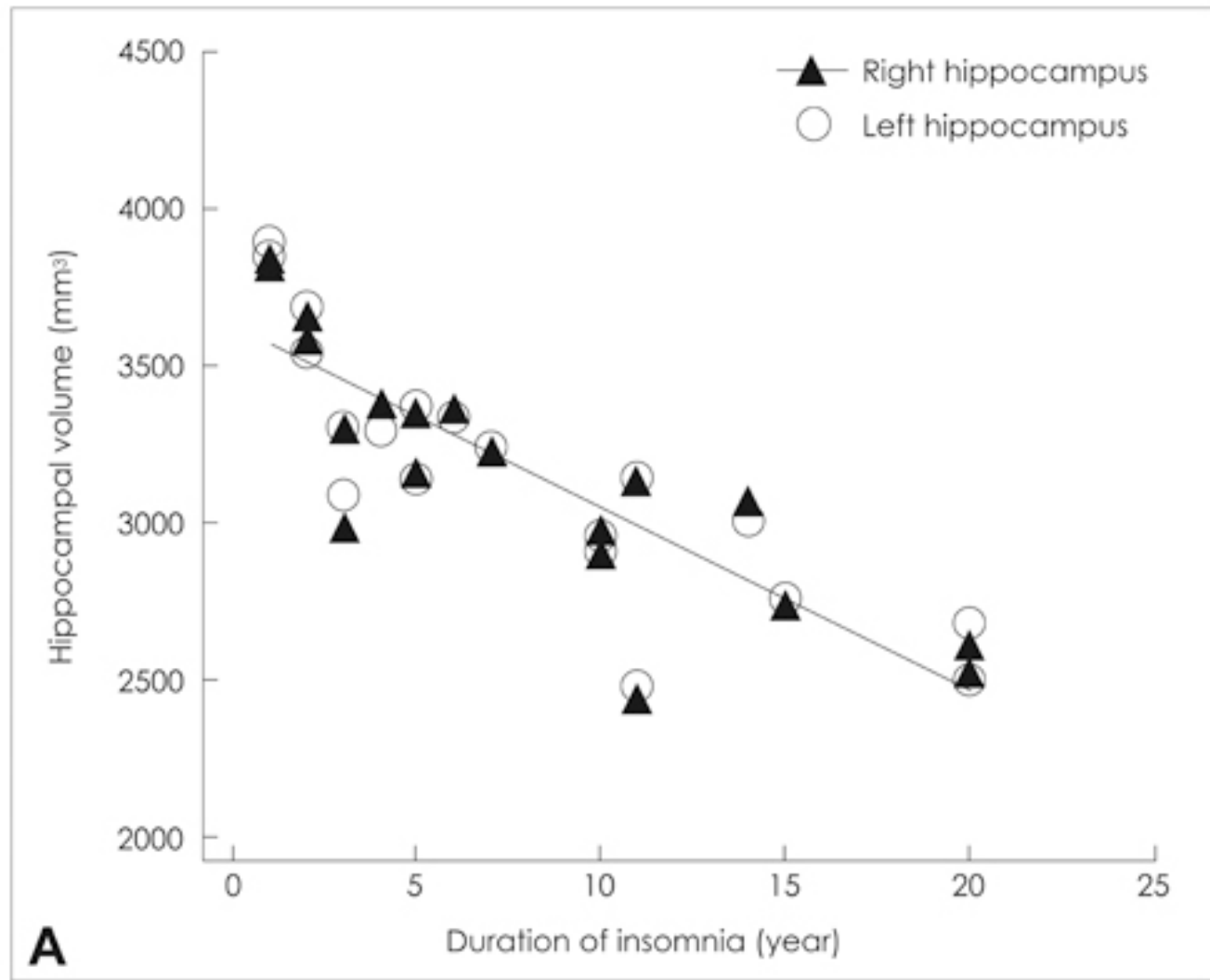


# Insomnia

- **Inability to fall sleep OR stay asleep.**
  - 10-20% of all adults
  - 40-50% of elderly have insomnia
  - Can be due to medical conditions such as pain, anxiety, stress, and depression
  - Consequences:
    - Fatigue
    - Weight gain
    - Stroke
    - Brain atrophy

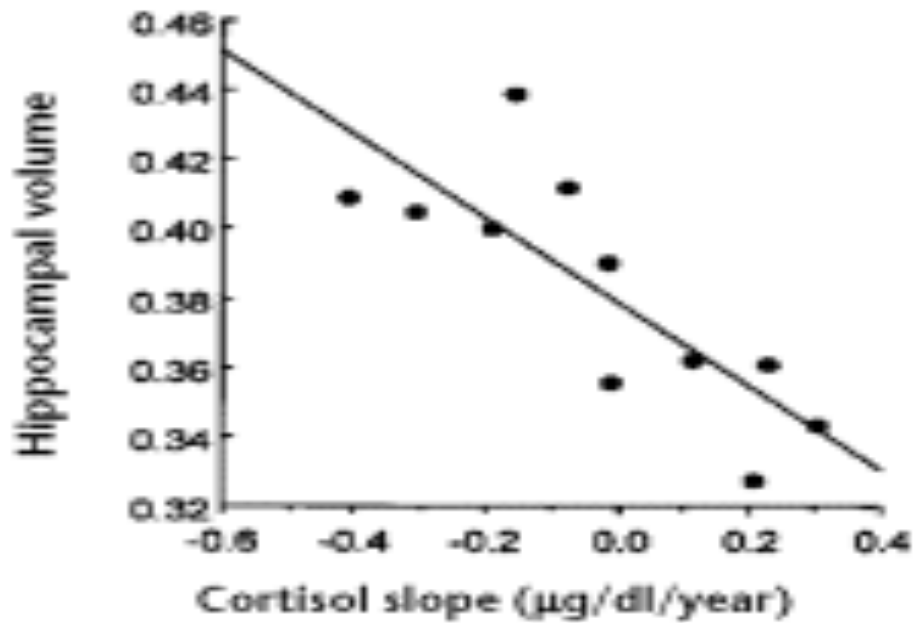


# Insomnia Shrinks Your Hippocampus

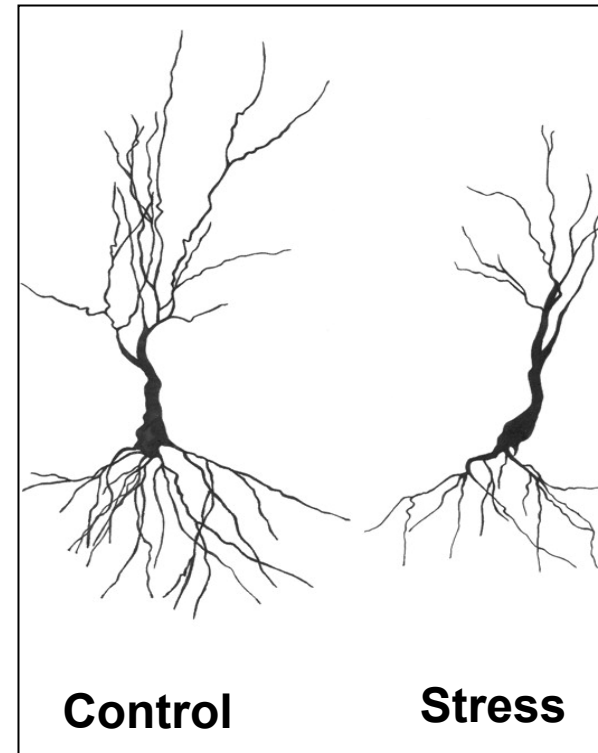


Ho et al; J Clin Neurol. 2012 Jun;8(2):130-8

# Stress Shrinks Your Hippocampus



Lupien et al (1998), Nature NeuroSci 1 (1), 69-73



# Insomnia: Treatment

- Address any underlying medical problems
- Check medication lists
- Take medication– Not preferred
- Improve your sleep hygiene



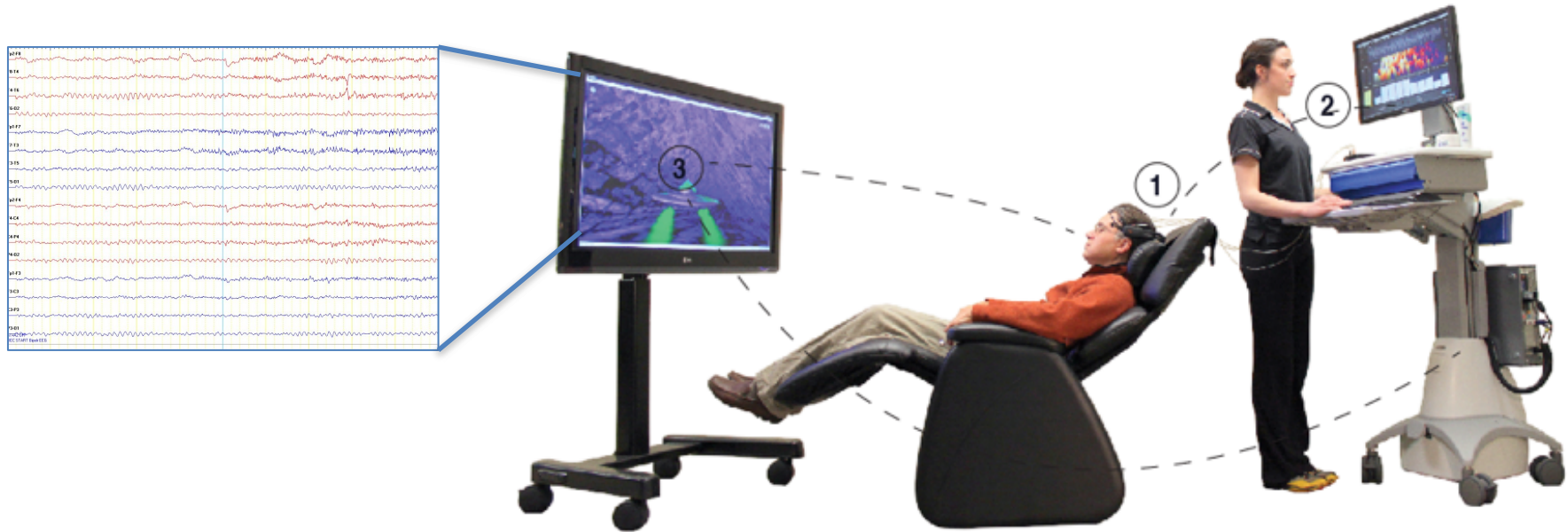


## Reset Your Internal Clock: Sleep Hygiene

1. Maintain a regular bedtime and wake up time
2. Establish a bedtime routine
3. Use the bed only for sleep
4. Remove the TV from the bedroom
5. Avoid watching the clock
6. Avoid afternoon Caffeine
7. Avoid naps
8. Reduce stress, consider mindfulness meditation



# Neurofeedback for Insomnia



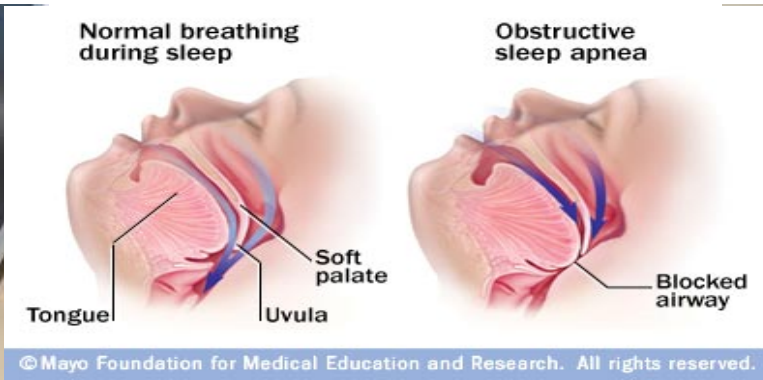
- Performed by a certified EEG neurofeedback specialist
- Live EEG feedback is provided through auditory and visual responses to help the patient move brain activity towards an optimal state
- Benefits are long-lasting

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# Sleep Apnea: Symptoms

- **Snoring:**
  - 90% of snoring is associated with sleep apnea
- **Excessive daytime sleepiness**
- **Frequent bathroom trips at night**
- **Waking up gasping for air**



# Sleep Apnea: Risk Factors

- Being an obese man
- Post-menopausal women
- Large neck circumference (overweight)
- Crowding of throat structures

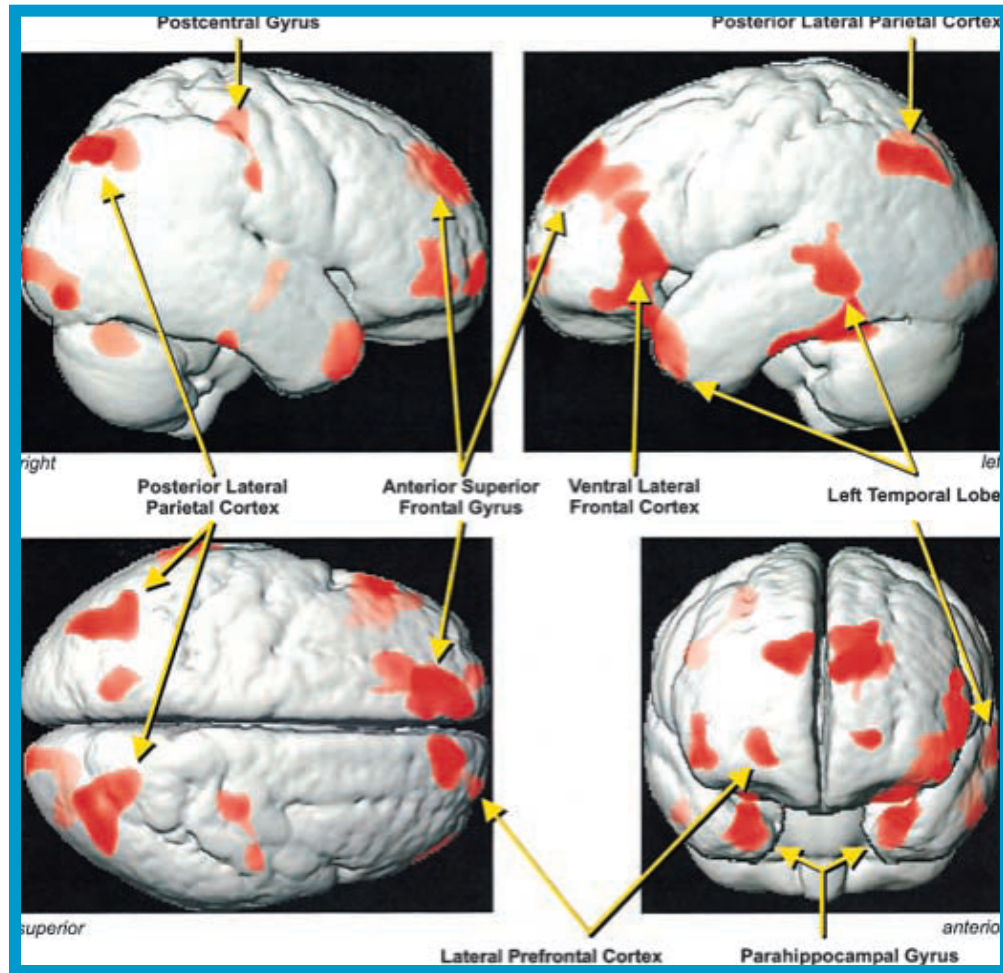
# Sleep Apnea: Dire Consequences



<http://nightshifttherapy.com/>



# Sleep Apnea: Less Brain Volume



*Am J Respir Crit Care Med* 2002; 166:1382–7

# Obesity Shrinks Your Hippocampus

- Associated with reduced brain volume

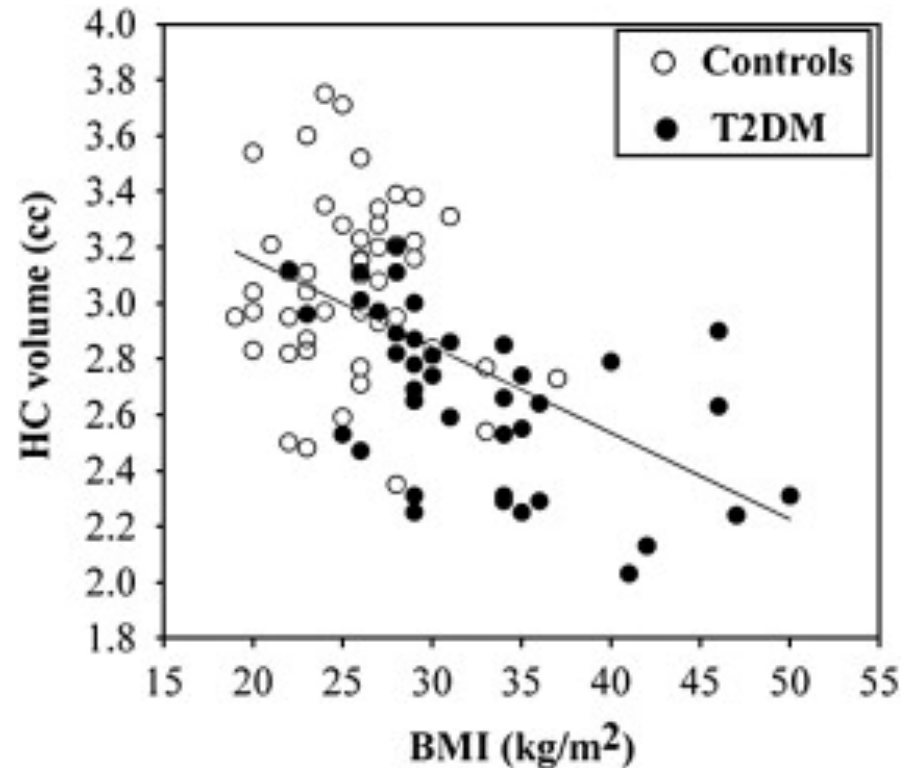
*Ward, et al., 2005*

- Slows cognitive function

*Debette, et al., 2011*

- Brains of overweight and obese individuals appeared 8 and 16 years older, respectively

*Raji, et al., 2010*



*Brain Research Volume 1280, 14 July 2009, Pages 186–194*

# Diagnosis of Sleep Apnea

- A sleep study in the lab  
or
- A home sleep test

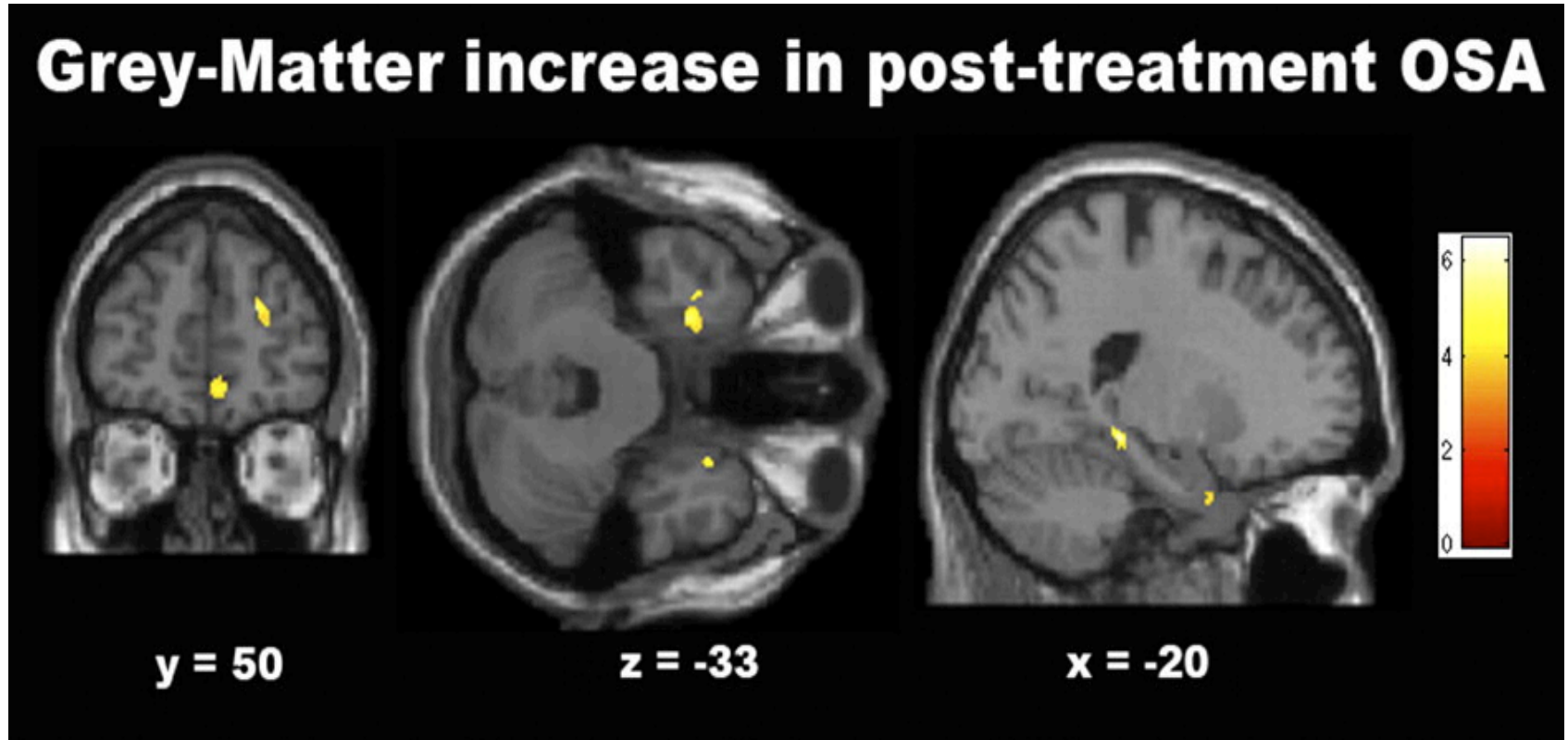


# Treatment

The most effective way to treat sleep apnea is CPAP



# Hippocampus Grows Bigger with Using CPAP to Treat Sleep Apnea



*Canesa, American Journal of Respiratory Medicine, 2011*



# Other Treatment Options

- Oral appliances.
- Surgery.
- Weight loss ( if applicable)
- Positional Therapy ( in some cases)





# See a Sleep Specialist!



# Objectives

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- How can we treat sleep apnea?
- **Brain Fitness Program**

# Brain Fitness Program Goals

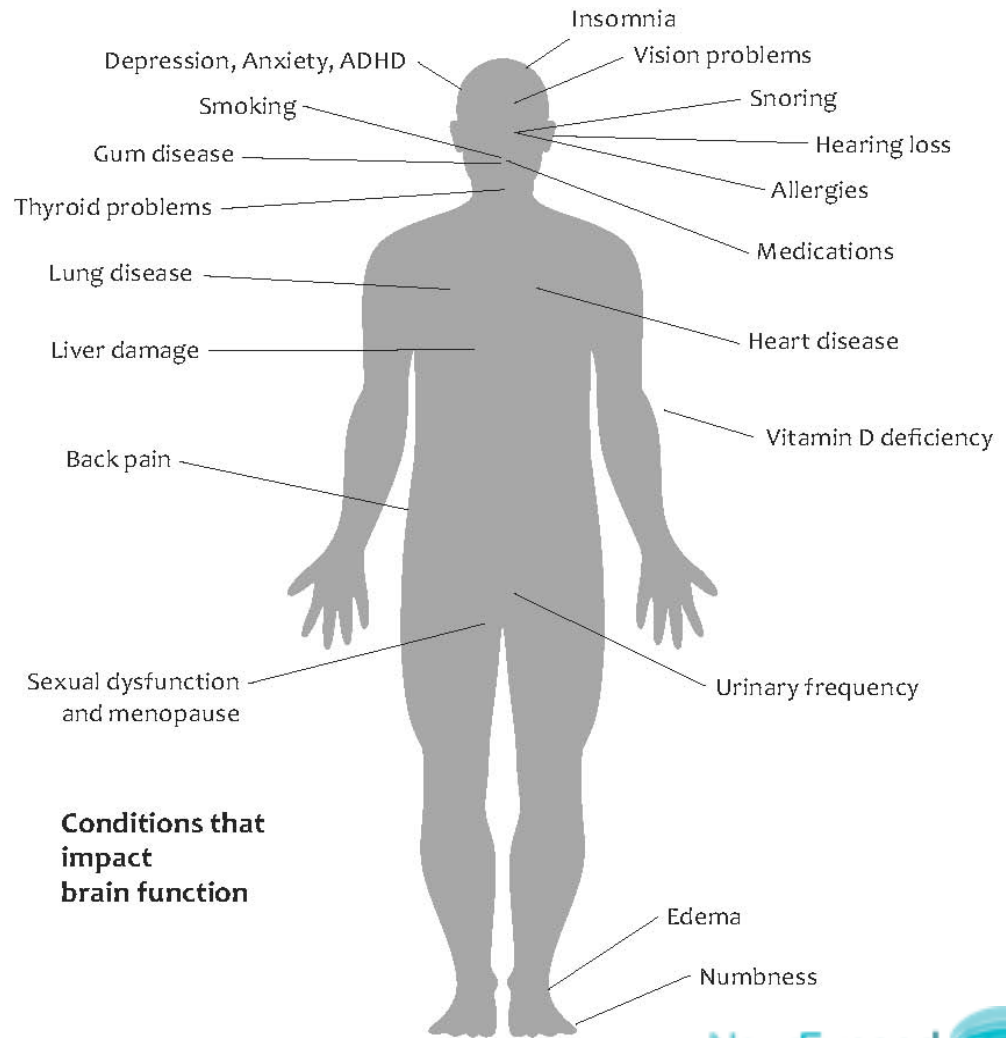
## Short Term

- Think faster
- Remember more
- Improve efficiency of problem solving
- Sharpen focus
- React quicker
- Better sleep

## Long Term

- Help to regrow brain cells in hippocampus
- Establish a brain healthy lifestyle change that results in lifelong benefits
- Reduce risk of dementia in late-life

# BFP: Evaluating & Treating All Causes of Memory Loss

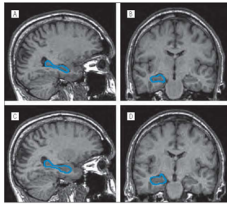


**Conditions that  
impact  
brain function**

# NeurExpand's Unique Integrative Approach

## Comprehensive Tests to Evaluate Brain Health

Brain MRI



Neurocognitive Evaluation



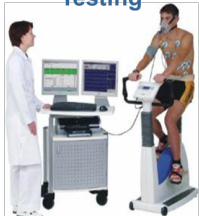
Brain Mapping-qEEG



Carotid Ultrasound



Cardiopulmonary Testing



Blood Test



Sleep Health Assessment



## Customized Treatment Program to Maximize Brain Performance

Brain Coaching



Exercise Therapy



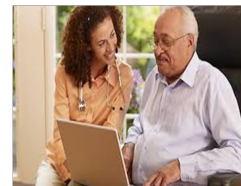
Cognitive Skills & Memory Training



Neurofeedback



Continual Progress Monitoring

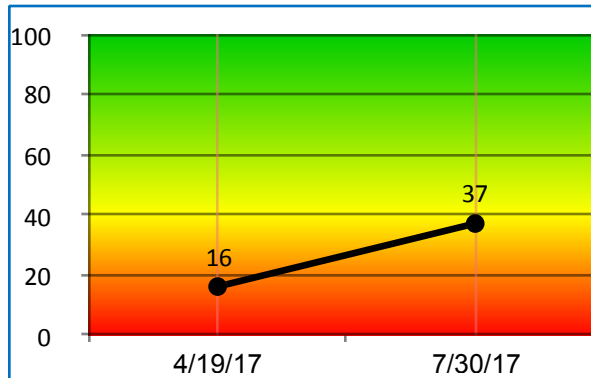


Diet & Lifestyle Counseling

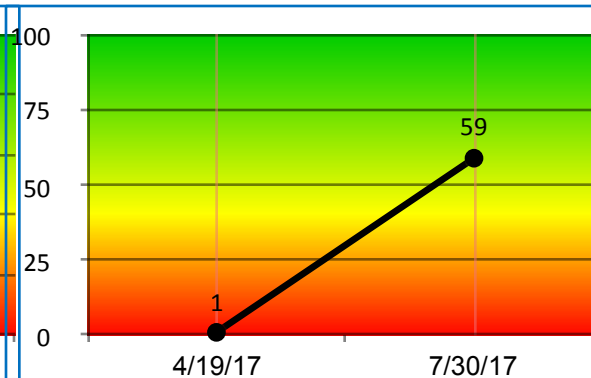


# Post Brain-Fitness Program

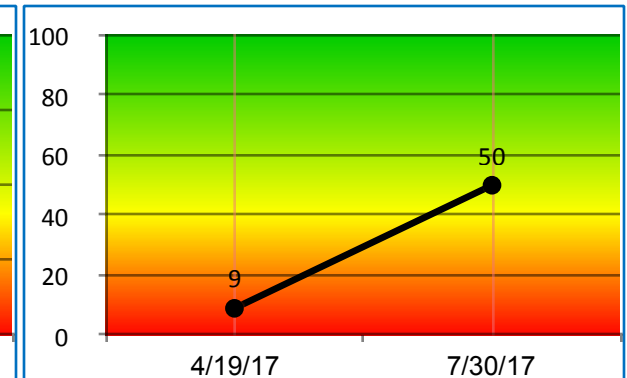
## Memory



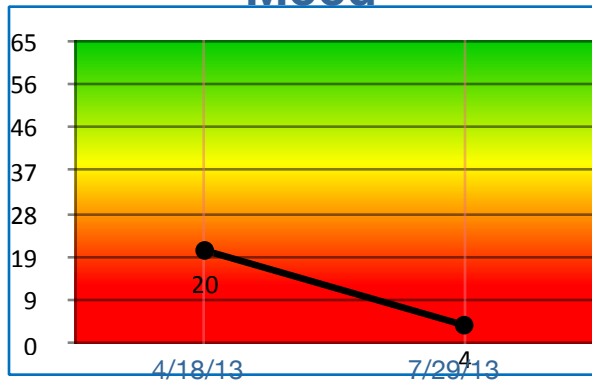
## Attention



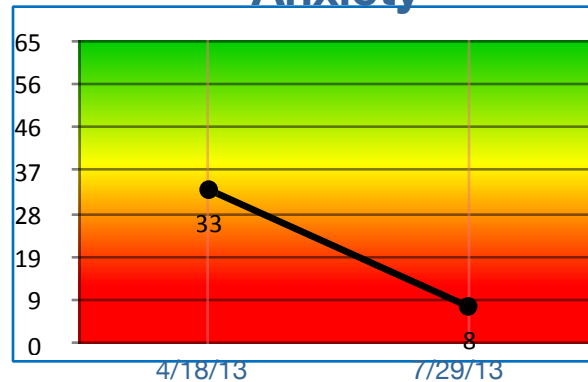
## Concentration



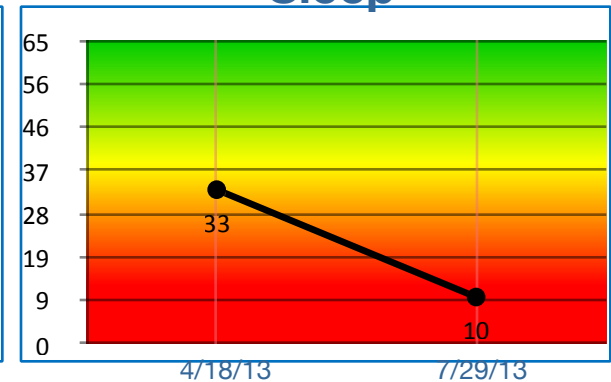
## Mood



## Anxiety

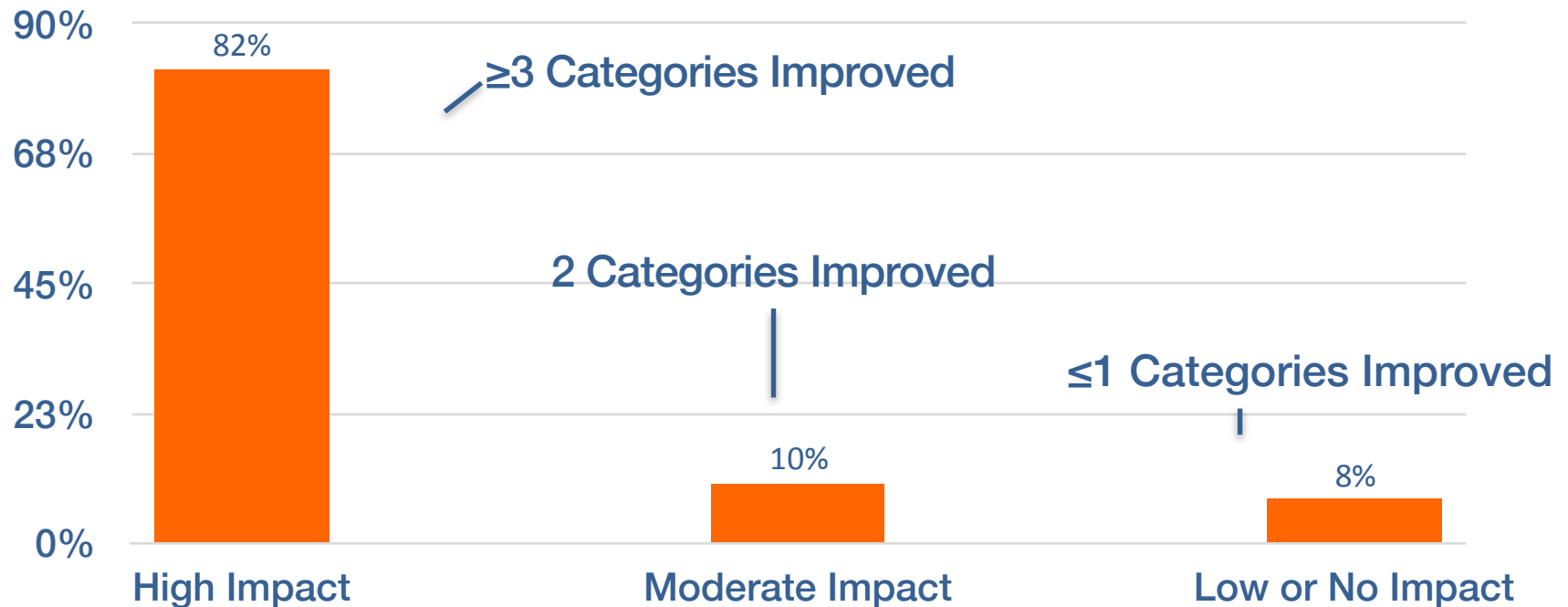


## Sleep



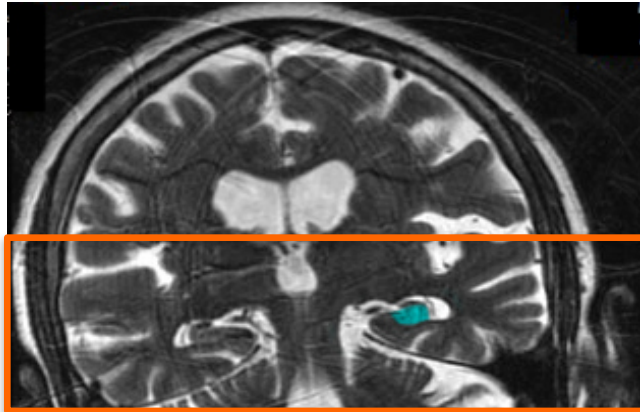


# Positive Impact of Brain Fitness Program in Patients with Mild Cognitive Impairment

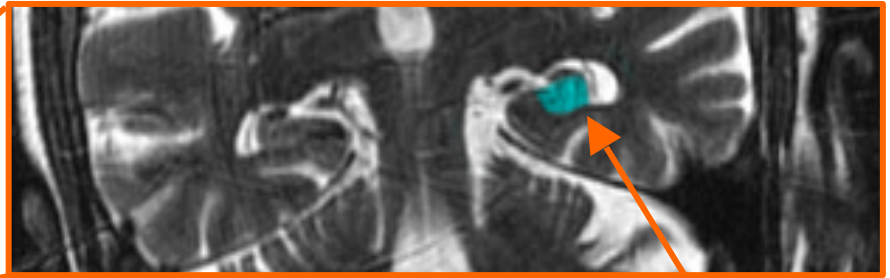


Note - Statistics are based upon 103 patients with an average age of 70.5 and an average MMSE of 27.3 that have completed the Brain Fitness Program and have taken the cognitive evaluation both prior to and upon completion of the BFP. The cognitive evaluation assesses 10 cognition criteria. Based upon statistical rules, a “high impact” is defined as having improved in 3 or more areas, a “moderate impact” is improvement in 2 areas, and “low or no impact” represents patients with benefits in 1 or no areas.

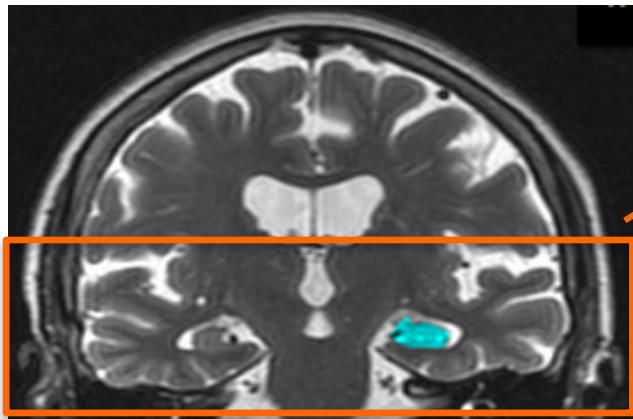
# Remarkable Results



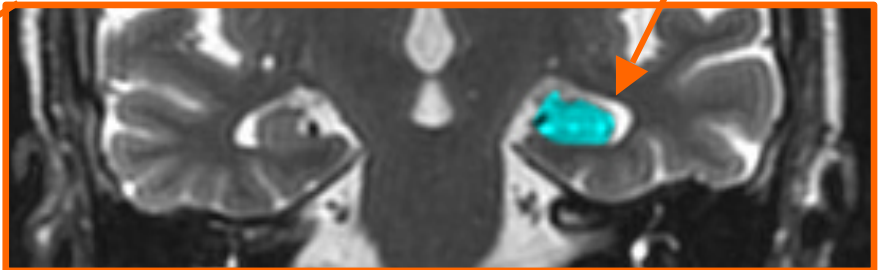
Before



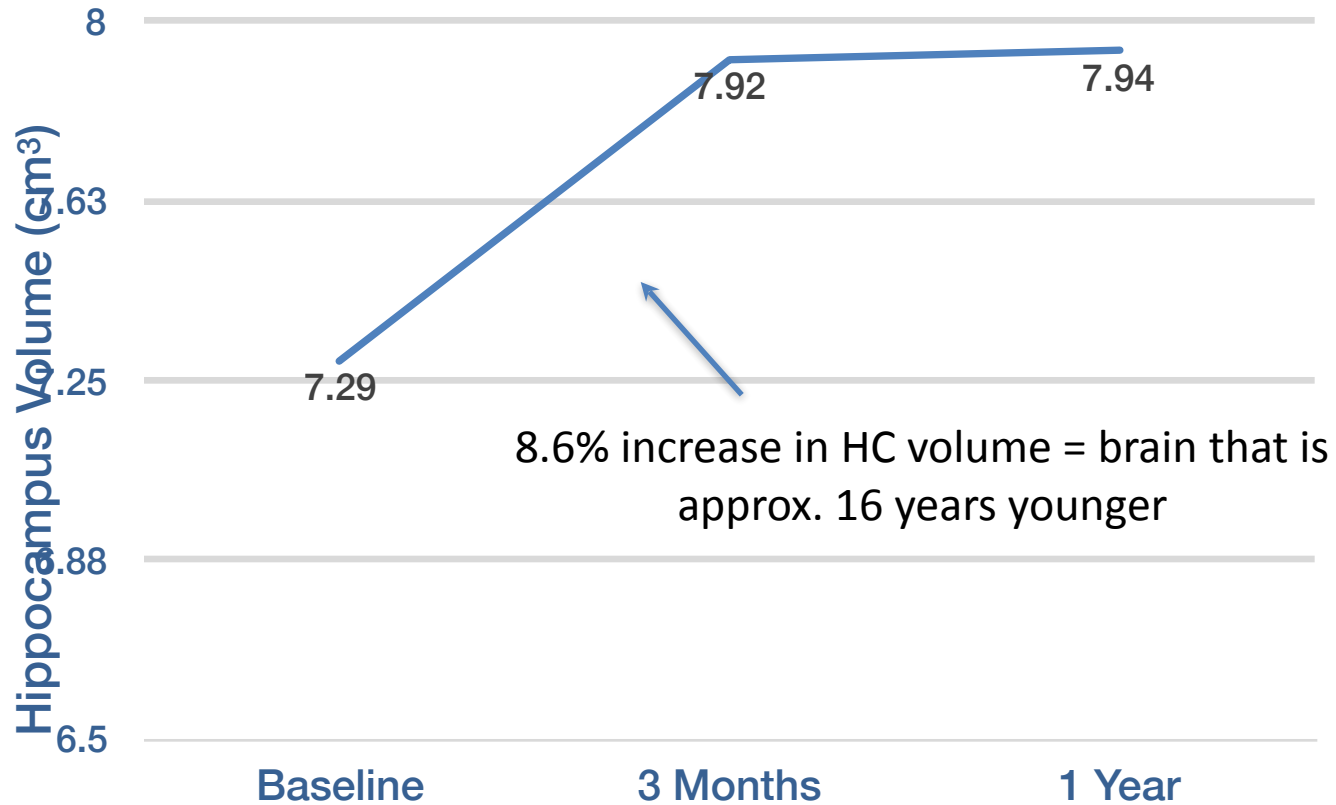
Hippocampus



After



# Sustained Benefits



# Summary

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# THANK YOU!

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