STRESS MANAGEMENT: THE SCIENCE BEHIND MEDITATION

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Montreal
Speaker disclosure

• I do not have an affiliation (financial or otherwise) with a pharmaceutical, medical device or communications organization.

• I do not intend to make therapeutic recommendations for medications that have not received regulatory approval (i.e. “off-label” use of medication).
Learning objectives

After this session, participants will be able to:

1. Differentiate meditation techniques according to a recognized scientific classification.

2. Understand the neurophysiological mechanisms associated with different levels of cognitive control.

3. Explore the clinical applications of different meditative practices in physical and mental health.
Why practice meditation?

Developmental Origins of Health and Disease

DOHaD

This new area of research shows that our response to stress is “programmed” very early, even before birth.
The changes made by the fetus in response to the intra-uterine environment result in permanent changes in physiology and metabolism, termed early life programming.

The key hypotheses to explain programming, is over exposure to glucocorticoids,

It results in offspring with an activated HPA axis and an adverse metabolic profile and behavioural phenotype in adulthood.
Project Ice Storm: follow-up at age 15 and 18

**Increased in:**
- Dietary problems
- Emotional problems
- Aggressiveness, drugs
- The loss of 10 points of IQ for boys
- Autistic traits
- Overweight

**Epigenetics:**
- DNA methylation is still present in 1675 sites linked to about 950 genes. A global effect on the genome.

“I thought that the effect of the difficulties experienced by the mother during pregnancy would subside around 5 or 6 years of age. But on the contrary, it increases with age.” Dr. Suzan King

Lei Cao-Lei, DNA Methylation Signatures Triggered by Prenatal Maternal Stress Exposure to a Natural Disaster: Project Ice Storm. PLOS 2014

King S. Maternal Stress Exposure to a Natural Disaster: Project Ice Storm. PLOS 2014
The allostatic theory

• **Neuroplasticity** is the ability of the brain to modify its structure depending on living experiences.

• When exposed to stress, the brain will **favour survival (allostasis)** at the cost of maintaining balance and development (homeostasis).

• The cumulative effect produces the **allostatic load**.

• The concept is articulated around the **perception of the brain** and its response to environmental challenges.

Ten physiologic indicators of allostatic load

1. Systolic blood pressure*
2. Diastolic blood pressure*
3. Waist-hip ratio
4. High-density lipoprotein (HDL) cholesterol*
5. Total/HDL cholesterol ratio*
6. Glycosylated haemoglobin*
7. Urinary cortisol*
8. Urinary norepinephrine*
9. Urinary epinephrine*
10. Serum dihydroepiandrosterone sulphate (DHEA-S)*

Myth #1: All meditations will bring similar results

Meditation alone doesn’t lower blood pressure
October 7, 2013

A new study found eight weeks of mindfulness meditation had no effect on people with slightly elevated blood pressure who were not yet taking medication.

NEW YORK: Stress reduction exercises have been linked to many health benefits, but lower blood pressure may not be one of them.

A new study found eight weeks of mindfulness meditation had no effect on people with slightly elevated blood pressure who were not yet taking medication.

“This doesn’t mean that meditation is bad. It just simply doesn’t lower blood pressure,” senior author Dr. Sheldon Tobe of Sunnybrook Health Sciences Centre in Toronto, said.

He said he was expecting to see an effect on blood pressure based on past studies showing benefits with mindfulness meditation. But when he looked back over those earlier trials, Tobe found the majority of participants had been taking blood pressure-lowering drugs.
The HARMONY study was a randomized, controlled trial examining the efficacy of an 8-week mindfulness-based stress reduction (MBSR) program for blood pressure (BP) lowering among unmedicated hypertensive participants.

CONCLUSION: Mindfulness meditation did not lower ambulatory BP by a statistically or clinically significant amount in untreated, stage 1 hypertensive patients when compared with a wait-list control group.

CONCLUSIONS: MBSR did not lower ambulatory BP by a statistically or clinically significant amount in untreated, stage 1 hypertensive patients when compared with a wait-list control group. It leaves untested whether MBSR might be useful for lowering BP by improving adherence in treated hypertensive participants.

CLINICAL TRIALS REGISTRATION: NCT00825526.

KEYWORDS: ambulatory blood pressure monitoring; behavior modification; blood pressure; hypertension; nonpharmacological therapy.
Policy Statement
American Heart Association

Transcendental Meditation (TM) is the only meditation practice that has been shown to lower blood pressure.

Other conclusions:

• Lower blood pressure through TM practice is associated with substantially reduced rates of death, heart attack and stroke.

• Alternative treatments that include the TM technique are recommended in treatment plans for all individuals with blood pressure greater than 120/80 mm Hg.

• Level of evidence and recommendation: IIB

TM and all-cause mortality

• Long-term follow-up of two RCT: hypertensive subjects (mean age 72 years) N=202

• Cardiovascular mortality was reduced by 30%

• All-cause mortality was reduced by 40% after 10 years (49% for cancer)

• Life expectancy was increased by 23 %.

FIGURE 1. Kaplan-Meier survival curves for all-cause mortality for subjects who completed post-testing in the original studies (relative risk 0.77, p = 0.04).

Long-Term Effects of Stress Reduction on Mortality in Persons ≥55 Years of Age With Systemic Hypertension; American Journal of Cardiology, 96 (2005): 1060-1064.
Meditation and Longevity

- Follow up 36 months (N=73)
- Mean age 81 years old

- **Survival after 3 years:**
  - TM: 100%
  - Mindfulness: 87%
  - Controls: 76%
  - Others: 63%
  
  \[ p = .00025 \]

• Many definitions of Mindfulness.

• What type of Mindfulness and explicit instructions were given to participants.

• Intensity and duration of the practice varies with different versions of the training.

• This leads to inappropriate comparisons between fundamentally different practices.
VERTICAL DIMENTION OF CONSCIOUSNESS

CONSCIOUS

PRECONSCIOUS

SUBLIMINAL

FRAGMENTED

Pure Consciousness (source of thoughts)
Three levels of cognitive control

• **FOCUSED ATTENTION:** Concentration, sustained focus and voluntary control of attention and cognitive processes. (Object-referral mode)

• **OPEN MONITORING:** Contemplation, dispassionate observation, non-evaluative awareness of ongoing experience. (Object-referral mode)

• **AUTOMATIC SELF TRANSCENDING:** Automatic (or reflex) transcending of the procedures of the meditation practice. (Self-referral mode)

Focused Attention: Gamma (20-50 Hz)

Open Monitoring: Theta (4-8 Hz)

Automatic Self-Transcending: Alpha 1 (8-10 Hz)

Travis and Shear, 2010
FOCUSED ATTENTION
Loving-Kindness compassion

This state is described as an “unconditional readiness and availability to help living beings”.

Instructions:
“During the training session, the subject will think about someone he cares about, such as his parents, sibling or beloved, and will let his mind be invaded by a feeling of altruistic love (wishing well-being) or of compassion (wishing freedom from suffering) toward these persons. After some training the subject will generate such feeling toward all beings and without thinking specifically about someone”.

OPEN MONITORING
What is MINDFULNESS?

“It is to stop and observe, eyes closed, what happens in oneself (one’s own breathing, body sensations, the incessant flow of thoughts) and around oneself (sounds, smells ...). Only observe without judging, without waiting for anything, without preventing anything from happening in the mind, but also without clinging to what is happening.”

This is the third wave of cognitive behavioural therapy. It strives to develop distancing from psychological events.

Dr. Christophe André, psychiatrist, Sainte-Anne de Paris hospital.
AUTOMATIC SELF TRANSCENDING
Transcendental Meditation (TM)

The practice of MT involve the mental use of a mantra (a sound with no meaning) according to a specific procedure without effort. The cognitive process then naturally turns to subtle levels of thought until the mind transcends the most subtle state and arrives at the source of thought. The result is the experience of the so-called “pure consciousness” which is consciousness without an object of experience other than itself.

TRANSCENDING DURING TM

Pure Consciousness
Cognitive Control

Highest

Mindfulness,
ZaZen
Kriya Yoga

Lowest

Travis and Shear, Consciousness and Cognition, 2010
Travis and Shear, Consciousness and Cognition, 2010

Transcendental Meditation technique

Restful Alertness

- **Red**: higher during TM
- **Blue**: lower during TM
Meditation experience is associated with differences in default mode network activity and connectivity

Judson A. Brewer1,2, Patrick D. Worhunsky3, Jeremy R. Gray3, Yi-Yuan Tang3, Jochen Weber4, and Hedy Kobr5

Abstract

Meditation has been associated with relatively reduced activity in brain network implicated in self-related thinking and mind wandering. Studies have typically compared meditation to rest, but little is known about brain activation patterns between meditators and controls at rest. In this study, we examine a range of brain activation patterns across individuals that has not been characterized. Therefore, this study compared meditation to resting while replicating the findings that meditation is associated with relatively low activity, and to extend these findings by testing whether default mode network activity is measured by the methods described in this study.

A self-referential default brain state: patterns of coherence power, and eLORETA sources during eyes-closed rest and Transcendental Meditation practice

Fred Travis1, David A. F. Haaga1, John Hagelin2, Melissa Tannen3, Alaric Aronander4, Sanford Nudich5, Carolyn Gaylord-King6, Sarina Grosswald7, and Robert S. Schneider8

Abstract

Activation of a default mode network (DMN) including prefrontal and parietal cortices shows robust changes with cognitive load, being more active during low-load tasks and less active during high-load tasks requiring executive control. Meditation practices exhibit various degrees of cognitive control. Thus, DMN activation patterns could provide insight into the nature of meditation practices. This 10-week random assignment study compared theta2, alpha1, alpha2, beta1, beta2, and gamma EEG coherence, power, and eLORETA cortical sources during eyes-closed rest and Transcendental Meditation (TM) practice in 36 male and female college students, average age 23.7 years. Significant between-group differences were seen between groups. Compared to eyes-closed rest, TM practice led to higher alpha and gamma spectral power, and lateral frontal and parietal eLORETA sources.

Wandering Minds: The Default Network and Stimulus-Independent Thought

Malia F. Mason1, Michael L. Norton2, and Scott T. Grafton3, C. Neil Macrae4

Abstract

Despite evidence pointing to a ubiquitous tendency of human minds to wander, little is known about the neural operations that support this core component of human cognition. Using both thought sampling and brain imaging, the current investigation demonstrated that mind-wandering is associated with activity in a default network of cortical regions that are active when the brain is "at rest." In addition, individuals' reports of the tendency of their minds to wander were correlated with activity in this network.
### Comparing three types of meditation

<table>
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Functions of the Default Network

- Memory of the past
- Envisioning the future
- Searching the mind of others
  - Altruism
  - Compassion
- Moral decision making
Post-traumatic stress syndrome - PTSD

Reduction in Posttraumatic Stress Symptoms

- Brooks (1985)
- Rosenthal (2012)
- Rees (2013)
- Kearney (2013)
- Kearney (2013)

- Effect Size
- Transcendental Meditation Practice
- Loving Kindness Meditation
- Mindfulness Meditation

- Rees at al. Journal of Traumatic Stress April 2013, 26, 295–298
- Rosenthal J Z. et al Military Medicine, 176, 6:626, 2012
- Brooks J S. et al Journal of counseling and development November 1985, vol 64
Meditation and Anxiety

Mindfulness
Effect size
-0.38 at 8 weeks; and
-0.22 at 3–6 months.

Transcendental Méditation
Effect size
-0.74 to -1.2
maintained at 3 years.
### Comparing three types of meditation

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High level of EEG coherence

Normal
Eyes closed

TM
EEG coherence

- Coherence quantifies the phase consistency between pairs of signals in specific frequency bands.

- Coherence is considered a measure of functional brain connectivity necessary for network formation and integration.

- Lower values are associated with white matter damage, decreased cerebral blood flow, schizophrenia, depression, and aging.

Frontal EEG Coherence

Global EEG Coherence correlate with:

**Increased**
- Intelligence (IQ)
- Creativity
- Learning ability
- Psychological stability
- Emotional maturity

**Improved**
- Short and Long term memory
- Academic Performance
- Alertness
- Reaction time
- Health…
“Brain integration (coherence) could become the new training goal for achieving excellence in any fields... Methods of improving cerebral integration could therefore be essential to reach the heights of any discipline.”

THANK YOU!

Questions?