

Physical Activity and the Brain

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Physical Activity and the Brain

Learning Objectives

- Different Types of Physical Activity
- Effects of Physical Activity on the Brain and Possible Mode of Action
- Physical Activity in Prevention and Treatment of Neurological Disorders in Children and Adults

Physical Activity and the Brain

- Introduction and Benefits
of Physical Activity in General
- Benefits of Exercise to the Brain
- Exercise in Improvement of Academic
Achievement in Children
- Exercise in Prevention and
Treatment of Dementia
- Conclusion

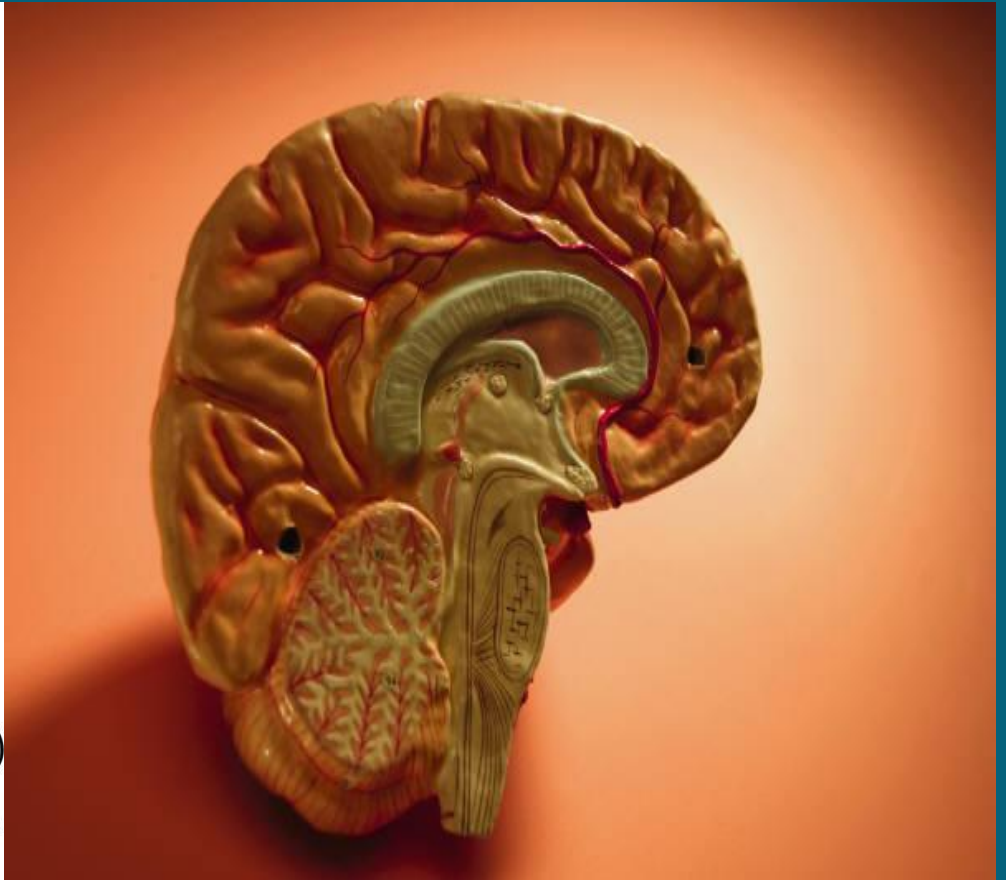
Types of Physical Activity

- Aerobic
- Muscle- Strengthening
- Bone Strengthening
- Stretching

Choose an exercise that
integrate different parts of body

Exercise in the Morning

Aerobic Exercise





Adverse Effects of Exercise

- Orthopedic Injuries
- Provoke Acute Coronary Syndromes
- Post Concussion Syndrome
and Dementia

Exercise as Preventative Medicine

(Effect on Mortality of Exercise and Drugs in four prevention regimens)

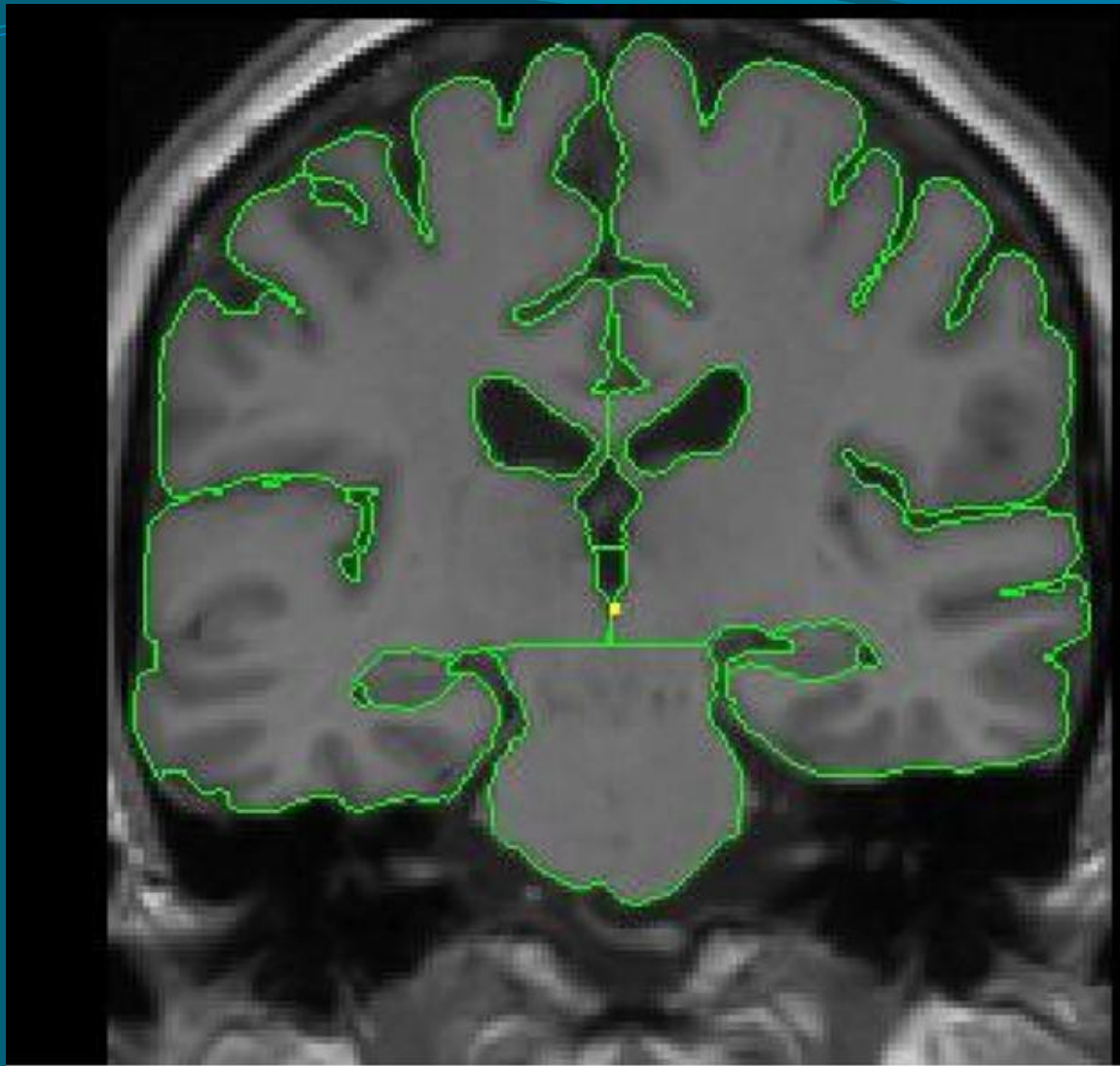
- Rehabilitation from Stroke {Blood Thinners}
- Prevention of Type-II Diabetes {Biguanides}
- Secondary Prevention of Coronary Artery Disease {Statins}
- Heart Failure {Diuretics}

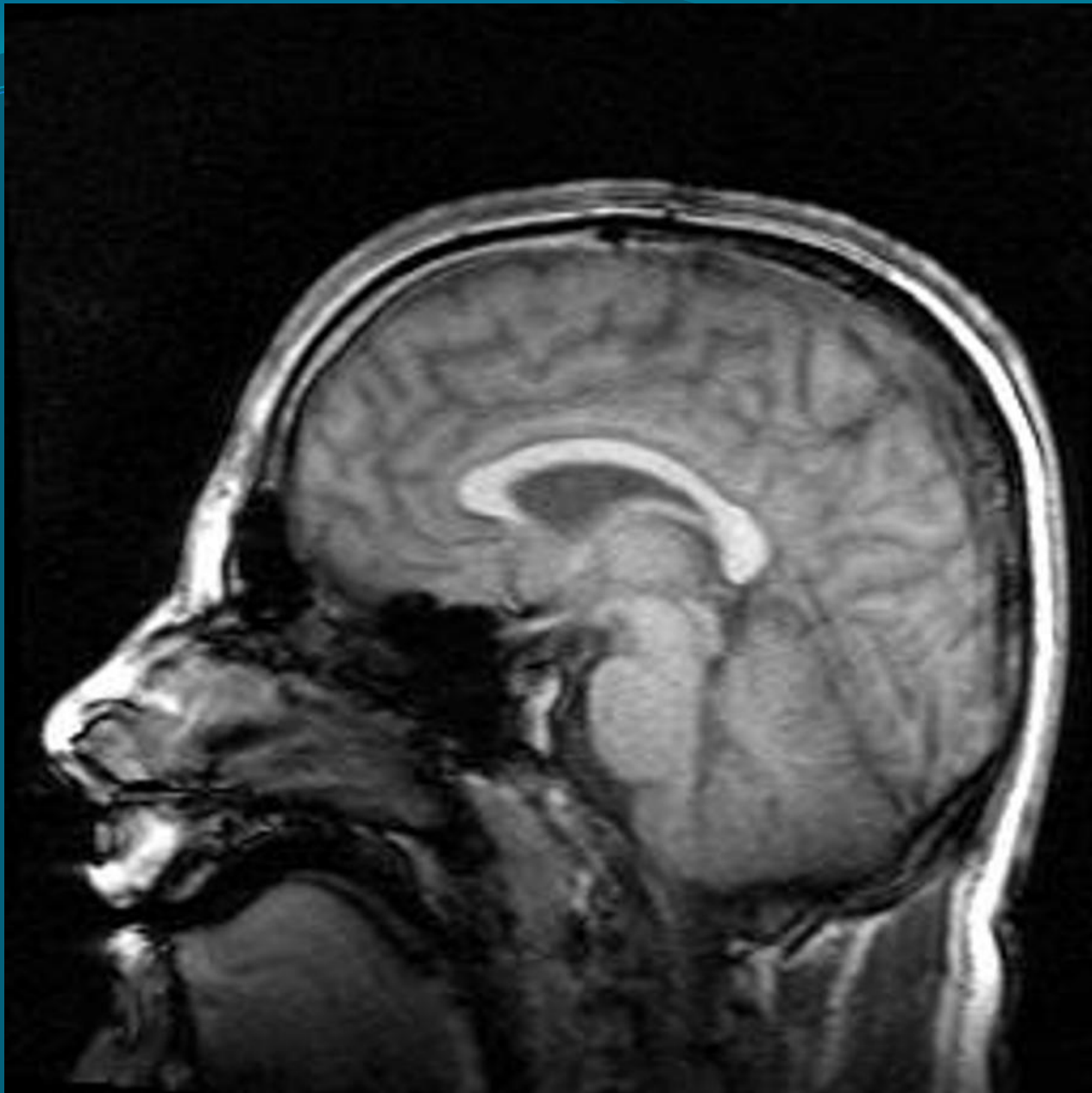
Misconceptions about the Brain

- Brain cells do not regenerate
- Areas of the brain, such as the hippocampus, do not add new neurons
- Myelination does not go on in our 50's and 60's

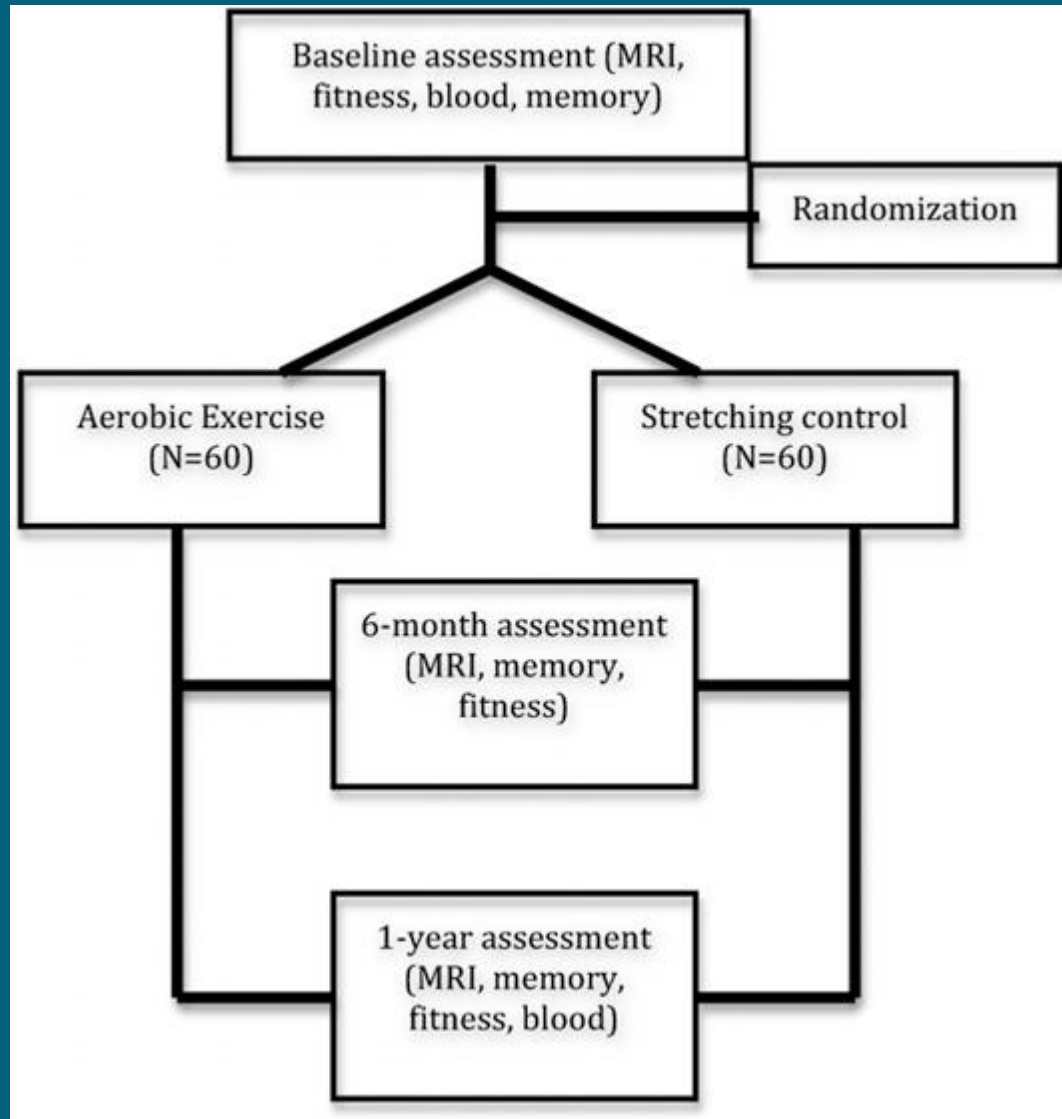
The Benefits of Exercise

- Increases Blood Supply
- Enhanced Neuroplasticity
[Increase in Synaptic Plasticity Genes, Gene Product]
- Hippocampal Dendrite Length and Dendritic Spine Complexity are Enhanced
- Elevates Brain Derived Neurotrophic Factor [BDNF]
- Insulin-like Growth Factor [IGFI]
- Drop in Stress Hormones





Exercise Training Increases Size of Hippocampus and Improves Memory

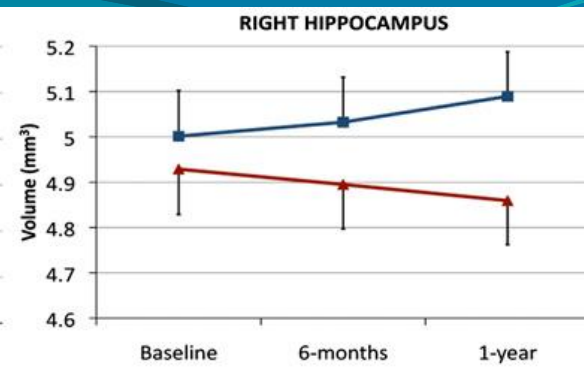
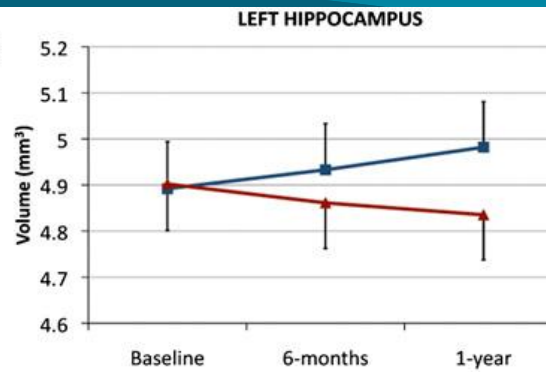
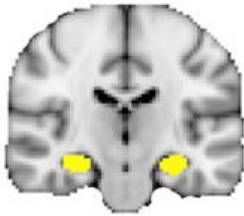


Ericson et al
PNAS 2011; 108:
3017 - 3022

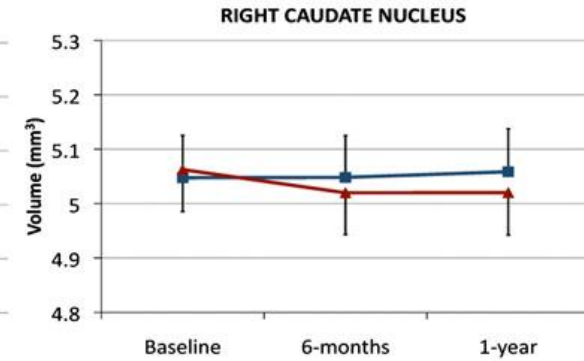
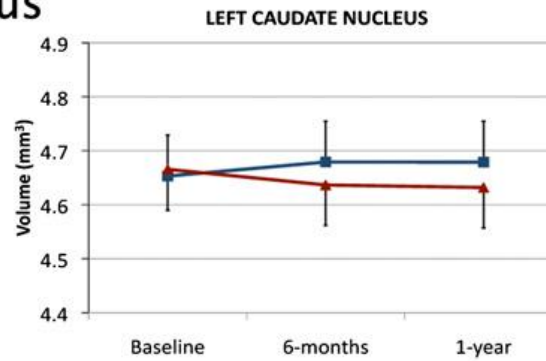
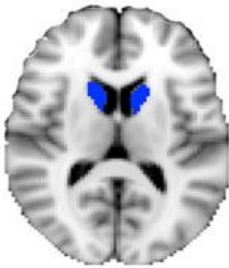
Table 1. Characteristics for the aerobic exercise and stretching control groups

Characteristic	Aerobic exercise	Stretching control
<i>n</i>	60	60
Age (y), mean (SD)	67.6 (5.81)	65.5 (5.44)
Sex (% female)	73	60
Attendance (%), mean (SD)	79.5 (13.70)	78.6 (13.61)
Fitness improvement (%), mean (SD)	7.78 (12.7)	1.11 (13.9)

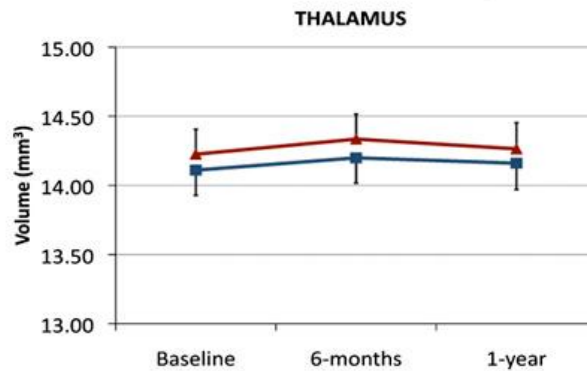
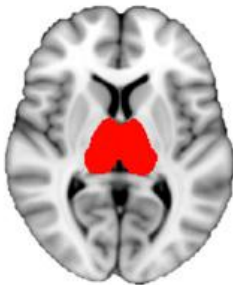
A Hippocampus



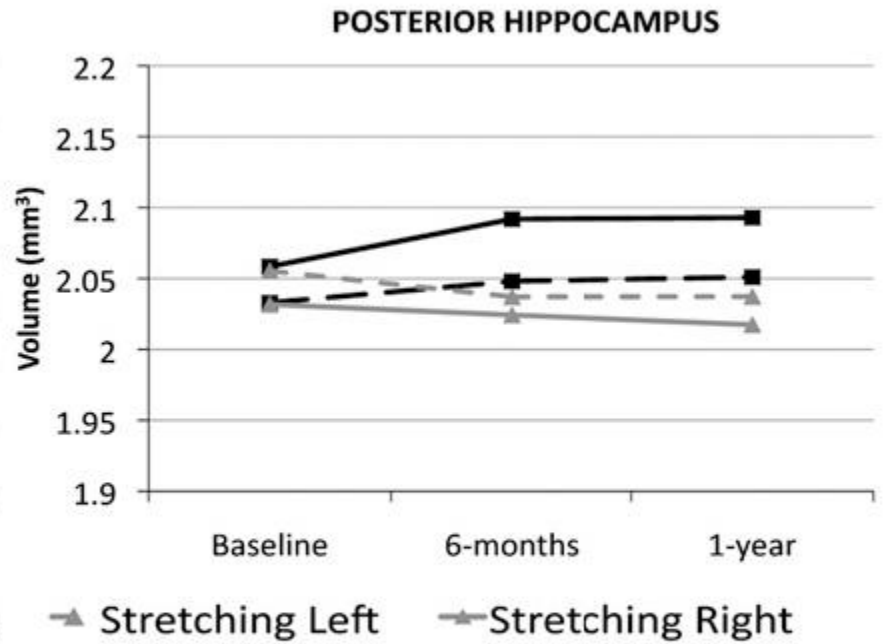
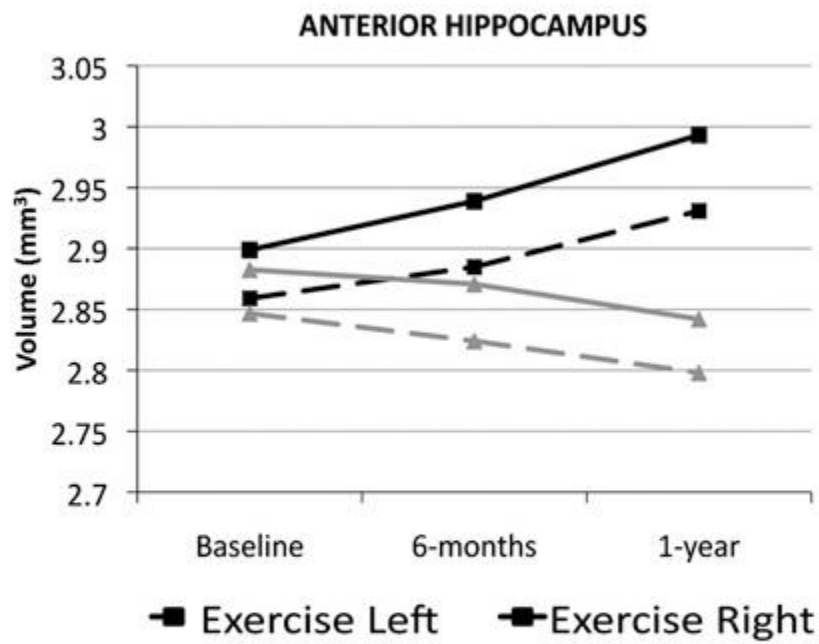
B Caudate Nucleus



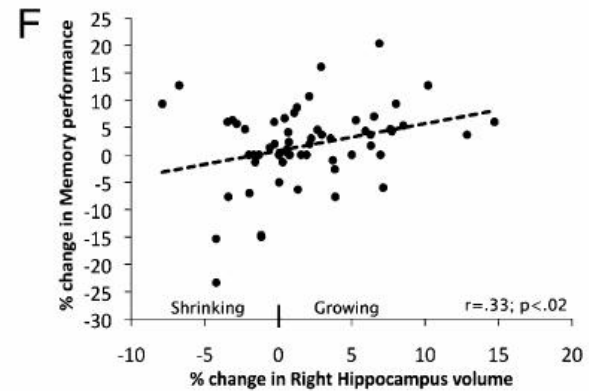
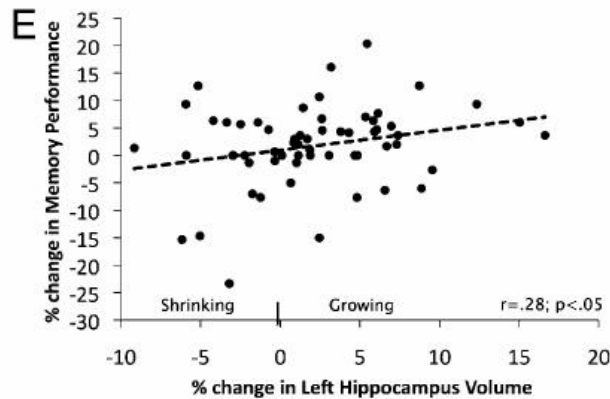
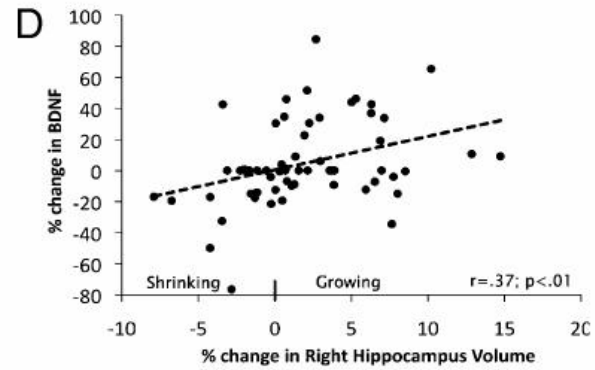
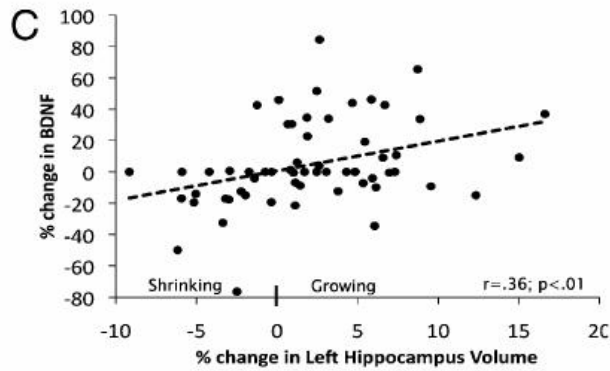
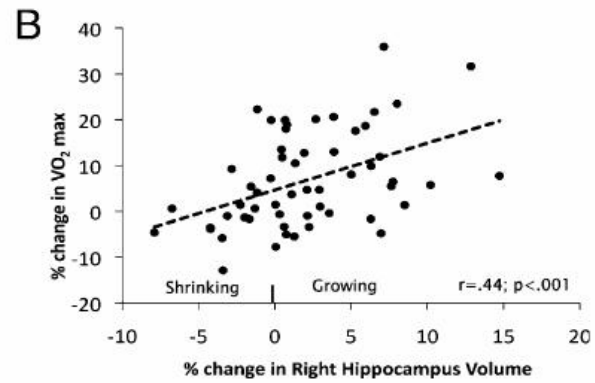
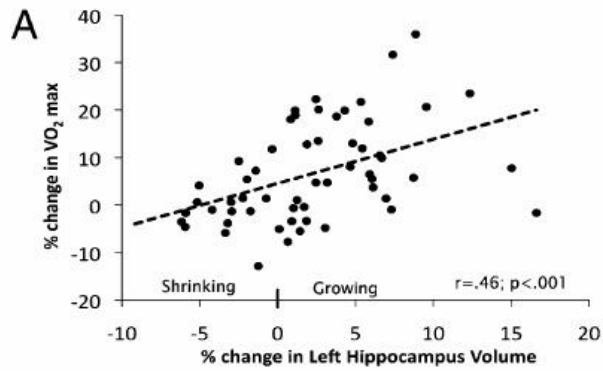
C Thalamus



■ Exercise
▲ Stretching



Erickson et al.



Physical Activity and Childhood Achievement

Evidence that Aerobic Fitness is More Salient than Weight Status in Predicting Standardized Math and Reading Outcomes in Fourth through Eight Graders

- Study of 11,747 Students in 47 Public Schools in Nebraska
- Aerobic Fitness – Progressive Aerobic Cardiovascular Endurance Run [Pacer]
- Nebraska State Accountability Math and Reading Test

Robert Rauner et al J Pediatrics 2013; 163: 344-348

Demographic and Descriptive Statistics of Students & School

Student Characteristics:

	<u>Fit Students [N=8116]</u>	<u>Unfit Students [N=3627]</u>
<u>BMI [Percentile]</u>	60.5	78.3
	<u>N[%]</u>	<u>N[%]</u>
Passed Math	6532 [80.5]	2386 [65.8]
Passed Reading	6845 [84.3]	2585 [71.3]
Free/Reduced Lunch	3039 [37.4]	2031 [56.0]
Boys	3646 [44.9]	2281 [62.9]
White	5846 [72.0]	2391 [65.9]

Robert Rauner et al J Pediatrics 2013; 63:344-8

Influence of Childhood Aerobic Fitness on Learning and Memory

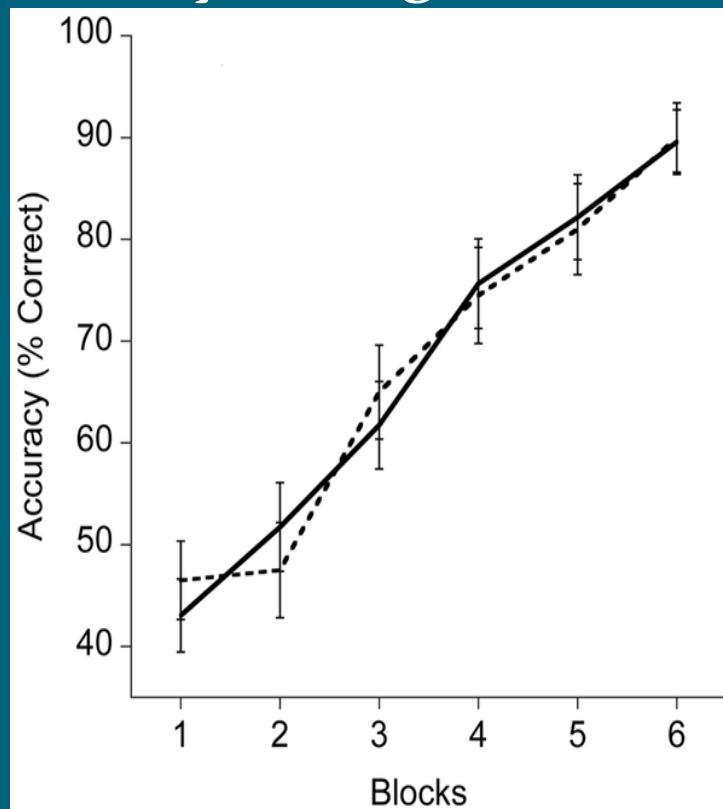
- To investigate Relationship Between Aerobic Fitness, Learning and Memory
- Task involved remembering names and locations on a
- fictitious map.
- Different learning strategies and recall procedures were employed to better understand effects on learning novel material.
- 48, 9-10 year old children were studied.
- Performed a task requiring them to learn the names of specific regions on a map, under two learning conditions in which they only studied (SO) versus a condition in which they were tested during study(TS)
- Lauren Raine et al [PLOS ONE 2013/Volume 8]

Mean Demographic Information for Higher Fit (HF) and Lower Fit(LF) Groups

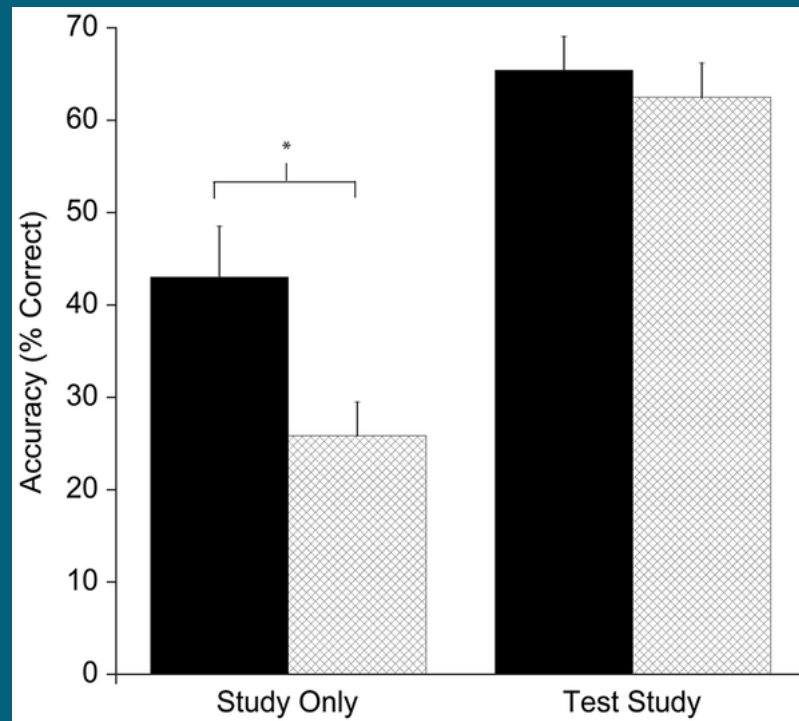
Measure	HF	LF
<i>n</i>	24 (14 female)	24 (12 female)
Age (years)	9.9 (0.1)	9.9 (0.6)
Socioeconomic Status (SES)	2.4 (0.1)	2.1 (0.1)
KBIT (IQ)	120.7 (2.2)	116.4 (1.4)
ADHD	35.0 (5.9)	33.3 (4.1)
VO ₂ max Relative*	51.4 (1.0)	37.3 (0.9)
VO ₂ max Percentile*	82.0 (1.3)	10.5 (1.4)

*Indicates significant difference, $p < 0.05$.
doi:10.1371/journal.pone.0072666.t001

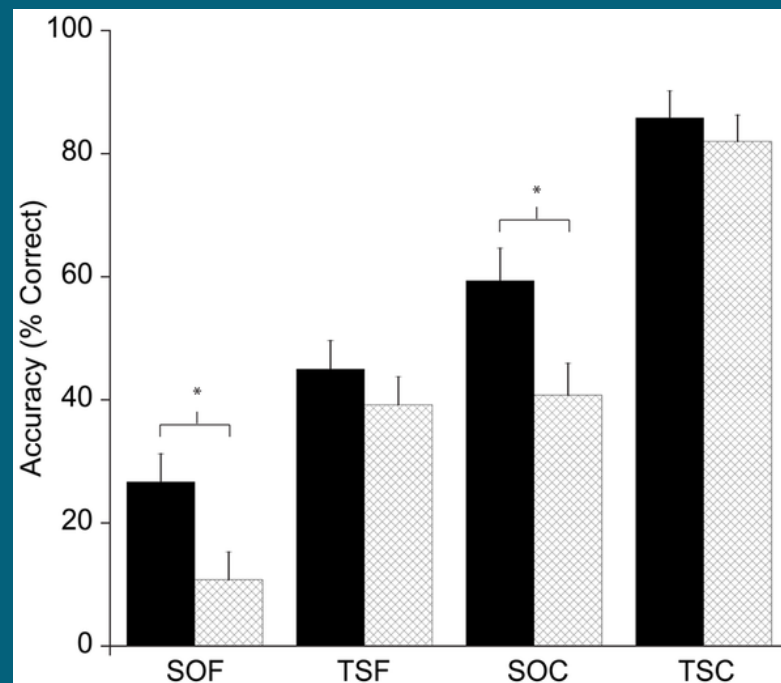
- Response accuracy for higher fit and lower fit



- Recall accuracy for higher fit and lower fit groups using the study only strategy



- Response accuracy for higher fit and lower fit groups on recall day



Physical Activity and Dementia

Different Varieties of Dementia

- Alzheimer Disease
- Dementia with Lewy Bodies
- Vascular Dementia
- Frontal Temporal Degeneration Syndromes
- Other Rarer Varieties of Dementia

Exercise and Alzheimer's Disease Biomarkers in Cognitively Normal Older Adults

- Pittsberg Compound – B [Positron Emissions Tomography]
- C.S.F Amyloid – B [AB)
- C.S.F TAU
- C.S.F Phosphorylated TAU [PTAU) 181

Kelvin Yliang et al
Ann Neurology 2010; 68:311-318
{Washington University, St. Louis MO}

Biomarkers and Relationship with Exercise

- 69 Older Adults [55-88 years]
- Cognitively Normal
- Physical Exercise Levels for Past Decade
- C.S.F Samples and Amyloid Imaging with PIB
- Low Exercise Levels were Associated with Elevated PIB, TAU, PTAU, and Lower AB42
- Active Individuals had Significantly Lower PIB and Higher AB42 Levels

Kelvin Yliang et al

Ann Neurology 2010; 68:311-318

{Washington University, St. Louis MO}

Physical Exercise as a Preventative or Disease Modifying Treatment of Dementia and Brain Aging

- Recent Meta Analysis of 29 Randomized Control Trials
- Significant Cognitive Benefits
- Functional MRI Improved
- Larger Hippocampal Volume
- Increased Cortical Volume
- Short Term Cognitive Benefit Among Those with MCI and Dementia
- . Eric Ahlskog et al (Mayo Clinical Proceeding 2011:86:876)

Physical Exercise and Mild Cognitive Impairment [Population Based Study] [Mayo.Clinic]

- Compared Physical Exercise in 198 with MCI to 1126 Cognitively Normal Subjects
- Moderate Intensity Exercise Carried out Either Mid-Life or Late Life was Associated with Reduced MCI

Y Geda et al ARCH.Neurology 2010; 67: 80-86

Effect of Physical Activity on Cognitive Function in Older Adults at Risk for Alzheimer's Disease

- 170 Participated in the Study [50 years or older]
- All volunteers reported memory problems did not meet criteria for Dementia
- Participants were randomly allocated
 - --Educational and Usual care
 - --24 Week home Based Physical Activity
- Main outcome measure was change in Alzheimer Disease Assessment scale over 18 months
- Participants in the Intervention Group improved 0.26 points, while those in the usual care group deteriorated 1.04 points

Summary

- Types of Physical Activity
- Physical Activity Improves Achievements in School
- Physical Activity Prevents and Treats Cognitive Impairment in Adults