NEUROSCIENCE OF INTEGRATED BODY MIND TRAINING.

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BRAIN NETWORKS

ARITHMETIC
ATTENTION
AUTOBIOGRAPHICAL MEMORY
FACES
FEAR
MUSIC
OBJECT PERCEPTION
READING AND LISTENING
REWARD
SELF RECOGNITION
WORKING MEMORY

FAN ET AL, 2001
Cortical surface area and cognitive conflict.


Fjell ET AL 2012
EFFORTFUL CONTROL

Activation Control: Capacity to perform an action when there is a strong tendency to avoid it.

R. I am often late for appointments.
R. I often make plans that I do not follow through with.
I can keep performing a task even when I would rather not do it.
I can make myself work on a difficult task even when I don’t feel like trying.
If I think of something that needs to be done, I usually get right to work on it.
I usually finish doing things before they are actually due (for example, paying bills, finishing homework, etc.).
R. When I am afraid of how a situation might turn out, I usually avoid dealing with it.

Attentional Control: Capacity to focus attention as well as to shift attention when desired.

R. It’s often hard for me to alternate between two different tasks.
When interrupted or distracted, I usually can easily shift my attention back to whatever I was doing before.
R. When I am happy and excited about an upcoming event, I have a hard time focusing my attention on tasks that require concentration.
R. It is very hard for me to focus my attention when I am distressed.
R. When I am trying to focus my attention, I am easily distracted.

Inhibitory Control: Capacity to suppress inappropriate approach behavior.

Even when I feel energized, I can usually sit still without much trouble if it’s necessary.

Self-control gradient.

Two decades of mindfulness research
Attention training and attention state training

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The ability to attend and to exercise cognitive control are vital aspects of human adaptability. Several studies indicate that attention training using computer based exercises can lead to improved attention in children and adults. Randomized control studies of exposure to nature, mindfulness and integrative body–mind training (IBMT) yield improved attention and self-regulation. Here, we ask how attention training and attention state training might be similar and different in their training methods, neural mechanisms and behavioral outcomes. Together these various methods lead to practical ways of improving attention and self-regulation.

Improving attention
A very diverse set of training methods have been shown to closely related to the training and to more general cognitive abilities [1–4]. All of these methods involve practice in some cognitive skill by repetitive trials on tasks similar to those used in schools or cognitive psychology laboratories. All of these studies aim for long term improvement in attention, but in most cases only short term improvements due to the training have been well studied.

On the surface, these AT methods differ considerably from mindfulness training, exposure to nature settings or IBMT, which we group as AST. Recently, both IBMT (emphasizing body–mind balance) and nature exposure (using attention restoration theory) have used randomized designs with attention measures similar to those used with AT and have also shown significantly greater improvements in attention following training than those from

Comparison of Scales of POMS pre- and post-training

A (anger—hostility); C (confusion—bewilderment); D (depression—dejection); F (fatigue—inertia); T (tension—anxiety); V (Vigor-Activity).

Comparison of Cortisol concentration in three different stages (stress management)

Tang et al, PNAS, 2007
BRAIN MECHANISMS

IBMT BRAIN CHANGES COMPARED TO RT

AGING STUDY

Diffusion Tensor Imaging

Jellison 2004
Conflict:
Incongruent RT - Congruent RT

Alerting:
Uncued RT - Alerting Cue RT

Orienting:
Spatial cue RT - Alerting cue RT

Decrease of AD in different brain regions after 2-wk IBMT. Statistical images are shown at PFWE < 0.05 corrected for multiple comparisons at sagittal section x = -13, x = -27, x = -35, and x = -41.

FA IBMT > RT

FA increase and AD and RD decrease in different brain regions after 4-wk IBMT. Statistical images are shown on the Johns Hopkins University Atlas (18) at PFWE < 0.05 corrected for multiple comparisons at sagittal section x = -13, x = -17, x = -21, and x = -25.
Correlation between TMD change and AD decrease at left posterior corona radiata after 2-wk IBMT. The horizontal axis indicates the POMS total score change and the vertical axis indicates the AD change at left posterior corona radiata.

Tang Y et al. PNAS 2012;109:10570-10574

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RT_Difficult Task

IBMT (pre_post)  Control (pre_post)

0
-50
-100
-150

Neurons--Dendrites--Axons--Myelin--Glial

Neurons are densely connected and have many dendrites

Axons conduct electrical signals and are surrounded by myelin

Cognitive-Affective Neural Plasticity following Active-Controlled Mindfulness Intervention

Micah Allen et al

Journal of Neuroscience October 31, 2012 • 32(44):15601–15610 • 15601
Demonstration of smoking change (parts per million, PPM) after 2 wk of IBMT and RT. After 2 wk of training, there were significant smoking reduction in the IBMT group (but not in the RT group).

Tang Y et al. PNAS 2013;110:13971-13975

Increased ACC activity after 2 wk of IBMT. After 2 wk of IBMT, we found significantly increased activity at ACC/medial PFC, orbitofrontal cortex, and inferior frontal gyrus/ventrolateral PFC (displayed at Pcorrected < 0.05).

Tang Y et al. PNAS 2013;110:13971-13975
Summary

- Brain Networks of Attention
- Training Executive Attention
- Network Training vs State Training
- IBMT Behavior Results
- IBMT Brain Results
- Application to Addiction