OVERVIEW

1. Introduction
2. Exercise
3. Stress
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   1. Nutrition
   2. Sleep
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6. Recommendations
FROM SCIENCE

CENTER FOR BRAINHEALTH

Established in 1999 under UT Dallas to focus on brain research

Grown from 25 to more than 145 research (Ph.D.s/scientists), clinicians and support staff

Outstanding reputation among peers and community as pioneers in brain research

67 research projects, 115 completed studies and more than 1,000 published articles

TO SOLUTIONS

BRAIN PERFORMANCE INSTITUTE

Created in 2013 as an extension of Center for BrainHealth to make proven programs widely available to a much larger group

Build global awareness of brain health and empower 500,000 people over the next 10 years

Although the headquarters will be based in Dallas, the scope is worldwide. There is no other organization like this in the country.

SHARED VISION AND FOUNDATION
HOLISTIC DOMAINS OF BRAIN HEALTH

- Physical Activity
- Stress Management
- Nutrition
- Sleep
- Social Relationships

Synergistic interactions across domains
MODERN SOLDIERING

Increased demand for decision making

VUCA environments

Individual is technologically enabled with lethal weapons

Decision making pushed down to lower levels

Need for accelerated learning

Research ongoing to identify preventive factors for brain & mental health injury
LIFESPAN DOUBLES BRAINSPAN

Fig. 1. Depiction of the zone of possible cognitive development across adult life for a given individual. The blue dots indicate a general developmental trend for the individual under typical circumstances. The upper and lower curves indicate optimal and suboptimal boundaries that define the zone of possibility (shaded gray area). Upward and downward movements at a given age (arrows) are influenced by biological, behavioral, and environmental influences. The functional threshold indicates a point at which goal-directed cognition in the ecology will be compromised.


BOTTOM LINE UP FRONT

OPTIMIZING BRAIN HEALTH IS NOT ACHIEVED BY A REDUCTIONIST APPROACH
WHAT’S GOOD FOR THE HUMAN IS GOOD FOR THE BRAIN

These elements work together synergistically to promote whole body health and brain health

- Exercise
- Stress management
- Nutrition
- Sleep
- Social relationships
- Mental Activity
PHYSICAL ACTIVITY
Neurogenesis occurs in the brain – exercise training increases

- Hippocampal size & memory
- Total brain volume
- White matter volume & integrity

Exercise stimulates brain growth factors (neurotrophins)

- BDNF, IGF1, VEGF, & others
  These stimulate neurogenesis, angiogenesis, & neuroplasticity

(Tarumi & Zhang, 2015) (Erickson, et al., 2011)
(Portugal, et al., 2013) (Voss, et al., 2015)
(Dishman, et al. 2006) (Erickson, et al., 2010)
PHYSICAL ACTIVITY HAS A POSITIVE EFFECT ON NEUROTRANSMITTERS

(Portugal, et al., 2013)
(Kayes & Hatfield, 2013)
• Improved affect & mood
• Reduced negative affect & mood
• Reductions in tension, anger, & depression
• Improved reaction time, processing speed, perception, memory, attention, dual-task & task switching activities, & inhibitory processes
• Reduced risk of age-related cognitive decline, dementia, & Alzheimer’s Disease
• Intellectual stimulation may play a modifying role on cognitive function & be synergistic with effects of exercise

(Hogan, 2013)
(Davenport et al., 2012)
High fitness correlated with improved brain fitness (VO2max)

Investment Hypothesis

Lifelong physical activity combined with healthy lifestyle factors may buffer against cognitive decline in aging

Aerobic activity in children is correlated with improved cognitive function

Emerging evidence indicates that aerobic and resistance training are important for maintaining cognitive & brain health in older age

Many experts often comment that if exercise came in a pill then it would be the most sought after drug

- Improves brain structure & function
- Improves markers for cellular aging – telomere length
- Increases resting cerebral blood which tends to decline with age
- Improves a range of physical indices
  - Blood pressure
  - Lipid profile
  - Balance
  - Strength
  - Endurance
  - Cardiovascular & cerebrovascular health
  - And more!

(Hogan, 2013)
THEORY OF COGNITIVE RESERVE

Ability of an individual to tolerate progressive brain pathology without demonstrating clinical cognitive symptoms.

1989 post mortem analysis of 137 individuals with Alzheimer’s Disease (AD)

Symptoms vs. pathology

Higher brain weight and greater number of neurons

Hypothesis: Greater “reserve” of neurons and cognitive abilities that offset losses of AD

Thus, the theory of cognitive reserve “ability of an individual to tolerate progressive brain pathology without demonstrating clinical cognitive symptoms”

(Stern, 2002)
(Davenport, et al., 2012)
HOW MUCH EXERCISE?

Daily Aerobic Activity
75 min/wk (vigorous)/150 min/wk (moderate)
3 hr per week vigorous physical activity
Men had 22% lower risk myocardial infarction
(Chomistek, et al., MSSE 43(10) 2011)
Consider 300 (weight loss) min/week
(Friedenreich, et al., 2015)

Resistance Exercises 2-3 times per week
Body weight
Resistance – many alternative forms exist

Stretch Daily
≥ 2 days/week major muscle groups
Consider yoga for flexibility and stress management
Consider stretching daily – before bedtime is good cue

Neuromotor Exercise
Functional fitness training 2-3 days/week for 20-30 min
STRESS
We are among the few animals that create stress by our thoughts

- Reduction of serotonin & dopamine in brain
- Chronic exposure to cortisol results in a smaller hippocampus (up to 14%) & hyperactive amygdala
- Increased sympathetic tone (Parasympathetic calms)
- Impaired memory & thinking ability
- Slows plasticity processes & accelerates brain aging

(Lupien, et al., 2005)
(Sapolsky, 2004)
Physically trained individuals show lower physiological & psychological responses to stressors.

In one study, participants with a higher aerobic fitness ($VO_{2\text{max}}$) had lower cortisol response to a stressful task.

Chronic exercise induces important moderating changes in response to stress.

EXERCISE IS A POWERFUL STRATEGY TO MITIGATE STRESS

(Zschucke, et al., 2014)
(Portugal, et al., 2013)
Mindfulness:

*Paying attention, in a particular way; on purpose, in the present moment, & non judgmentally* - Jon Kabat-Zinn

One month MT improved attention & self-regulation with less negative moods

- White matter changes & ↑ blood flow in anterior cingulate gyrus
- More positive & less negative mood self-reports
- Less depression & anxiety
- ↓ stress-induced cortisol
- Improved attention & self-regulation
- 20-30 min/day 5 days/week

(Tang, et al., 2015)

Gray matter structural changes

- Showed increases in gray matter in hippocampus, posterior cingulate cortex, temporo-parietal junction, & cerebellum
- (8 weeks ≈ 45 min/day (body scan, sitting meditation, & mindful yoga)

(Holzel, et al., 2011)
HOW IS MINDFULNESS PRACTICED?

From mindfulnet.org
Mindfulness training promotes

- Well-being (Goyal et al., 2014)
- Strengthens attention & working memory
  Stress increases mind-wandering off-task thoughts, and performance failures
  - Stress decreases attentional focus & negative mood

(Jha, et al., 2010; Maclean, et al., 2010; Van Vugt & Jha, 2011; Baijal, et al., 2011; Leonard, et al., 2013)

A wandering mind is an unhappy mind

(Killingsworth & Gilbert, 2010)
Study: Investigated brief mindfulness training on an over-selectivity task in a sample of TBI patients

10 min mindfulness awareness of breathing exercise

Results: Brief mindfulness exercise can reduce levels of stimulus over-selectivity
30 min focused attention
MEDITATION + 30 min moderate-intensity AEROBIC EXERCISE
= > COGNITIVE CONTROL <
DEPRESSION & RUMINATION

Combination of mental & physical training results in greater cognitive gains than either one alone

Combined cognitive & exercise training can be effective for improving cognitive functions & functional status of older adults with & without cognitive impairment
In theory there is no difference between theory and practice. In practice there is.

- Yogi Berra
NUTRITION
NUTRITION FOR BRAIN HEALTH

- Mediterranean diet may be effective to slow cognitive decline associated with aging
- Emphasis on plant foods, less animal foods & dairy, and consumption of olive oil, fish, berries, vegetables
- High consumption of vegetables, particularly leafy greens may be correlated with slower cognitive decline with aging
- According to Henriette vanPraag from National Institute on Aging, effects of exercise on brain may be enhanced by consumption of foods containing omega fatty acids and plant phytochemicals

(Morris, et al., 2015)
(Morris, et al., 2006)
(Kang, et al., 2005)
(Nooyens, et al., 2011)
(Chen, et al., 2012)
OTHER LIFESTYLE FACTORS
Sleep

- Critical for brain and overall health
- Most need 7-8 hours per night
- Sleep deprivation/disturbances increase risk for chronic disease, depression, & impaired cognitive performance
- Clears toxins
  (Irwin, 2014; Balkin, 2014; Xie, et al., 2013)

Social Relationships

- Loneliness is a risk factor for poor cognitive function in older adults
- Many studies have shown that loneliness increases risk of dementia and depression
- Strong relationships bolster psychological resilience
  (Zhong et al., 2016; Cacioppo, et al., 2014; Seeman, et al., 2001)
COGNITIVE TRAINING
FALSE CLAIMS AND DECEPTIVE ADVERTISING

Feds say they "preyed on consumers"

Brain game–maker fined $2 million for Lumosity false advertising

By Emily Underwood | Jan. 5, 2016, 5:00 PM
• Data presented at OTSG’s Brain Health Consortium April 2014
• Only 10% (n=17/154) of the identified brain fitness products had efficacy data
• Of those with efficacy data, 9 products showed some improvement in either working memory or attention in a healthy adult population
• There is a strong correlation between targeted training and working memory improvements
• Video games may improve processing speed & attention
• Some evidence exists that supports the use of brain training products to improve brain health, but studies are small and results vary across studies
• Much more study needed to determine dose response and future studies should seek to standardize methods
• Comprehensive review of computerized rehabilitation treatments for attention & executive function for acquired brain injury
• Evidence suggests significant improvements in attention & executive function in 23/28 studies
• Results are promising
• Limitations
  – Small sample sizes 26/28 fewer than 50 subjects, some as few as 1-4
  – Lack of control groups in 1/3 studies
  – Mixed methods & lack of standardized outcome measures
  – Large variety of outcome measures used

RECENT SYSTEMATIC REVIEW ARTICLE
THE BRAIN FITNESS CENTER
NICOE BLDG 19; 5TH FLOOR, AUDIOLOGY AND SPEECH CENTER

A resource to help patients gain a head-to-toe workout; available for anyone looking to optimize performance regardless of diagnosis.

BFC Staff

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THREE CURRENT RESEARCH PROTOCOLS

ORRB AND HRV EMWAVE BIOFEEDBACK TRAINING

COMMERCIAL COMPUTER-BASED PROGRAMS

WEEKLY MIND-BODY & HRV CLASSES

Questions and referrals: (301) 319-2178 or stephanie.a.marble2.ctr@mail.mil
STRATEGIC MEMORY ADVANCED REASONING TRAINING
Developed by Center for BrainHealth research team

Strategy-based “top-down” cognitive brain training program

SMART provides a way of thinking

Uses practical strategies that require concerted effort in order to strengthen frontal networks, increase mental efficiency and productivity, and build cognitive resilience

How to think, not what to think.
Top-down processing strategies to apply to daily tasks:

1. Strategic Attention – Input Management
   - Management of input by blocking distractions & irrelevant input
   - Practice regular mental breaks
   - Limit multi-tasking – focus on single task

2. Integrated Reasoning – Dynamic Updating of Input
   - Engage in synthesis, abstraction, meaning, & implementation processes – “gist reasoning”

3. Innovative Thinking – Cognitive Flexibility
   - Examine information from divergent perspectives
   - Develop multiple solutions to problems
   - Formulate novel applications

Strengthens problem solving skills & mitigates concrete thinking while developing deeper level thinking

(Vas, Spence, & Chapman, 2015), (Vas, et al., 2015), (Chapman, 2013)
Exercise & stay active
Manage stress
Eat well - consider a Mediterranean diet
Sleep 7-8+ hours per night
Use your brain well
Build strong bonds
Live with joy