



# LIMITLESS

**YOUR BRAIN ON EXERCISE**

PRESENTED BY

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- **PACIFIC BRAIN HEALTH CENTER**  
Research, Education, FitBrain Program
- **MSC APPLIED NEUROSCIENCE**
- **PHD STUDENT: HEALTH & HUMAN PERFORMANCE**  
Focus in Gerontology
- **BS EXERCISE SCIENCE**
- **BRAIN HEALTH COACH**
- **NSCA - CPT**
- **FUNCTIONAL AGING SPECIALIST**



# WHAT CONSTITUTES BRAIN HEALTH (RESPECTIVE TO AGE)?

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- **PRESERVATION OF BRAIN VOLUME**
- **PRESERVATION OF BRAIN FUNCTION**
- **MAINTAINED/IMPROVED COGNITION**
- **REGULATION OF MENTAL HEALTH**
- **RESILIENCE TO INSULTS/STRESSORS**

# CONDITIONS THAT AFFECT COGNITION AND BRAIN HEALTH

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**MEDICATIONS**



**OBESITY & METABOLIC DISORDERS**



**CARDIOVASCULAR CONDITIONS**



**CANCER & CHEMOTHERAPY**

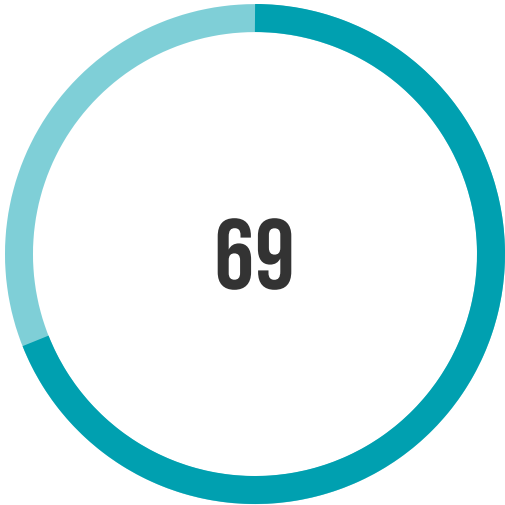


**NEUROLOGICAL &  
NEURODEGENERATIVE CONDITIONS**

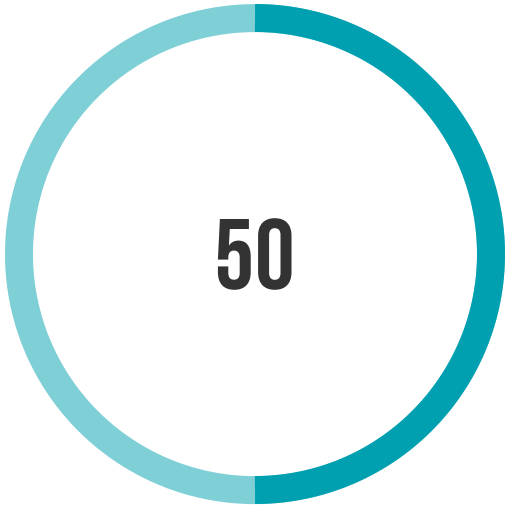


**MENTAL HEALTH**

# GLOBAL PREVALENCE (IN MILLIONS)



TBI



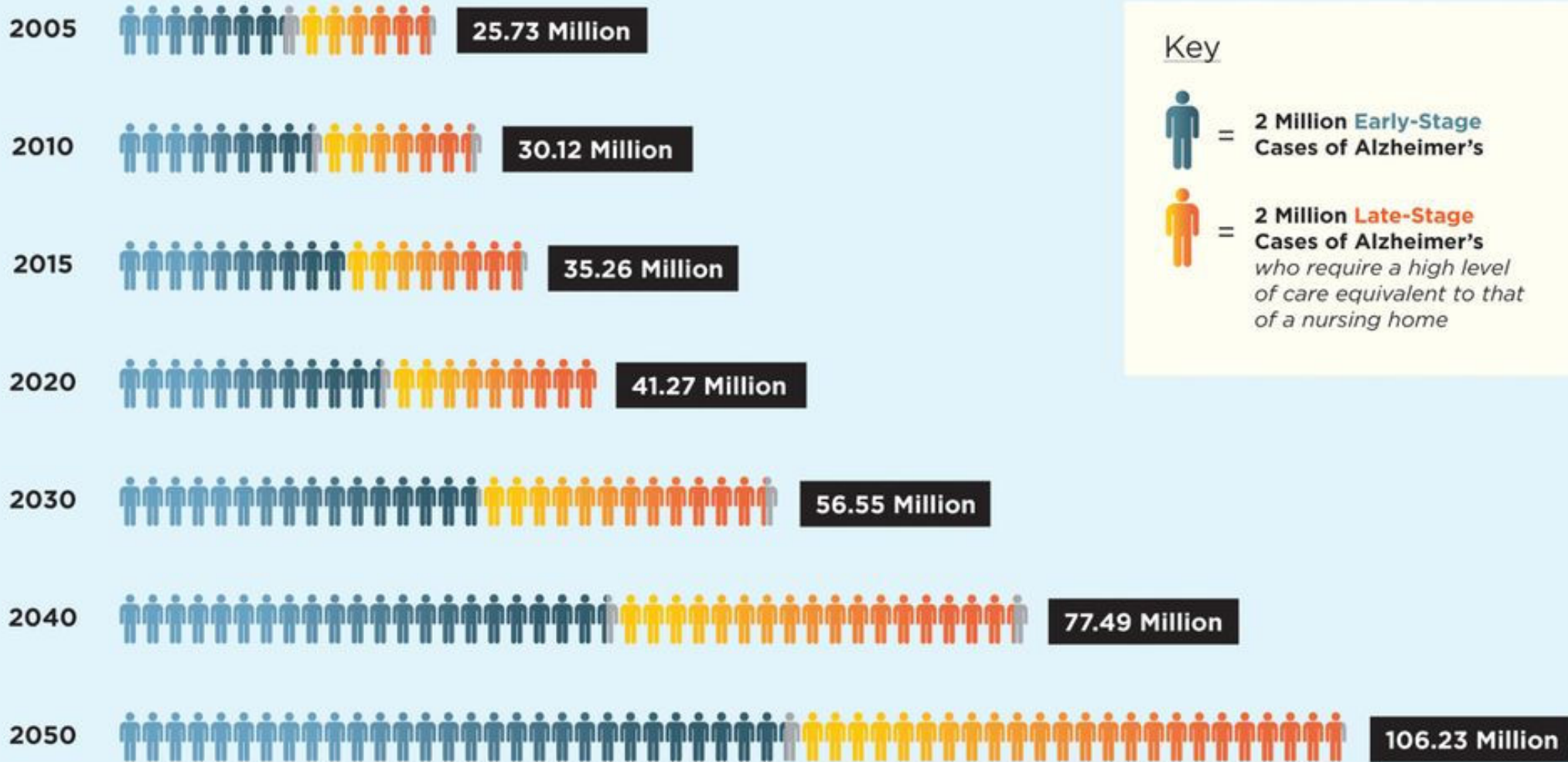
DEMENTIA



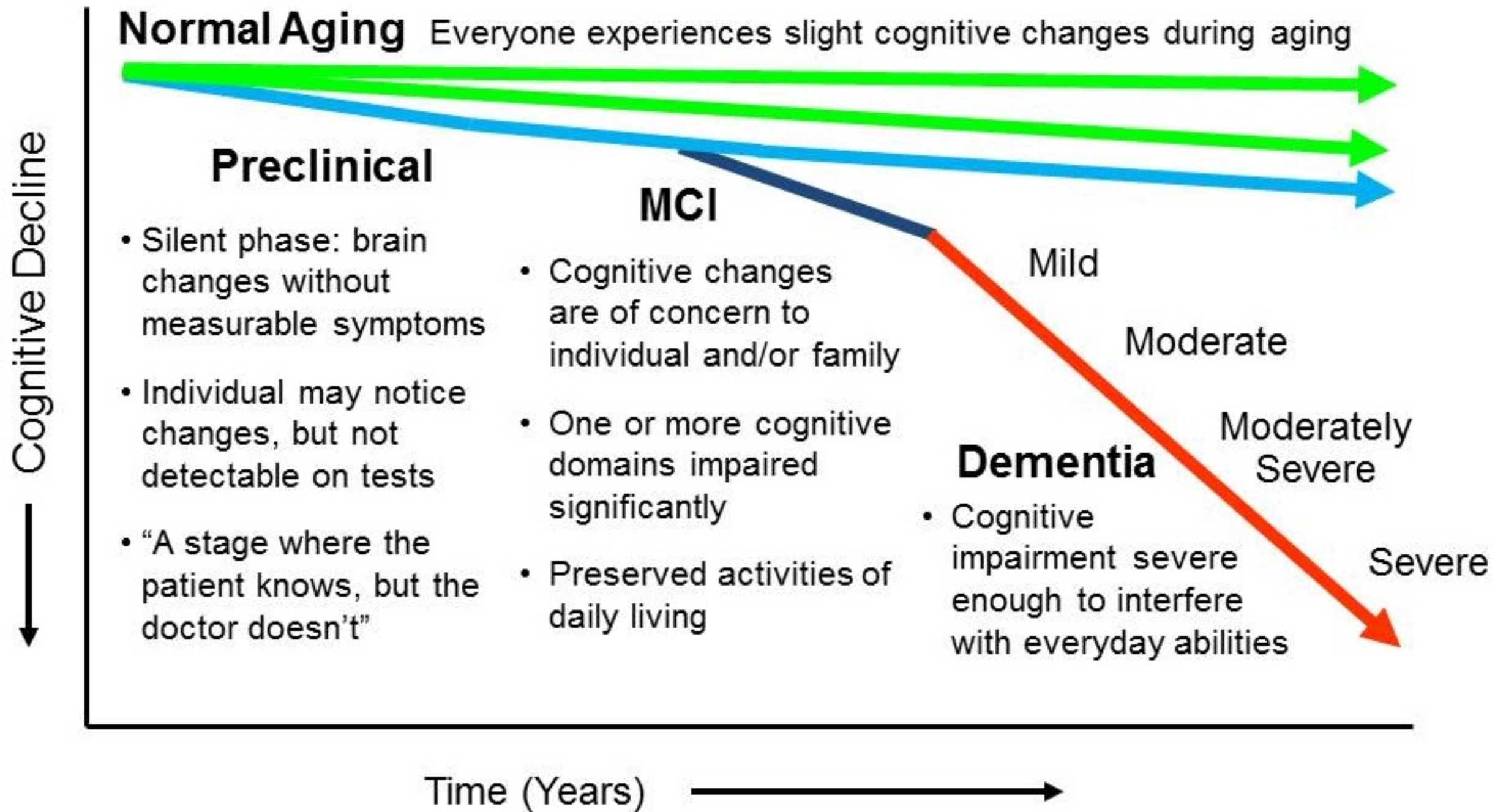
PARKINSON'S

# WORLDWIDE PROJECTIONS OF ALZHEIMER'S PREVALENCE

FOR THE YEARS 2005-2050, BY STAGE OF DISEASE (IN MILLIONS)

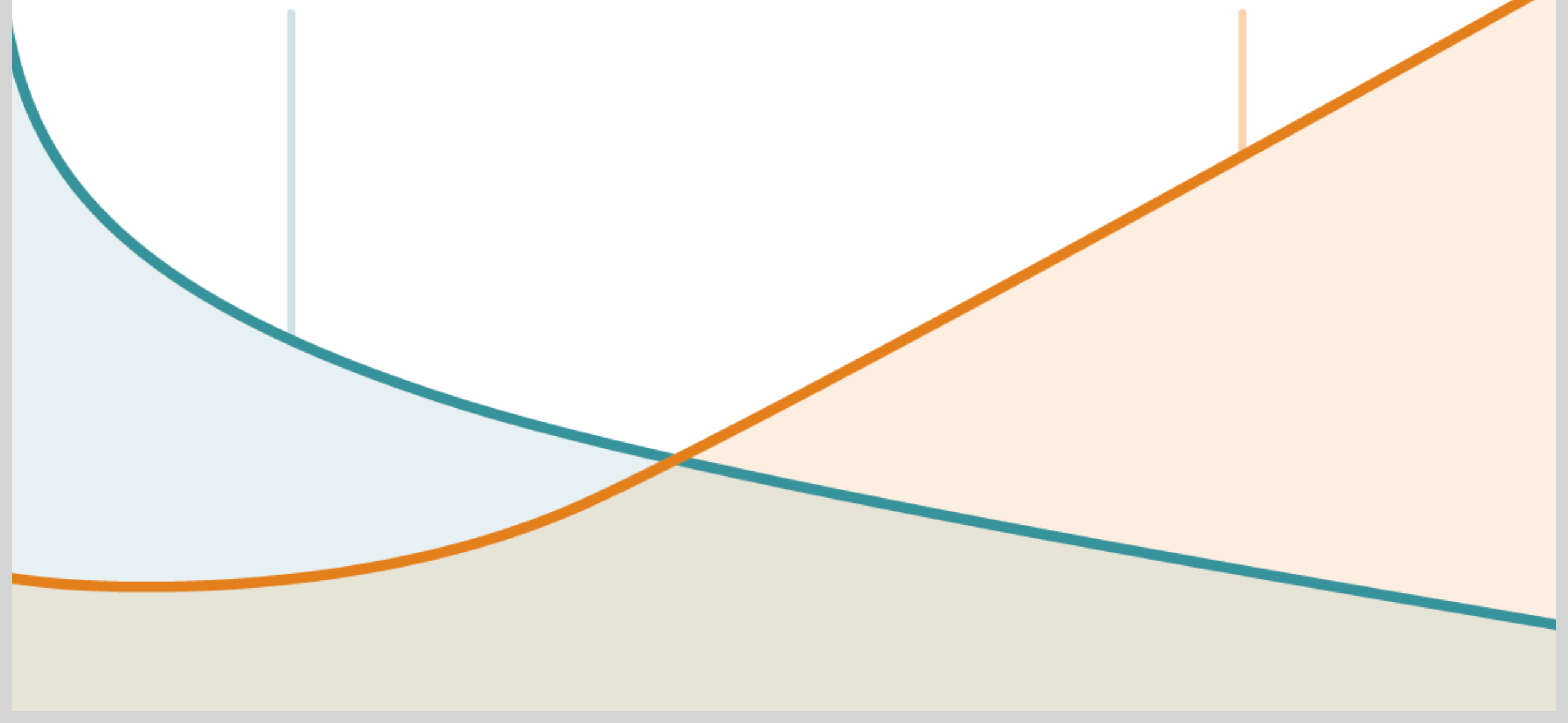




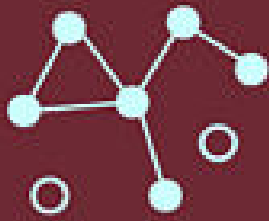


The brain's **ability to change**  
in response to experiences

The **amount of effort**  
such change requires



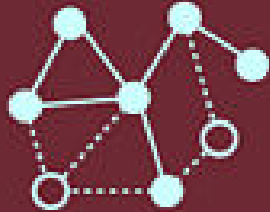




## NEUROGENESIS

Continuous generation of new neurons in certain brain regions

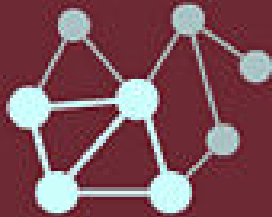
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## NEW SYNAPSES

New skills and experiences create new neural connections

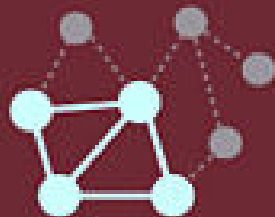
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## STRENGTHENED SYNAPSES

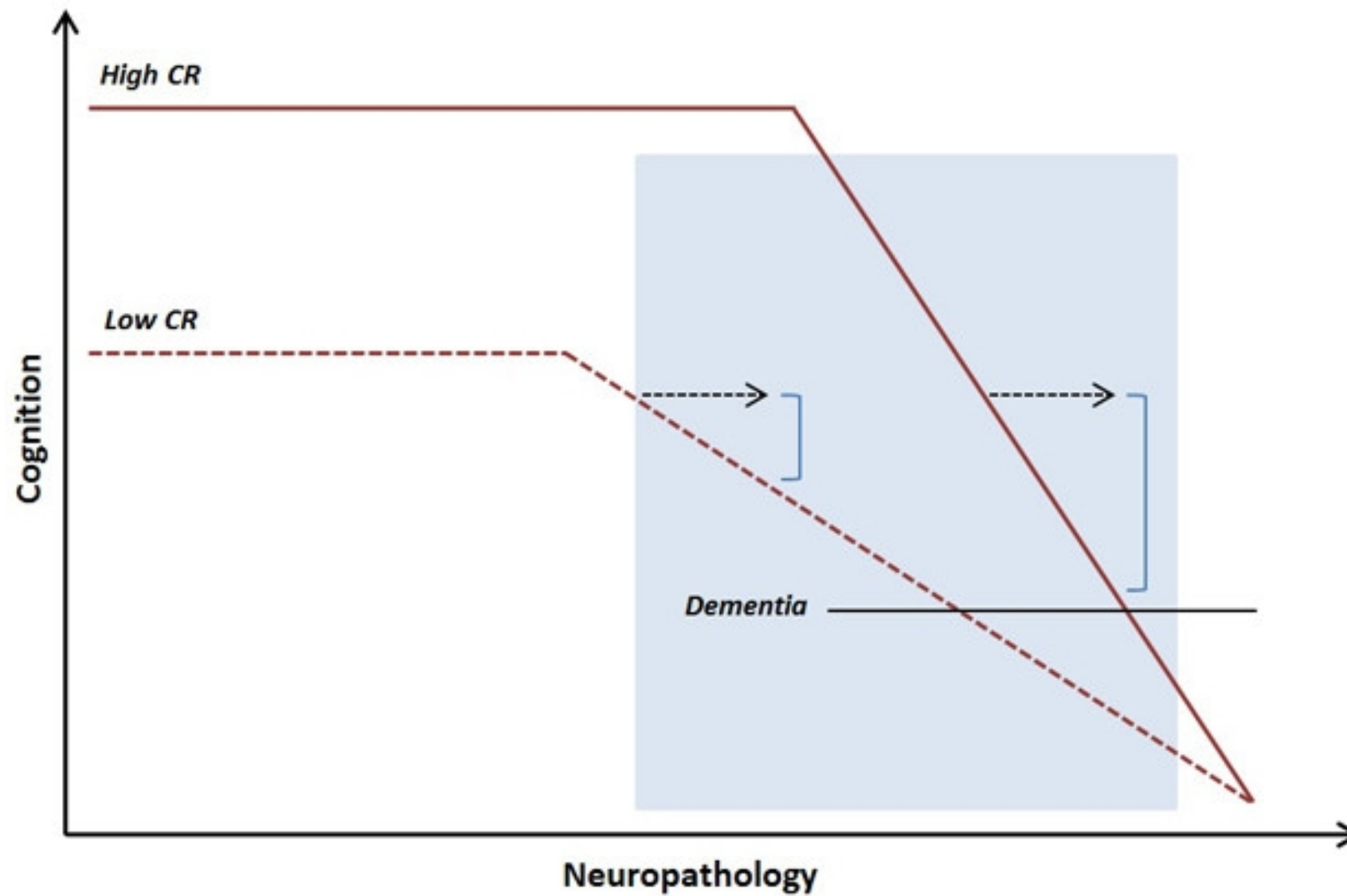
Repetition and practice strengthens neural connections

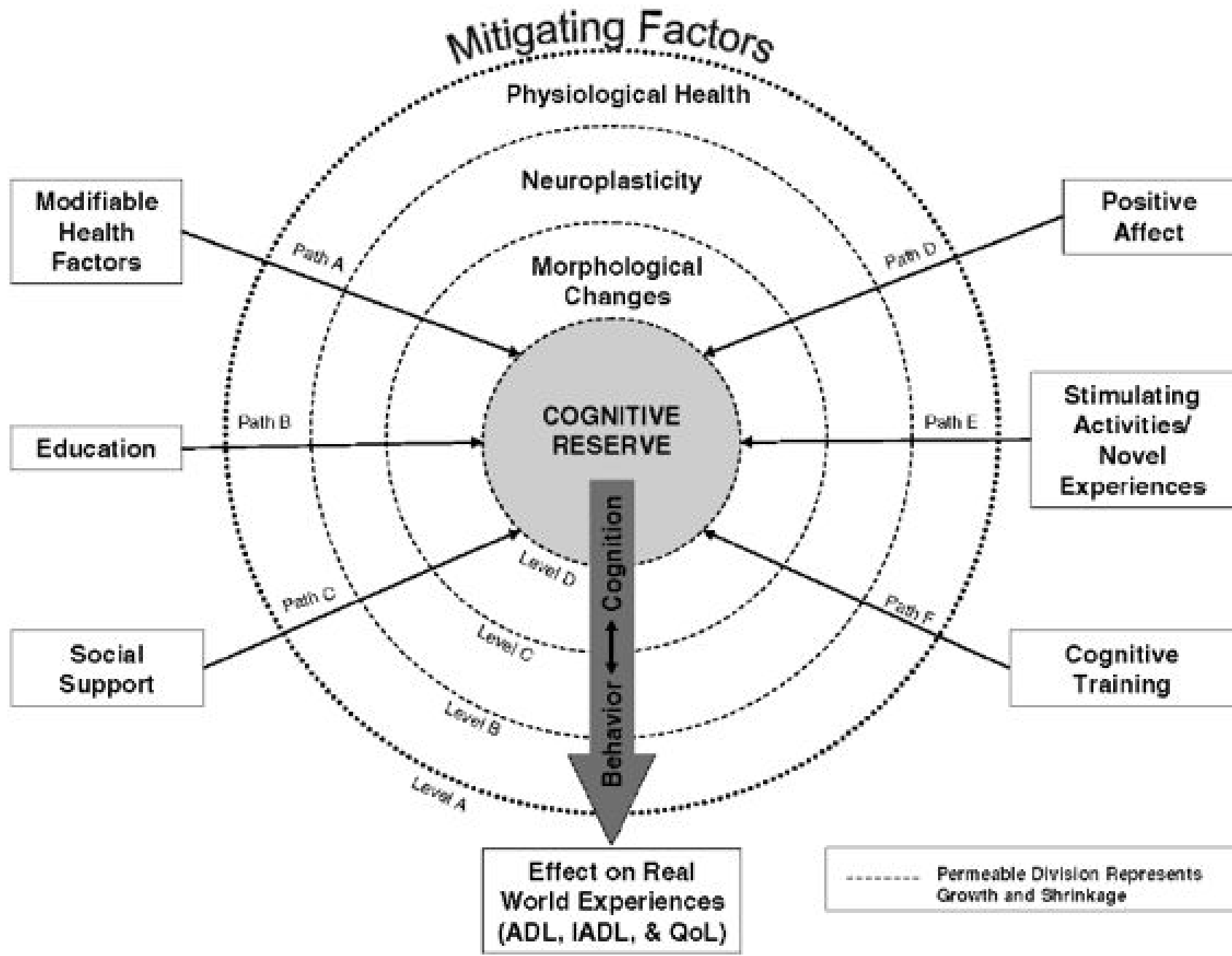
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## WEAKENED SYNAPSES

Connections in the brain that aren't used become weak





# Mitigating Factors

Physiological Health

Neuroplasticity

Morphological Changes

**COGNITIVE RESERVE**

Behavior ↔ Cognition

Effect on Real World Experiences (ADL, IADL, & QoL)

----- Permeable Division Represents Growth and Shrinkage

**Modifiable Health Factors**

**Education**

**Social Support**

**Positive Affect**

**Stimulating Activities/ Novel Experiences**

**Cognitive Training**

Path A

Path B

Path C

Path D

Path E

Path F

Level D

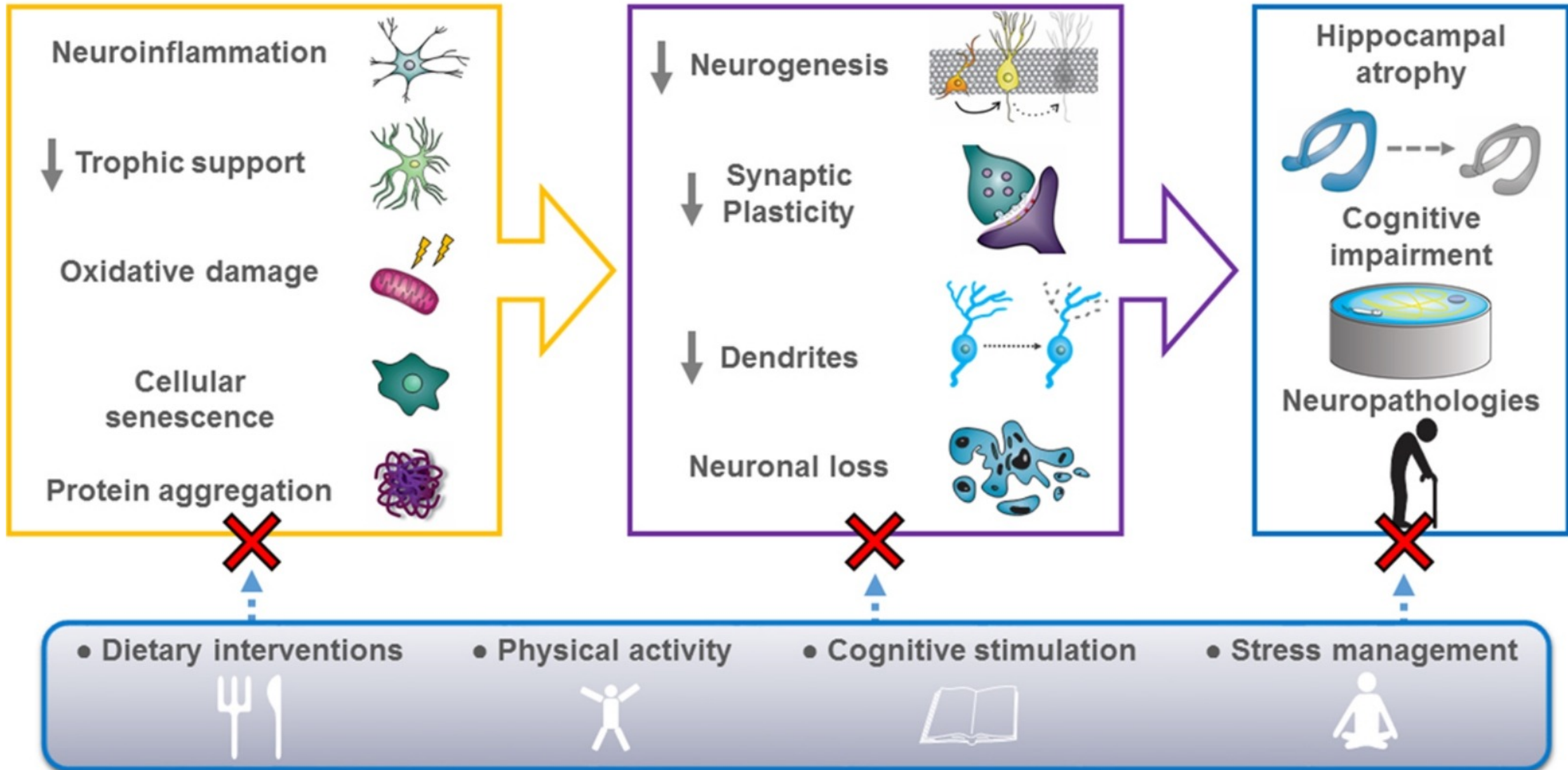
Level C

Level B

Level A



# Aging hippocampus



# LIFESTYLE FACTORS THAT INFLUENCE BRAIN HEALTH & COGNITION



**EXERCISE & PHYSICAL  
ACTIVITY**



**SLEEP**



**DIET**



**STRESS MANAGEMENT**



**MEDICATIONS**



**COMORBIDITIES**



**COGNITIVE STIMULATION**



**SOCIAL SUPPORT**

# EXERCISE & THE BRAIN

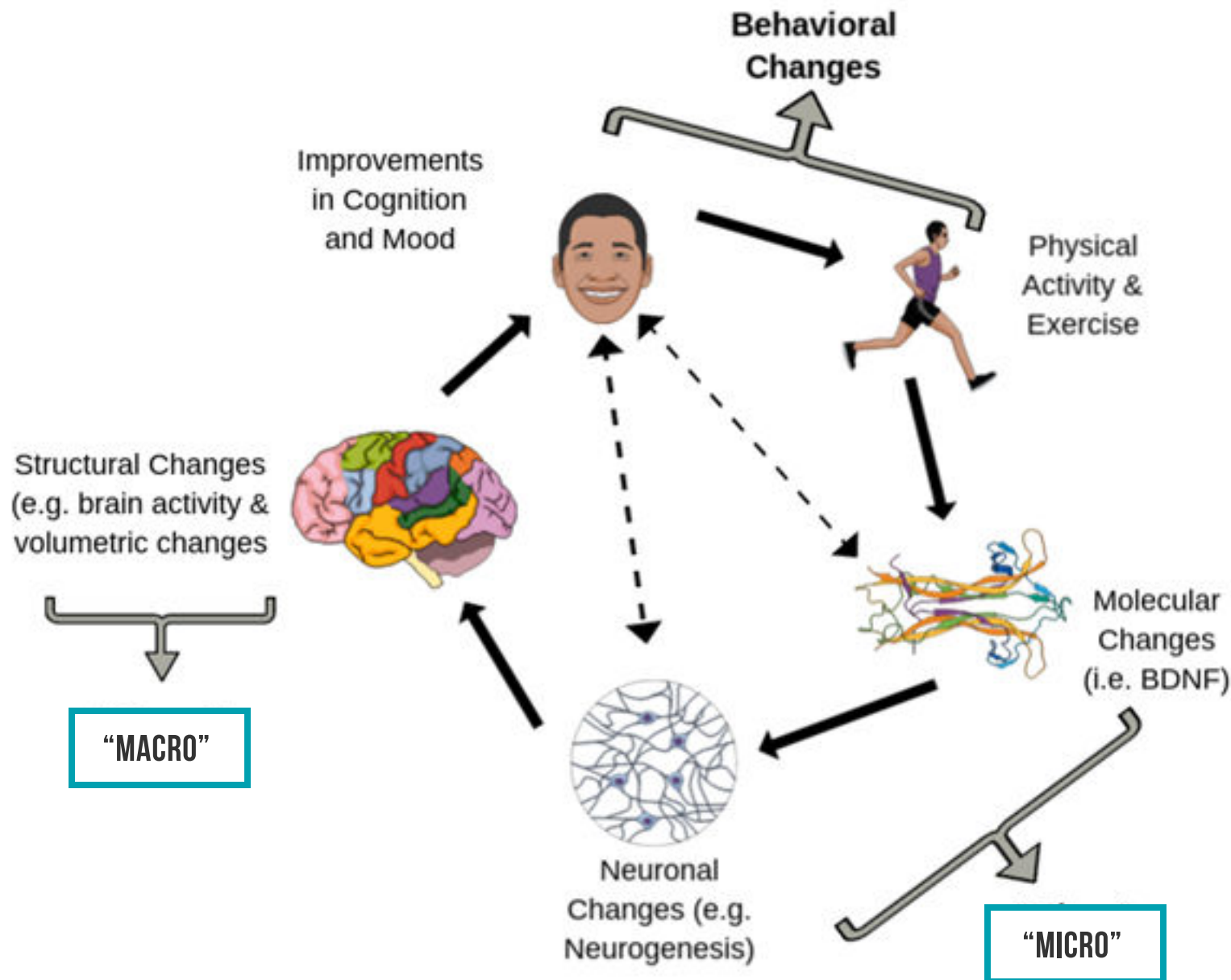


# COMPONENTS OF THE BRAIN

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- **NEURONS (BRAIN CELLS)**
- **SYNAPSES (CONNECTIONS)**
- **BEHAVIOR**  
Cognition AND/OR Mood
- **SIGNALLING FACTORS**  
Growth factors, hormones, proteins, etc
- **BRAIN REGIONS**  
Functionally AND/OR Structurally
- **BRAIN NETWORKS (CEN/DMN)**
- **GLIAL CELLS (SUPPORT)**
- **BLOOD SUPPLY**

# HOW EXERCISE CAN AFFECT THE BRAIN



- **BEHAVIORAL**

Mood  
Cognition

- **“MICRO”**

Neurons  
Vessels  
Growth Factors

- **“MACRO”**

Function  
Structure

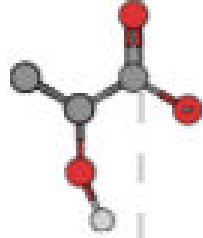
15 min >> 30 min >> 60 min >> 120 min >> 3 hrs >> 24 hrs



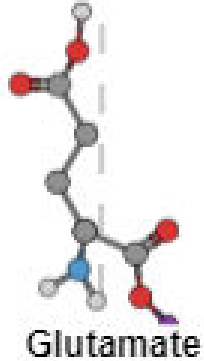
PFC Activation



GABA



Lactate



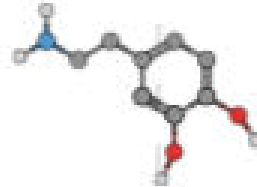
Glutamate



BDNF



PFC-dependent  
Cognitive  
Functioning



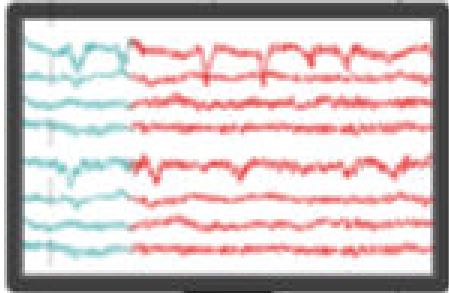
Dopamine



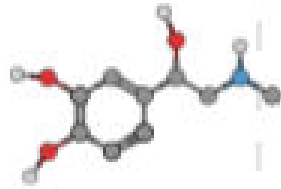
Stress  
Reduction



Mood States  
(Decreased  
Negative Mood,  
Increased  
Positive Mood)



Delta, Theta,  
Alpha, Beta



Norepinephrine



Cortisol



Serotonin

Basso, J. C., & Suzuki, W. A. (2017). The effects of acute exercise on mood, cognition, neurophysiology, and neurochemical pathways: a review. *Brain Plasticity*, 2(2), 127-152.



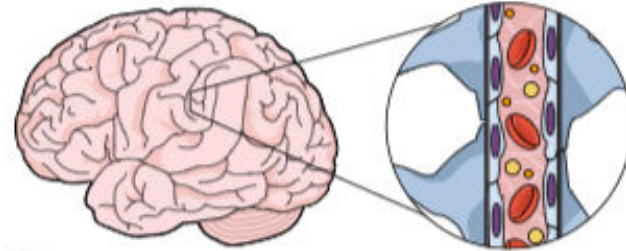
# Effects of Exercise on Angiogenesis

(re)Generating Vascular Networks

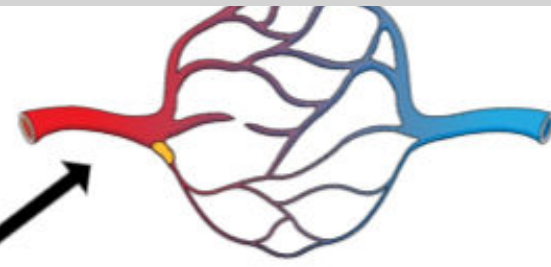
*Regenerative Angiogenesis, Volume: 120, Issue: 9*



Stimulus for  
Angiogenesis  
(Exercise)



Increase in Cerebral  
Blood Flow (CBF)



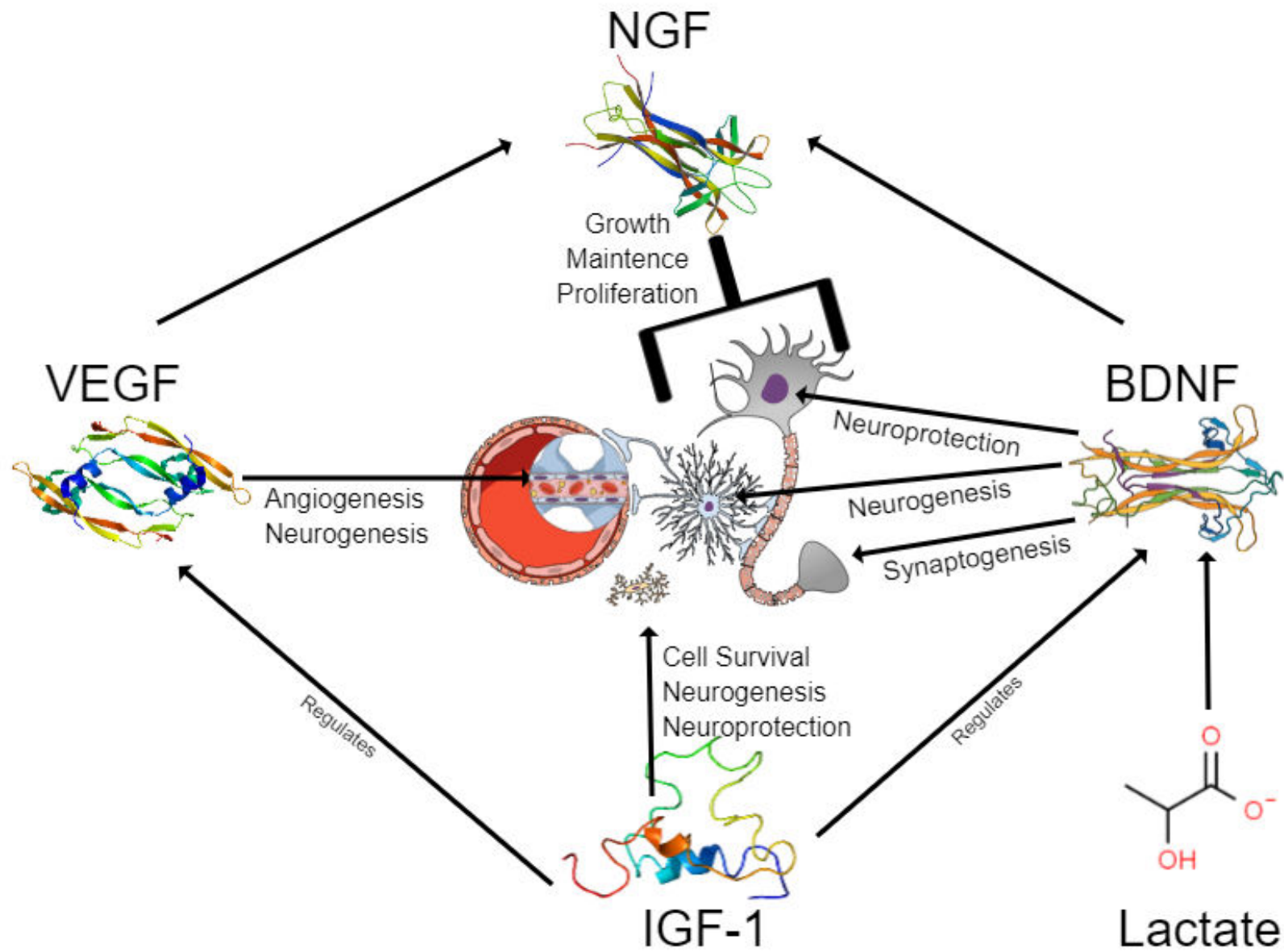
Healthy  
Angiogenesis

- Increased Capillary Density
- Responsive to Metabolic Demands
- Improved Connectivity of Vascular Network

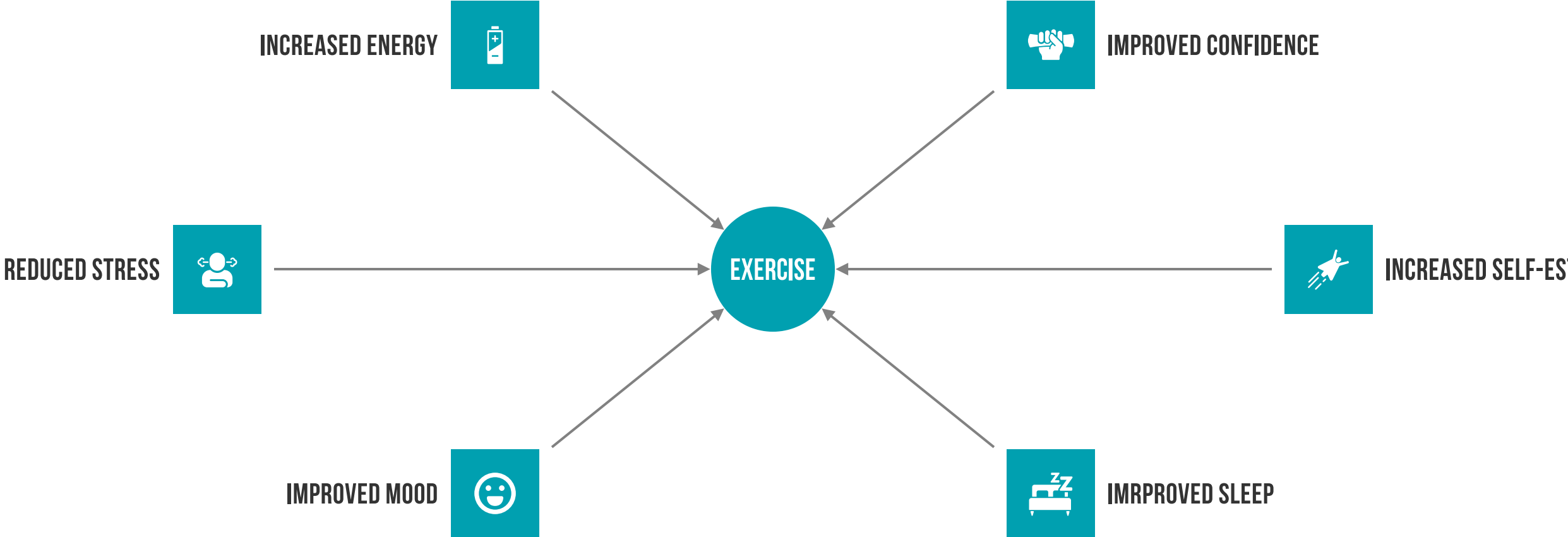


Facilitates  
Neurogenesis

- Neuroprotective
- Synergistic to Learning & Memory
- Promotes Growth Factors



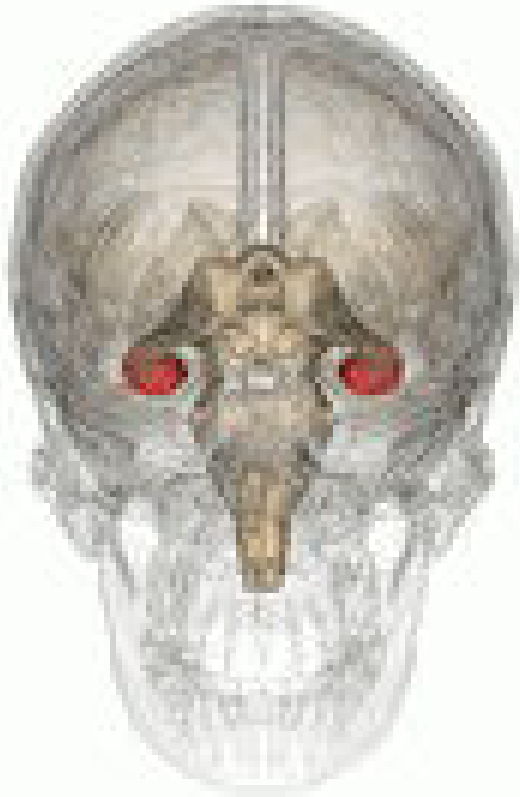
# EXERCISE EFFECTS ON MENTAL HEALTH





# HIPPOCAMPUS & EXERCISE

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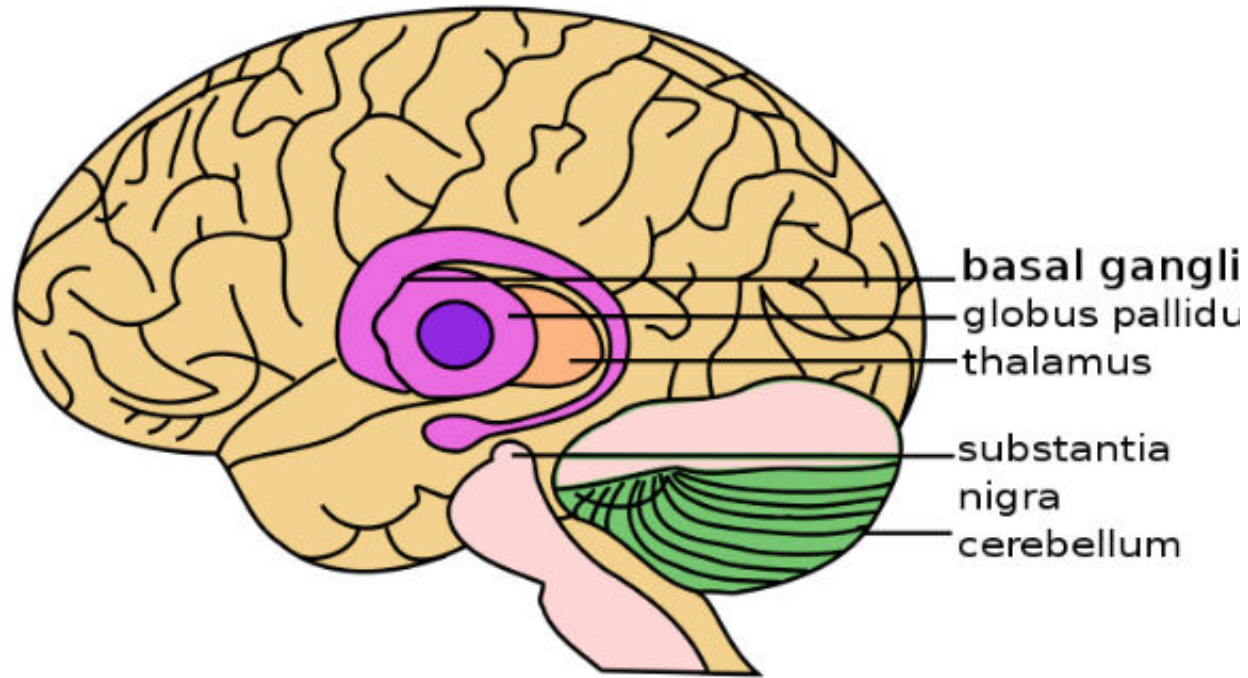
- **LOCATED IN THE TEMPORAL LOBES**
- **INCREASES IN STRUCTURE & VOLUME WITH AEROBIC EXERCISE**
- **ALSO RESPONDS TO RESISTANCE TRAINING & PHYSICAL ACTIVITY**
- **RELATED TO IMPROVEMENTS IN MEMORY**

# EFFECTS OF RESISTANCE TRAINING ON THE BRAIN



- **STRUCTURAL & FUNCTIONAL IMPROVEMENTS IN THE FRONTAL LOBE**
- **INCLUDES IMPROVEMENTS IN EXECUTIVE FUNCTIONS**  
the “CEO” of the brain  
(coordinates other skills and functions)
- **LOWER WHITE MATTER ATROPHY & LESIONS**

# MOTOR FITNESS EFFECTS

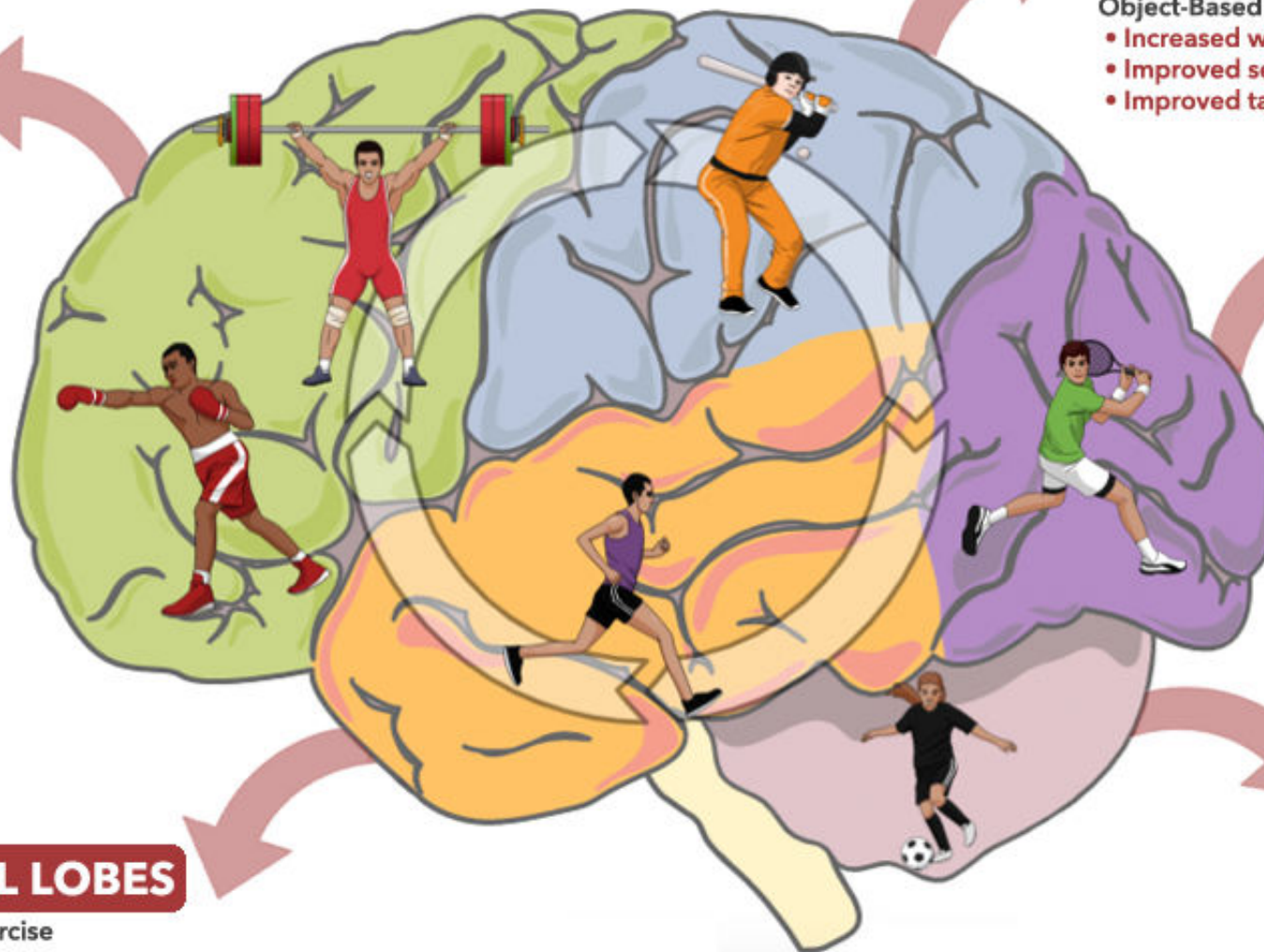


- **IMPROVES CEREBELLAR + BASAL GANGLIA SIZE AND STRUCTURE**
- **SPECIALIZED SKILL-BASED PATHWAYS THAT MEDIATE COGNITIVE IMPROVEMENTS**
- **SPORTS, DANCE, MARTIAL ARTS**  
From Ping Pong to Tai Chi!
- **COGNITIVE-MOTOR DUAL-TASKING**

## FRONTAL LOBE

Cognitively-Demanding Activities  
Open Skill Activities  
Resistance Training  
Mind-Body Exercise

- Increased Gray Matter
- Improved Executive Functions
- More Efficient Brain Activity



## PARIETAL LOBE

Sensory-Rich Activities  
Visuo-spatial Demands  
Object-Based Activities

- Increased white matter & volume
- Improved sensory network activity
- Improved task-switching abilities

## OCCIPITAL LOBE

Visuo-spatial Demands  
Visual Attention Demands  
Motor Control & Stimulation

- Increased white & gray matter
- Improved visual skills & attention
- Increased volume & function

## TEMPORAL LOBES

Cardiovascular Exercise  
Closed Skill Activities  
Generalized Physical Activity

- Improved Learning & Memory
- Increased Neurogenesis
- Increased Hippocampal Volumes

## CEREBELLUM

Coordinative Exercise  
Skill & Motor Learning  
Open Skills Activities

- Increased cerebellar volume & function
- Improved coordination & attention
- Higher nerve cell & blood vessel volume



# DEFINING EXERCISE MODALITIES

# PRIMARY EXERCISE MODALITIES

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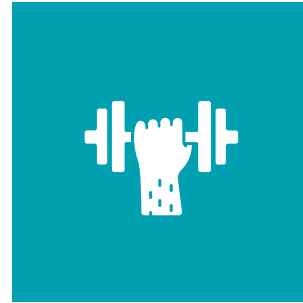


## AEROBIC

Steady State

Interval

Intensity (L,M,H)



## STRENGTH

Closed Skill Training

Open Skill (Functional) Training

Bodyweight Strength



## NEURO(MOTOR)/SKILL

Sports, Dance, Martial Arts

Mind-Body Exercise

Dual-Task/Exergaming

**“OPEN SKILL EXERCISE IS MORE EFFECTIVE FOR IMPROVING SOME ASPECTS OF COGNITIVE FUNCTION COMPARED WITH CLOSED SKILL EXERCISE.”**

Gu, Q., Zou, L., Loprinzi, P. D., Quan, M., & Huang, T. (2019). Effects of open versus closed skill exercise on cognitive function: A systematic review. *Frontiers in psychology*, 10, 1707.

## Open



## Closed

Environment is constantly changing

Movements have to be continually adapted

Predominately externally paced

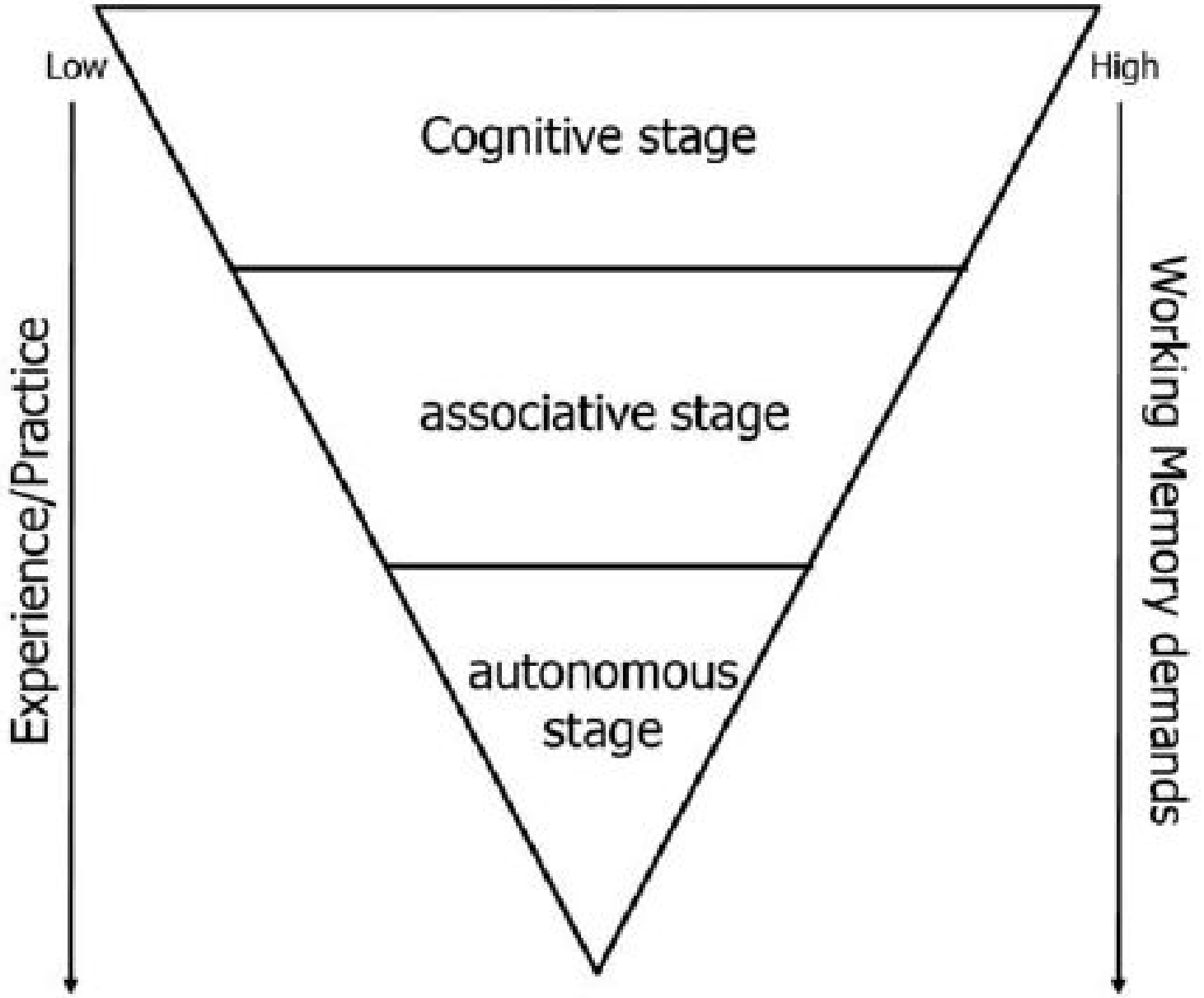
Stable & predictable environment

Movements have a clear beginning & end

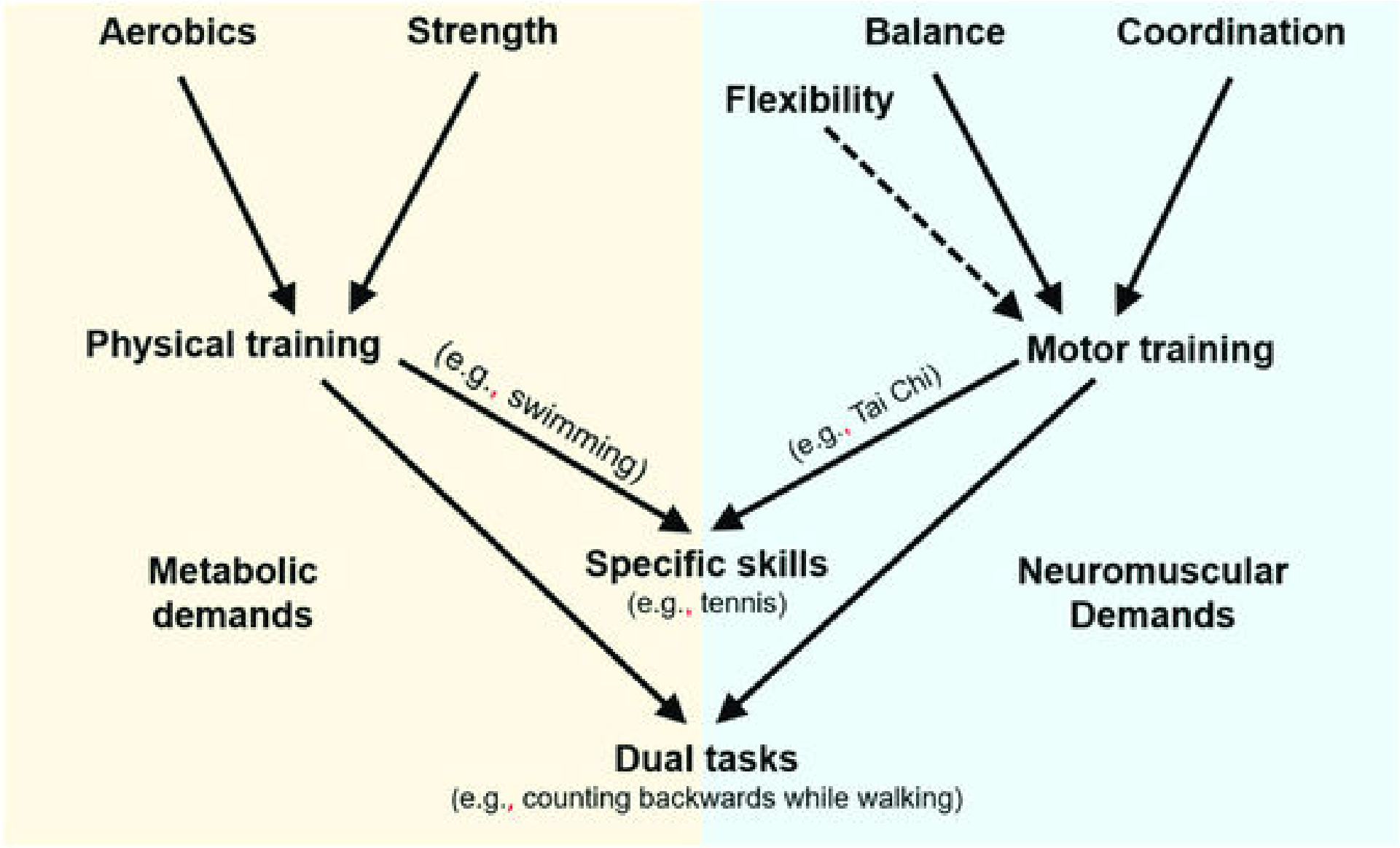
Performer knows what to do & when



**Controlled processing**



**Automatic processing**





# DUAL TASK DEFINITION

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- **TO TRAIN INDIVIDUALS TO BE ABLE TO PERFORM TWO TASKS SIMULTANEOUSLY, ONE PRIMARY AND OTHER SECONDARY, THAT CAN BE:**
  - performed independently
  - measured separately
  - have distinct goals.

ADAPTED FROM MCISAAC ET AL, BUILDING A FRAMEWORK FOR A DUAL TASK TAXONOMY. BIOMED RES INT 2015



# DUAL-TASK INTERFERENCE INCREASES WITH AGING

Credit to John Dean & Josefa Domingues



**STOP WALKING TO TALK**



**WORD FINDING TO TALK  
WHILE WALKING**



**EATING AND TALKING**



**SHORT TERM RECALL OF A  
PASSWORD WHILE SETTING UP**

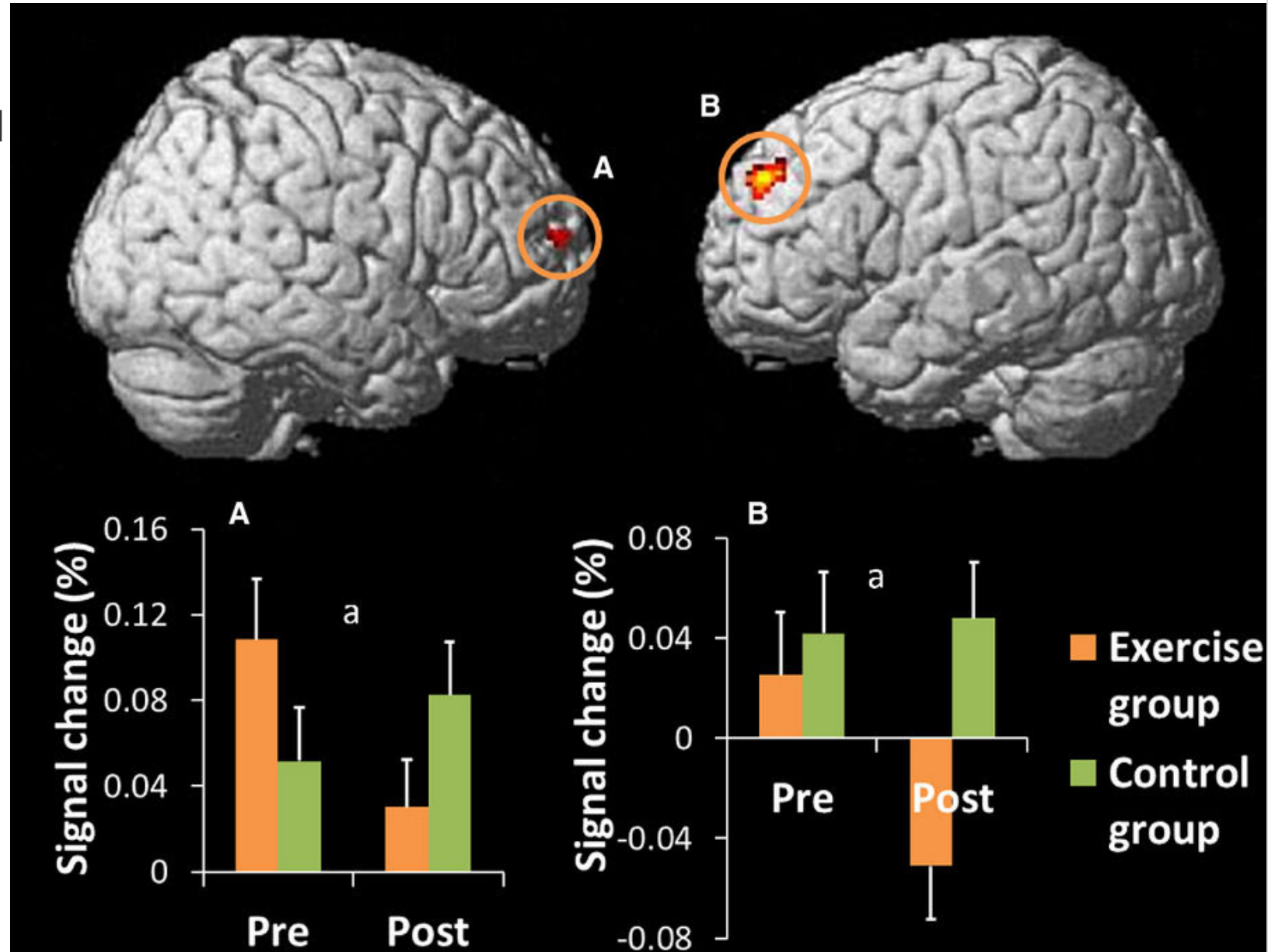
# IS DUAL TASKING BETTER THAN PHYSICAL EXERCISE ALONE?

Zhu et al. (2016) combined data from 20 randomized controlled studies with 2667 participants and found:

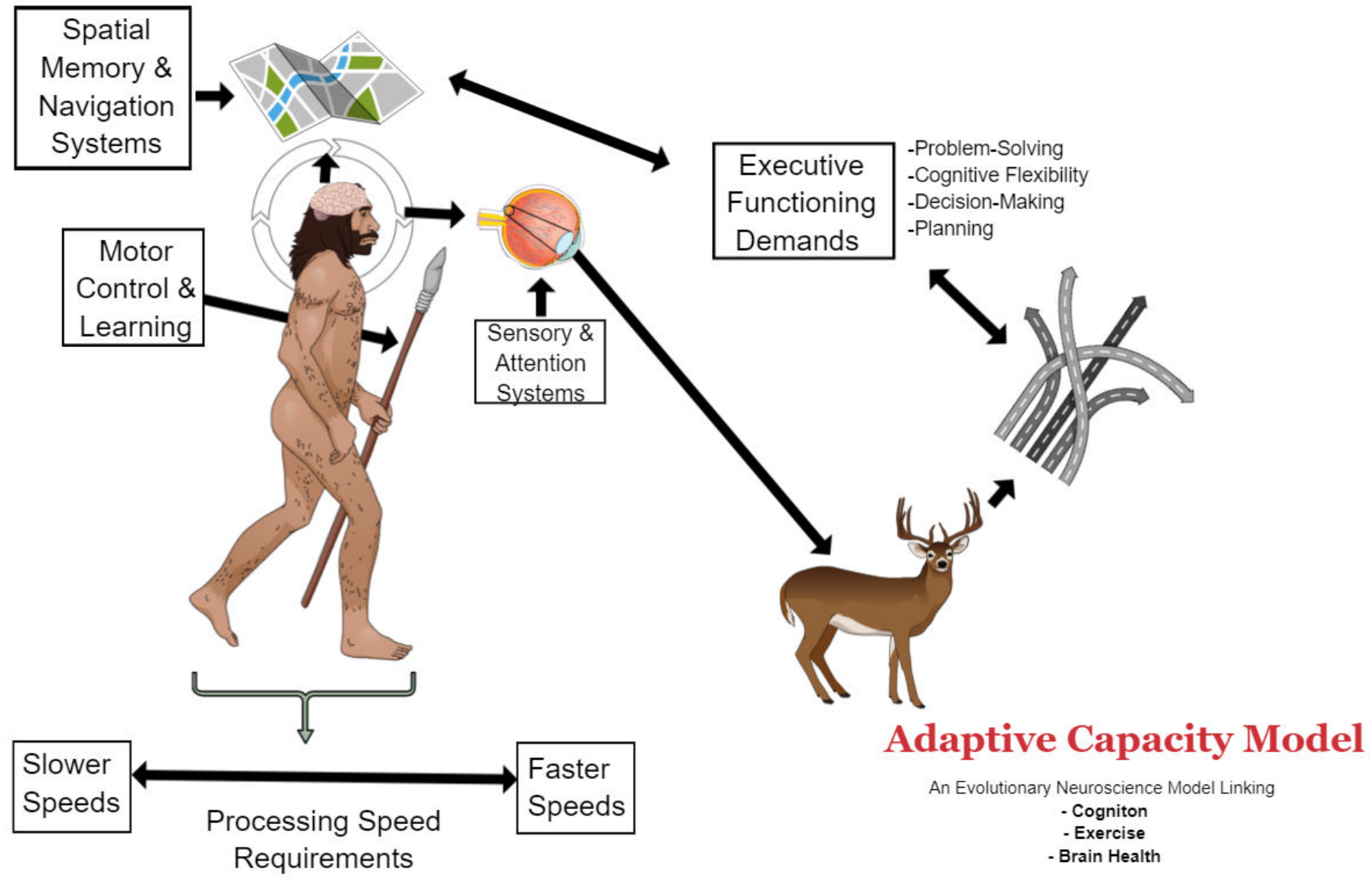
- **DUAL TASKING IMPROVED COGNITION GREATER THAN NO INTERVENTION**
- **DUAL TASKING IMPROVED COGNITION BETTER THAN PHYSICAL EXERCISE BY ITSELF**
- **DUAL TASKING IMPROVES COGNITION MORE IN OLDER PARTICIPANTS**
- **DUAL TASKING EFFECTS APPEAR TO LAST LONGER THAN SINGLE TASKING EFFECTS**

## DUAL TASKING LEADS TO MORE EFFICIENT FRONTAL LOBE ACTIVITY

Nishiguchi et al. (2015) reported that a 12-week program that combined physical and cognitive exercise yielded not only improvements in executive functioning performance (e.g., attention) but also led to more efficient brain activity (in the pre-frontal cortex) as measured by fMRI.





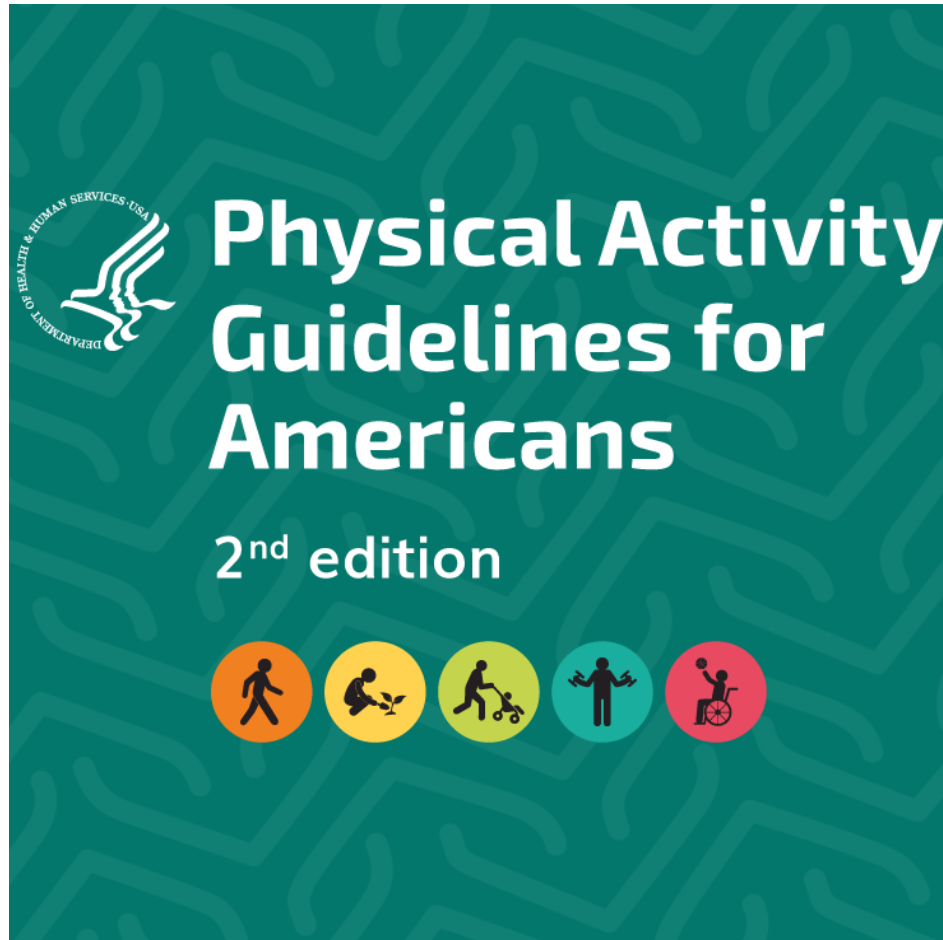


*Raichlen et al., 2017, Trends in Neuroscience*



# EXERCISE PRESCRIPTIONS

# IS THE GENERAL RECOMMENDATION ENOUGH FOR BRAIN HEALTH?



- “FOR SUBSTANTIAL HEALTH BENEFITS, ADULTS SHOULD DO AT LEAST 150 MINUTES (2 HOURS AND 30 MINUTES) TO 300 MINUTES (5 HOURS) WEEK OF MODERATE TO VIGOROUS INTENSITY AEROBIC EXERCISE ...OR EQUIVALENT”
- ADDITIONAL BENEFITS FOR “NEUROMOTOR” TRAINING, STRENGTH TRAINING, AND MORE MINUTES (I.E. 300)
- MULTIDOMAIN EXERCISE PROGRAMS SLOW PROGRESSION OF COGNITIVE DECLINE MORE THAN SHORTER SINGLE MODALITY
- 52 HOURS OF EXERCISE LEADS TO IMPROVEMENTS IN EF'S & PROCESSING SPEED IN OLDER ADULTS - REGARDLESS OF MODALITY

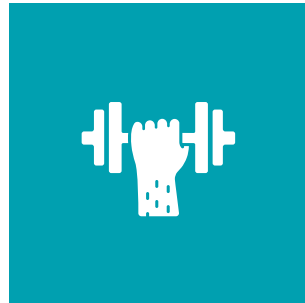
# PRIMARY EXERCISE MODALITIES

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## AEROBIC

Steady State  
Interval



## STRENGTH

Closed Skill Training  
Open Skill (Functional) Training



## MOTOR/SKILL

Sports, Dance, Martial Arts  
Mind-Body Exercise

# ELEMENTS OF A “BRAIN-HEALTHY” EXERCISE PROGRAM

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- **MINIMUM OF 150 MINUTES (2.5 HOURS) PER WEEK**
- **MULTI-DOMAIN (AEROBIC + RESISTANCE + NEUROMOTOR)**
- **INCORPORATES LOW, MODERATE & HIGH INTENSITIES**
- **INCORPORATE OPEN SKILL & COGNITIVE DEMANDS**
- **DESIGN FOR ENJOYMENT & BEHAVIOR CHANGE**

# SAMPLE EXERCISE PROGRAM - BEGINNER

	Monday	Wednesday	Friday	Saturday
Type	Bike & Weights	Dance (Zumba)	Bike & Weights	Walking
Time	30 min ea (60 min total)	60 min	30 min ea (60 min total)	60 min
Intensity	6-8/10	4-7/10	6-8/10	2-5/10



# EPAP for Attention

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
<b>Multi-component</b> (AT +RT + Balance)	<b>Tai Chi</b> (group)	<b>Multi-component</b> (AT +RT + Balance)	<b>Dance</b> (skill-based)	<b>Multi-component</b> (AT +RT + Balance)	<b>Tai Chi</b> (home)	<b>Dance</b> (skill-based)
- 60 min (20 min/type)	-30 min	- 60 min (20 min/type)	- 60 min	- 60 min (20 min/type)	-30 min	- 60 min
- Moderate intensity	-Low Intensity	- Moderate intensity	-Low to Moderate Intensity	- Moderate intensity	-Low Intensity	-Low to Moderate Intensity

# ACUTE VARIABLES

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**FREQUENCY**



**DURATION**



**INTENSITY**



**SKILL**



**NOVELTY**



**ENVIRONMENT**

# LIFESTYLE FACTORS THAT INFLUENCE BRAIN HEALTH & COGNITION



**EXERCISE & PHYSICAL  
ACTIVITY**



**SLEEP**



**DIET**



**STRESS MANAGEMENT**



**MEDICATIONS**



**COMORBIDITIES**



**COGNITIVE STIMULATION**



**SOCIAL SUPPORT**

# TIPS FOR STARTING A BRAIN HEALTH PROGRAM FOR FIT PROS

---

- **CONTINUED EDUCATION**
- **PARTNER W/ ALLIED MEDICAL**
- **PRODUCT/TOOL/TECH SELECTION**
- **IDENTIFY SERVICES**
- **TEST WITHIN CUSTOMER BASE & ITERATE**

[WWW.BRAINHEALTHTRAINER.COM](http://WWW.BRAINHEALTHTRAINER.COM)

USE CODE BRAIN300 FOR 50% OFF ENROLLMENT



# BRAIN HEALTH TRAINER

**ACE** →  
APPROVED





A young man in a red long-sleeved shirt is smiling and looking towards an older woman with grey hair wearing a blue t-shirt. They are in a gym setting with a red wall and a treadmill in the background. The woman is leaning forward, looking at something out of frame.

# ACE SENIOR FITNESS SPECIALIST: BOOTH 347

[www.acefitness.org/idea2022](http://www.acefitness.org/idea2022)

ACE SPECIALIST PROGRAM


## Senior Fitness

As an ACE Senior Fitness Specialist, you'll help a growing population of older adults gain strength, ward off muscle deterioration and reduce instances of inactivity-related disease and cognitive decline.



## RYAN GLATT, MS, CPT, NBC-HWC

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 [www.brainhealthtrainer.com](http://www.brainhealthtrainer.com)  
**BRAIN300**

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