



MONASH University

The Connection: Mindfulness and the mind-body response

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The Connection

Featuring world leading experts in mind body medicine and remarkable true stories of recovery.



Mind your body.

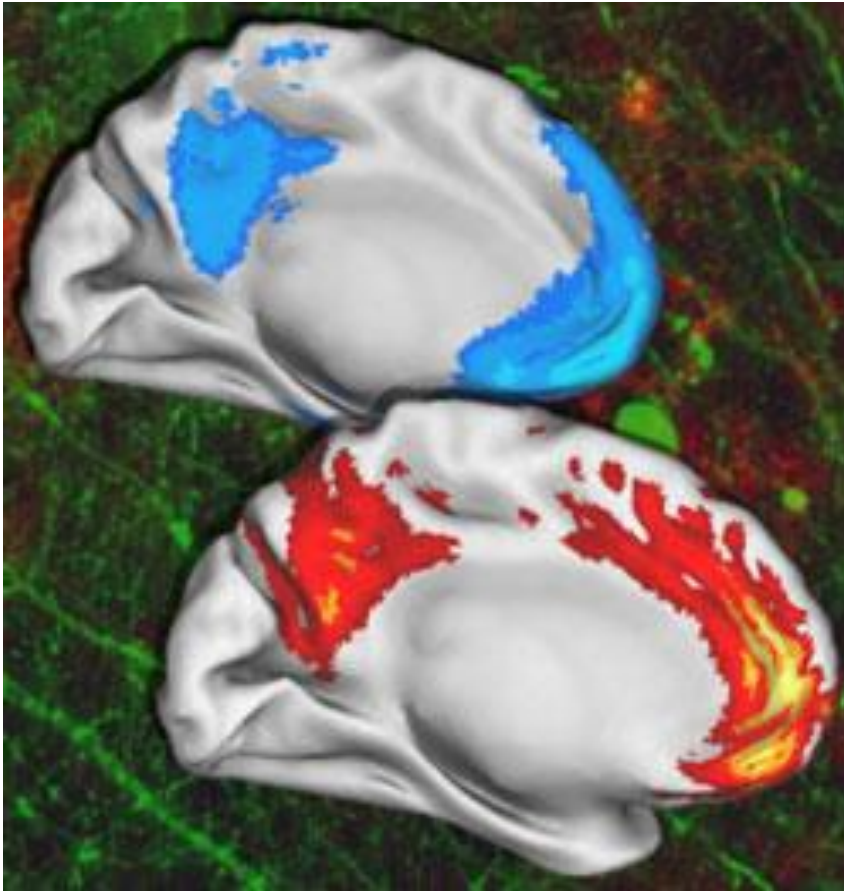


- <https://www.theconnection.tv/>

The philosophy of mindfulness

- Self rides in the chariot of the body,
- Intellect the firm-footed charioteer,
- Discursive mind the reins,
- Senses are the horses,
- Objects of desire the roads.
- When Self is joined to body, mind, sense, none but He enjoys.
 - Katha Upanishad

The Default Brain



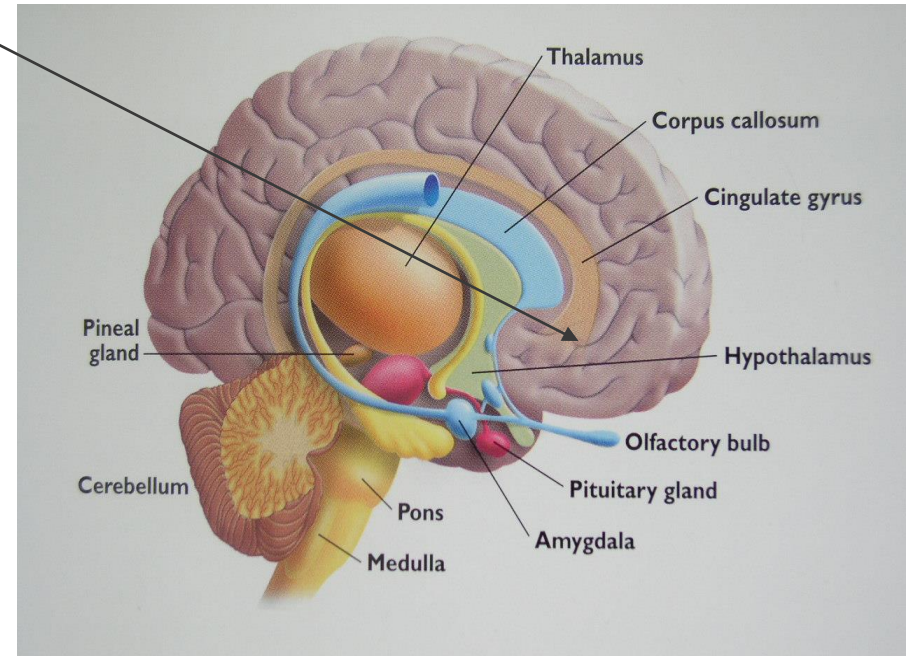
- Attentive
 - Tasks associated with paying attention
 - Brain efficient and quiet
- Default state (mode)
 - Mind is inattentive, distracted, idle, recalling past, daydreaming, ruminating, worrying ...
 - Areas active in default mode similar to areas affected by Alzheimer's Disease

The Default Brain associated with:

- **Stress** (Brewer et al., 2011)
- **Anxiety** (Zhao et al., 2007)
- **Depression** (Greicius et al., 2007)
- **ADHD** (Uddin et al., 2008a)
- **Schizophrenia** (Pomarol-Clotet et al., 2008)
- **Autism** (Kennedy & Courchesne, 2008)
- **Alzheimer's disease** (Firbank et al., 2007)
- **Criminal recidivism** (Aharoni et al., 2013)
- **Reduced performance** (Brewer et al., 2011)

Executive functioning

- Frontal lobes (prefrontal cortex) centre for executive functioning
 - Attention regulation
 - Self-awareness
 - Working memory
 - Reasoning and decision making
 - Emotional regulation
 - Appetite regulation
 - Impulse control
 - Directs immune system
- Limbic system – emotion centre
 - Includes the amygdala
- Mesolimbic reward system – appetites
 - Important for addictions and unhealthy lifestyle



Falling attention spans

- According to a Microsoft Canada report, the average human's attention span is below that of a goldfish (8 sec vs. 9 sec)
- “We are moving from a world where computing power was scarce to a place where it now is almost limitless, and where the true scarce commodity is increasingly human attention”
 - Satya Nadella
 - <file:///Users/craighassed/Downloads/microsoft-attention-spans-research-report.pdf>

Overloaded circuits

- “Bain and Company, the consultancy, has estimated that executives in the 1970s had to deal with fewer than 1,000 phone calls, telexes and telegraphs a year from people outside their company. These days, 30,000 external communications clog managers’ inboxes annually. As Henry Mintzberg asks in his 2009 book, *Managing*: “Might the internet, by giving the illusion of control, in fact be robbing managers of control? In other words, are the ostensible conductors becoming more like puppets?”
 - Financial Times, UK March 5, 2016.

Mobile phone use and car accidents

- Passenger carriage increased the likelihood of a crash (odds ratio 1.6)
- Carrying two or more passengers were twice as likely to crash as unaccompanied drivers (OR 2.2)
- Driver's use of a mobile phone within 5 min before a crash associated with fourfold increased likelihood of crashing (OR 4.1)
 - McEvoy SP, Stevenson MR, Woodward M. The contribution of passengers versus mobile phone use to motor vehicle crashes resulting in hospital attendance by the driver. *Accid Anal Prev.* 2007 Nov;39(6):1170-6.

- “The faculty of voluntarily bringing back a wandering attention over and over again, is the very root of judgment, character, and will. No one is compos sui if he have it not. An education which should improve this faculty would be the education par excellence.”

– William James,
Principles of
Psychology, 1890

Mindfulness and attention regulation

- Being mindful involves **attention** and **attitude**
- **Attention regulation** has three aspects
 1. To know where our attention is
 2. To prioritise where the attention needs to be
 3. For the attention to go there and stay there
- **Mindful attitude**
 1. Openness
 2. Curiosity
 3. Acceptance
 4. Self-compassion

Mindfulness

- Developed through:
 1. Formal practice (attention training / meditation)
 2. Informal practice (being mindful while engaged in activities)
 3. Cognitive practices
 - Implicit in formal and informal practices
 - The 'big four' cognitive practices are:
 1. Perception
 2. Letting go (non-attachment)
 3. Acceptance
 4. Presence of mind (being in the present moment)

Applications of mindfulness

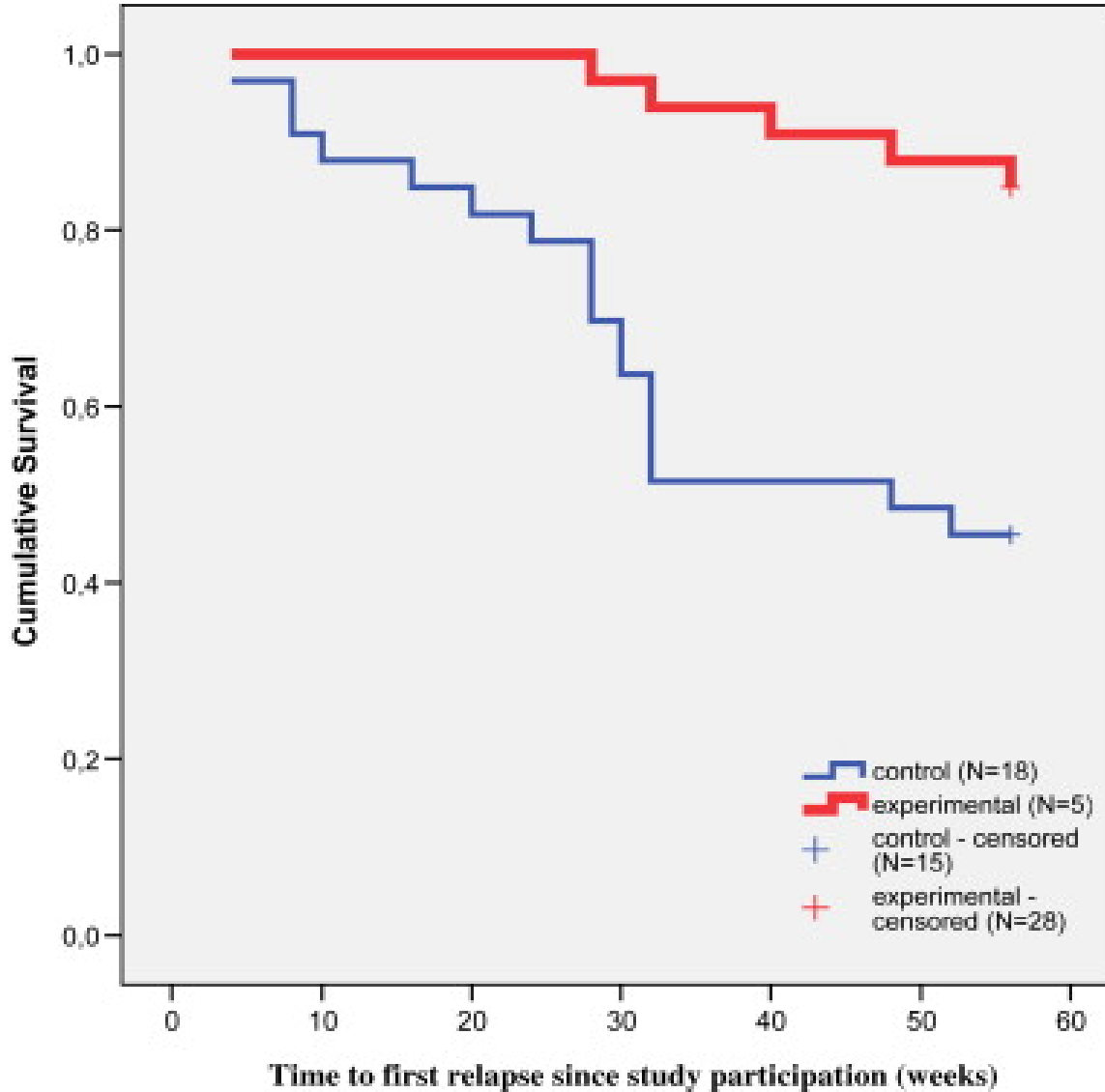
- **Mental health:** E.g. therapeutic application for depression, anxiety, panic disorder, stress, emotional regulation, addiction, sleep problems, eating disorders, psychosis, ADHD, autism, reduced burnout, greater resilience...
- **Neuroscience:** E.g. structural and functional changes in the brain, stimulation of neurogenesis, possible prevention of dementia and cognitive decline, down-regulating the amygdala, improved executive functioning and working memory, reduced default mental activity, improved self-monitoring and cognitive control, improved perception of sensory input...
- **Clinical:** E.g. therapeutic applications for pain management, symptom control, coping with chronic illness (e.g. cancer and MS), metabolic and hormonal benefits (e.g. reduced allostatic load, cortisol), facilitating lifestyle change (e.g. weight management, smoking cessation), improved immunity (e.g. improved resistance, reduced inflammation), improved genetic function and repair, slower ageing as measured by telomeres...
- **Performance:** E.g. sport, academic, leadership qualities, mental flexibility and problem solving, decision-making, sunk-cost bias...
- **Education:** E.g. improved problem-solving, executive functioning and working memory, better focus, less behavioural problems, fostering growth mindsets...
- **Relationships:** E.g. greater emotional intelligence and empathy, improved communication, reduced vicarious stress and carer burnout...
- **Spiritual:** E.g. transcendence, unity, deep peace, connectedness...

Default mode network

- Default mode flourishes in various forms of psychopathology e.g. depression, anxiety, schizophrenia and autism
- Default activity decreased or deactivated when paying attention e.g. in experienced mindfulness practitioners
- In experienced mindfulness practitioners, even when the default mode network is active, brain regions associated with self-monitoring and cognitive control are co-activated reducing vulnerability to default thinking
 - Brewer JA, Worhunsky PD, Gray JR, et al. Meditation experience is associated with differences in default mode network activity and connectivity. Proc Natl Acad Sci U S A. 2011 Dec 13;108(50):20254-9.

MBCT and depression

- RCT investigated the effects of Mindfulness-based cognitive therapy (MBCT) on the relapse in depression, time to first relapse and the quality of life
- 106 recovered depressed patients with a history of at least 3 depressive episodes
- Treatment as usual (TAU) vs MBCT plus TAU 60 week f/up
- Relapse/recurrence significantly reduced and the time until first relapse increased in the MBCT plus TAU c/w TAU
- MBCT plus TAU group also showed a significant reduction in both short and longer-term depressive mood, better mood states and quality of the life
 - Godfrin KA, van Heeringen C. The effects of mindfulness-based cognitive therapy on recurrence of depressive episodes, mental health and quality of life: A randomized controlled study. Behav Res Ther. 2010 Aug;48(8):738-46.



Mindfulness and healthcare quality

- Observational study of clinicians caring for patients
- Measured patient-clinician communication quality and patient ratings
- Comparing clinicians with highest and lowest mindfulness scores: high-mindfulness clinician consultations:
 - Patient-centered pattern of communication (OR 4.14)
 - Engaged in more rapport building and discussion of psychosocial issues
 - Displayed more positive emotional tone with patients
 - Patients more likely to give high ratings on clinician communication and to report high overall satisfaction
 - Beach MC, Roter D, Korthuis PT, Epstein RM, et al. A Multicenter Study of Physician Mindfulness and Health Care Quality doi: 10.1370/afm.1507 Ann Fam Med 2013;11(5):421-428.

GPs, mindfulness and burnout

- Mixed methods study of Dutch GPs participating in an MBSR course
- Questionnaires assessed burnout, work engagement, empathy, and mindfulness skills, before and after MBSR training/waiting period
- MBSR group reported:
 - Decrease in depersonalisation
 - Dedication increased
 - Mindfulness skills increased
 - Work engagement increased in Vigour and Dedication (but not Absorption)
- Qualitative data: MBSR course increased GP wellbeing and compassion towards themselves and others, including their patients
 - Verweij H, Waumans RC, Smeijers D et al. Mindfulness-based stress reduction for GPs: results of a controlled mixed methods pilot study in Dutch primary care. Br J Gen Pract. 2016 Feb;66(643):e99-e105. doi: 10.3399/bjgp16X683497.

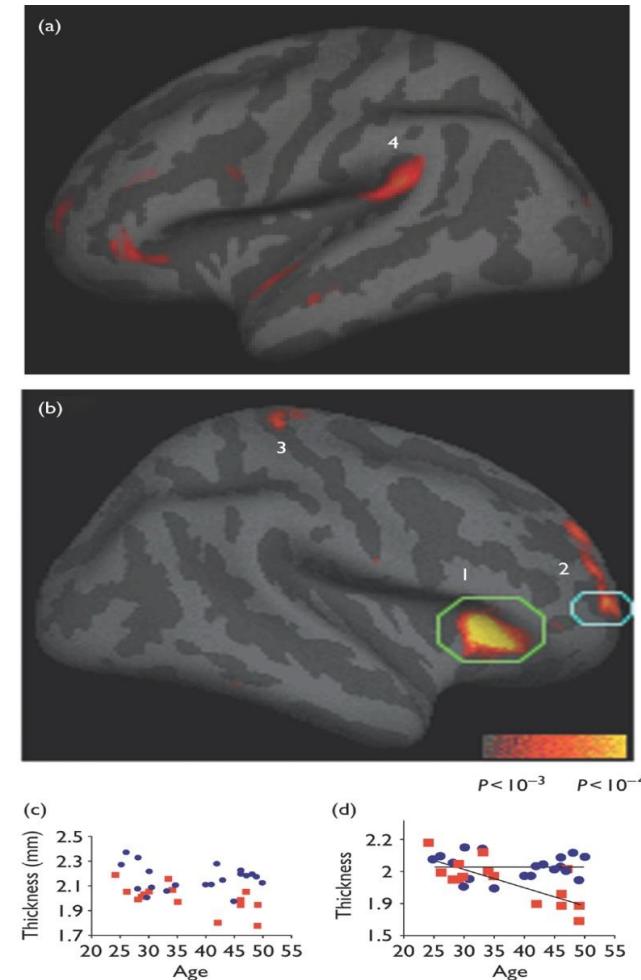
Emotional Intelligence & mindfulness

- Mindfulness related to aspects of personality and mental health
 - Lower neuroticism, psychological symptoms, experiential avoidance, dissociation
 - Higher emotional intelligence and absorption
 - Baer RA, et al. Assessment. 2004;11(3):191-206.

EI	Definition
Self-awareness	Ability to recognise and understand emotions, drives and effects
Self-regulation	Can control or redirect disruptive impulses, can think before acting
Motivation	Passion for work that goes beyond money or status, energy and persistence
Empathy	Ability to understand emotions of others, skill in interacting with others
Social skill	Can manage relationships and build networks, can find common ground, rapport

Mindfulness and the brain

- Mindfulness training improves functioning in areas related to executive functioning, attentional control, self-regulation, sensory processing, memory and regulation of the stress response
 - Thickening of cortex in regions associated with attention, self-awareness and sensory processing thicker in meditators
 - “The regular practice of meditation may have neuroprotective effects and reduce the cognitive decline associated with normal aging.”
 - Hölzel BK, Carmody J, Evans KC, et al. Stress reduction correlates with structural changes in the amygdala. Soc Cogn Affect Neurosci. 2010 Mar;5(1):11-7.
 - Hölzel BK, Carmody J, Vangel M, et al. Mindfulness practice leads to increases in regional brain gray matter density. Psychiatry Res. 2011 Jan 30;191(1):36-43.
 - Kilpatrick LA, Suyenobu BY, Smith SR, et al. Impact of Mindfulness-Based Stress Reduction training on intrinsic brain connectivity. Neuroimage. 2011 May 1;56(1):290-8.
 - Lazar SW, Kerr CE, Wasserman RH, et al. Neuroreport. 2005;16(17):1893-1897.
 - Pagnoni G, Cekic M. Neurobiology of Aging. 2007;28(10):1623-7.



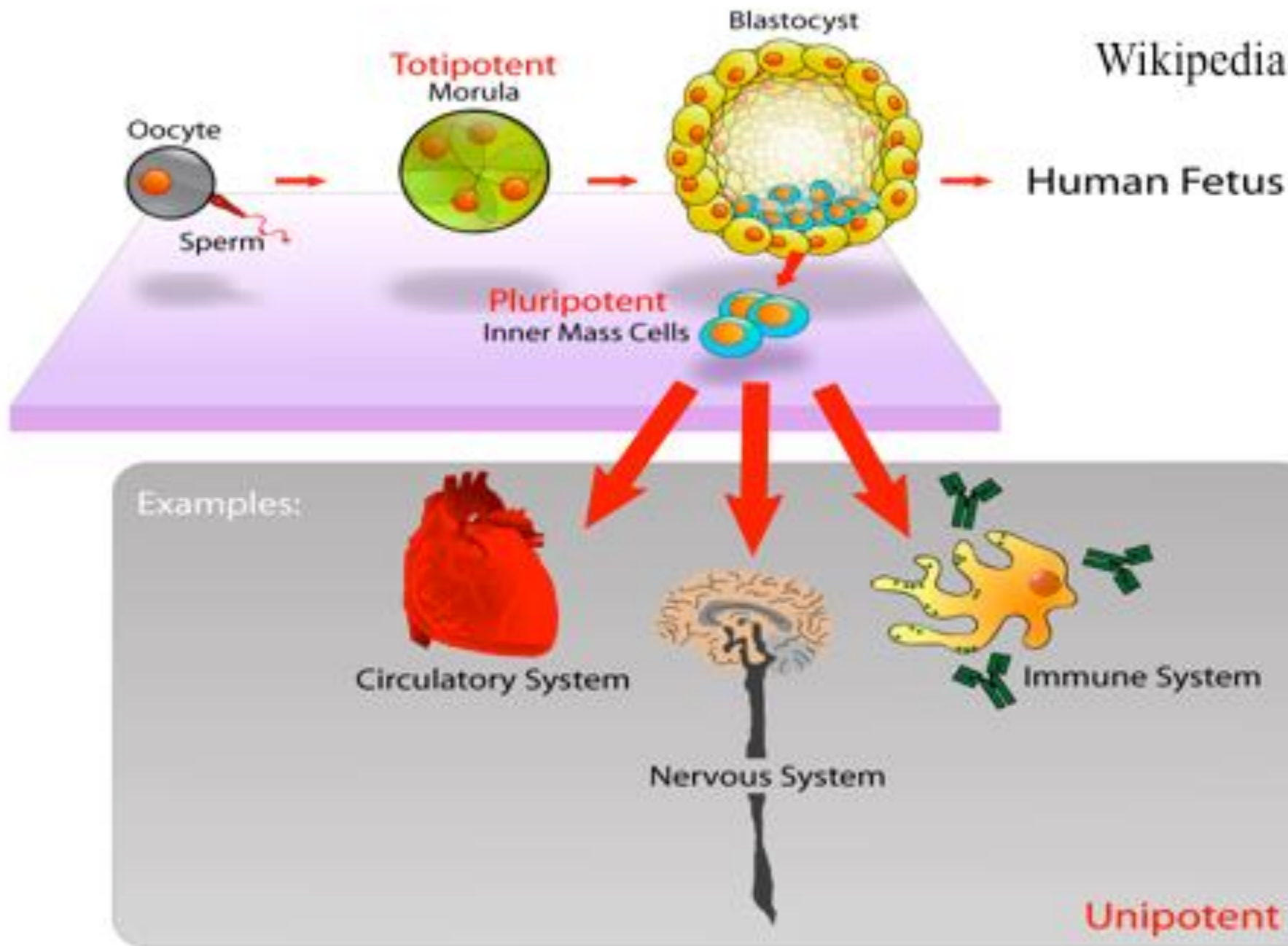
Mindfulness and mental flexibility

- Mindfulness leads to:
 - reduced cognitive rigidity via the tendency to be "blinded" by experience
 - “a reduced tendency to overlook novel and adaptive ways of responding due to past experience, both in and out of the clinical setting.”
 - Greenberg J, Reiner K, Meiran N. "Mind the trap": mindfulness practice reduces cognitive rigidity. PLoS One. 2012;7(5):e36206. Epub 2012 May 15.

Epigenetics

- Epigenetics is made up of two parts: epi- (Greek: επί- over, outside of, around) and -genetic
 - It is the study of the chemical processes over and above the DNA that influence the way our DNA expresses itself due to enzymes which change the gene or switch on and off their activity
- We now know that factors such as environment, lifestyle and mental state all influence how genes express themselves (phenotype)
- We get dealt the genetic hand, but we get to play it

Wikipedia



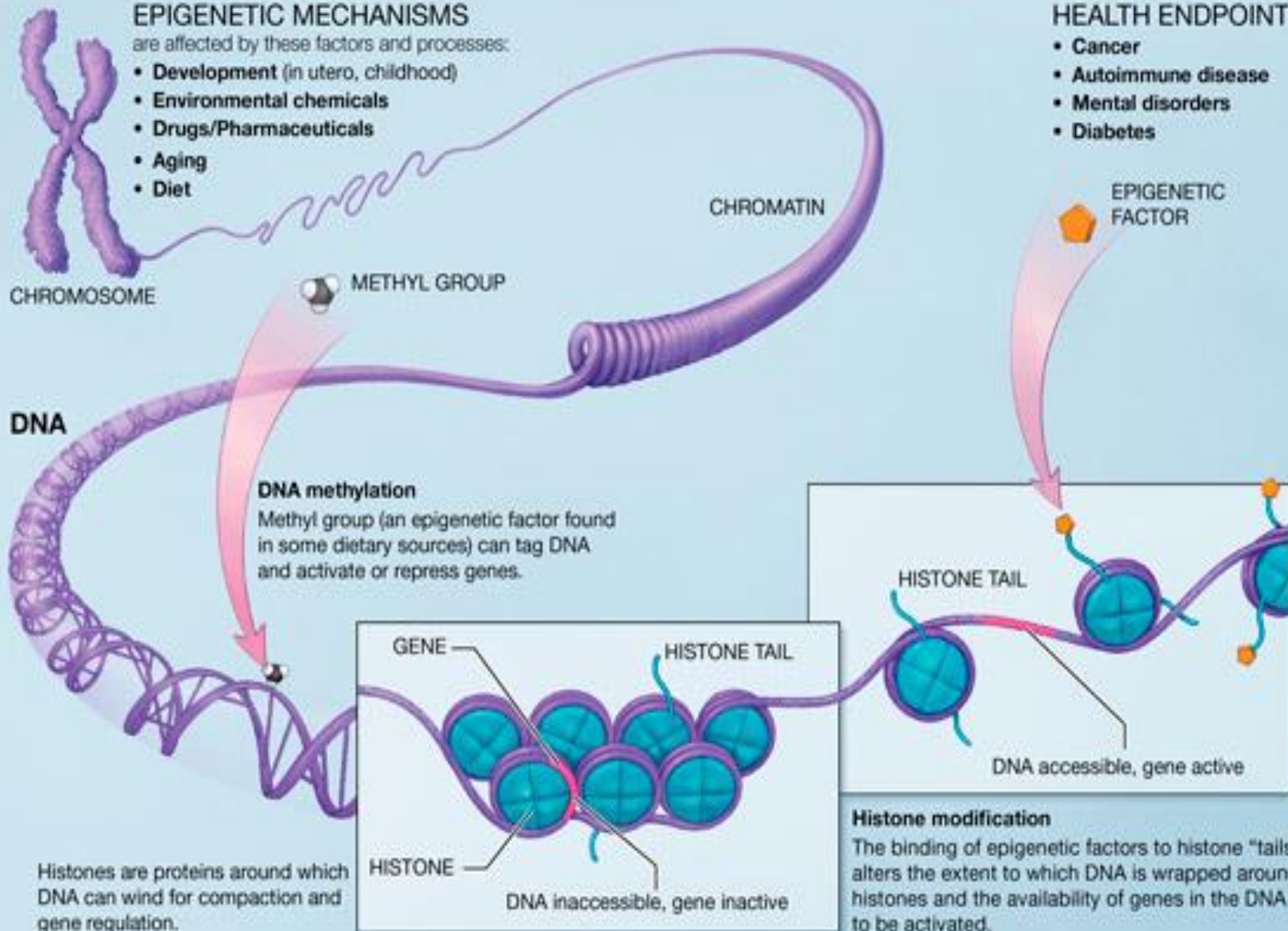
EPIGENETIC MECHANISMS

are affected by these factors and processes:

- Development (in utero, childhood)
- Environmental chemicals
- Drugs/Pharmaceuticals
- Aging
- Diet

HEALTH ENDPOINTS

- Cancer
- Autoimmune disease
- Mental disorders
- Diabetes



Addiction and genetics

- For a person with a genetic predisposition to addiction “*exposure to environmental insults induces stable changes in gene expression, neural circuit function, and ultimately behavior.*”
- Once these genetic switches for addiction are thrown they can be very difficult to switch off again
 - Peña CJ, Bagot RC, Labonté B, Nestler EJ. Epigenetic Signaling in Psychiatric Disorders. J Mol Biol. 2014 Apr 5. pii: S0022-2836(14)00174-0. doi: 10.1016/j.jmb.2014.03.016.

Mindfulness, craving and ‘urge surfing’

- Study on the effectiveness of suppression vs. mindfulness-based strategy for coping with cigarette cravings
- Both groups reported significantly reduced amount of smoking and increased self-efficacy in coping with smoking urges
- Only participants in the mindfulness group demonstrated reductions in negative affect (mood), depressive symptoms, and marginal reductions in their level of nicotine dependence
 - Rogojanski J, Vettese LC, Antony MM. Coping with Cigarette Cravings: Comparison of Suppression Versus Mindfulness-Based Strategies. *Mindfulness* 2011;2(1):14-26. DOI: 10.1007/s12671-010-0038-x

TELOMERES

Embryonic Stem Cell

Adult Stem Cell

Telomere Long

Telomere Short

Telomerase Active

**Telomerase
Inactive or Absent**

**Telomere is a
Repeating DNA
Sequence**



Stress & telomere shortening

- In healthy premenopausal women psychological stress (both perception and chronicity) a/w known determinants of cell senescence and longevity:
 - higher oxidative stress
 - lower telomerase activity
 - shorter telomere length
- Those with the highest levels of perceived stress c/w low stress have telomeres shorter on average by the equivalent of at least one decade (9-17 years) of additional aging
- Findings have implications for understanding how stress may promote earlier onset of age-related diseases
 - Epel ES et al. Proc Natl Acad Sci U S A. 2004;101(49):17312-5.

Maternal mental health and offspring TL

- Mental health of a woman during pregnancy affects the telomeres of her offspring
- Study of maternal stress during pregnancy measured in 94 healthy young adults
- Of these 45 were offspring of mothers who had experienced a severe stress during pregnancy and 49 were offspring of mothers who had a healthy, uneventful, relatively stress-free pregnancy
- Prenatal stress was a significant predictor of subsequent short adult telomere length in the offspring independent of other factors
 - Entringer S, Epel ES, Kumsta R, et al. Stress exposure in intrauterine life is associated with shorter telomere length in young adulthood. Proc Natl Acad Sci U S A. 2011;108(33):E513-8.

Genetic ageing & pessimism

- Combination of low optimism & high pessimism increases risk for disease and early mortality
- Study investigated whether tendency towards optimism or pessimism associated with Telomere Length and increased inflammation in healthy post-menopausal women
- Pessimism is independently associated with shorter Telomere length and higher inflammation (Interleukin-6 concentrations)
 - Lin J, Dhabhar FS, Wolkowitz O, Tillie JM, Blackburn E, Epel E. Pessimism correlates with leukocyte telomere shortness and elevated interleukin-6 in post-menopausal women. Brain Behav Immun. 2009 May;23(4):446-9.

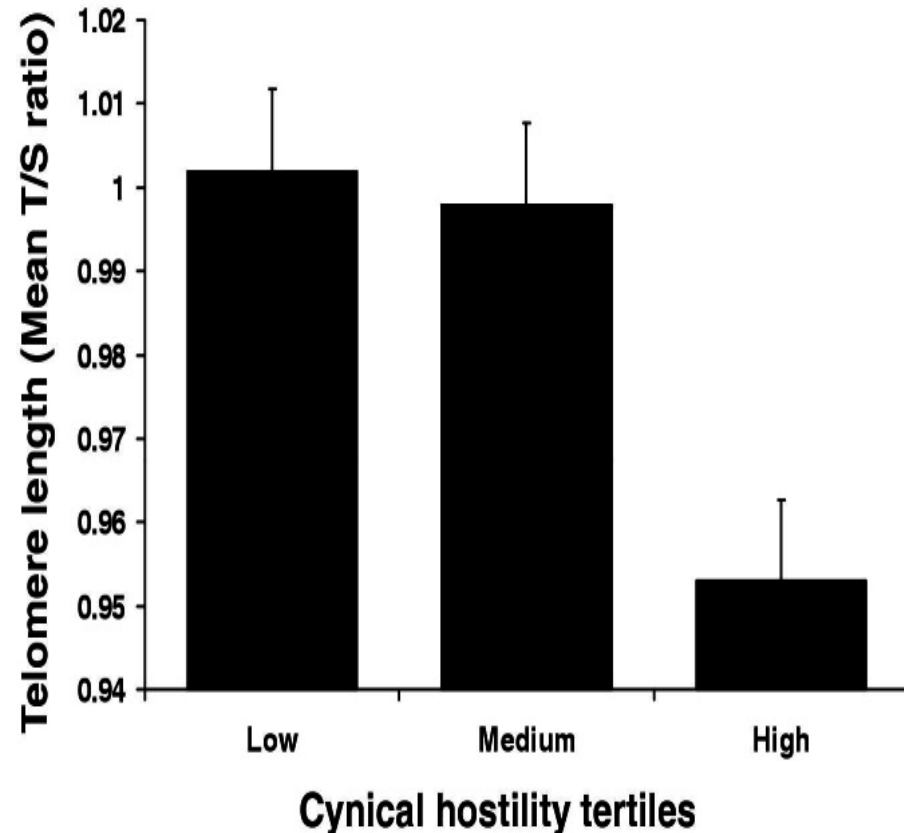
Racial discrimination and telomeres

- Racial discrimination has a strong influence on the mental and emotional health of racial minority groups in the community
- A study in the US found that "interpersonal experiences of racial discrimination and the internalization of negative racial bias, operate jointly to accelerate biological aging" as measured by telomere length in African American men
 - Chae DH, Nuru-Jeter AM, Adler NE, et al. Discrimination, racial bias, and telomere length in African-American men. *Am J Prev Med*. 2014 Feb;46(2):103-11. doi: 10.1016/j.amepre.2013.10.020.

Hostility and telomere length

- High-hostile men had significantly shorter leukocyte TL than their low-hostile counterparts
- The relationship between hostility and disease is stronger in men than in women, and men generally have a shorter life expectancy than women

» Brydon L, Lin J, Butcher L, Hamer M, Erusalimsky JD, Blackburn EH, Steptoe A. Hostility and cellular aging in men from the Whitehall II cohort. *Biol Psychiatry*. 2012 May 1;71(9):767-73. doi: 10.1016/j.biopsych.2011.08.020.



Mind wandering, ageing (telomere length)

- The greater the level of mind wandering, the greater the level of telomere shortening (a marker of biological age)
 - Epel ES, Puterman E, Lin J, Blackburn E, et al. Wandering Minds and Aging Cells. Clinical Psychological Science 2012 doi: 10.1177/2167702612460234

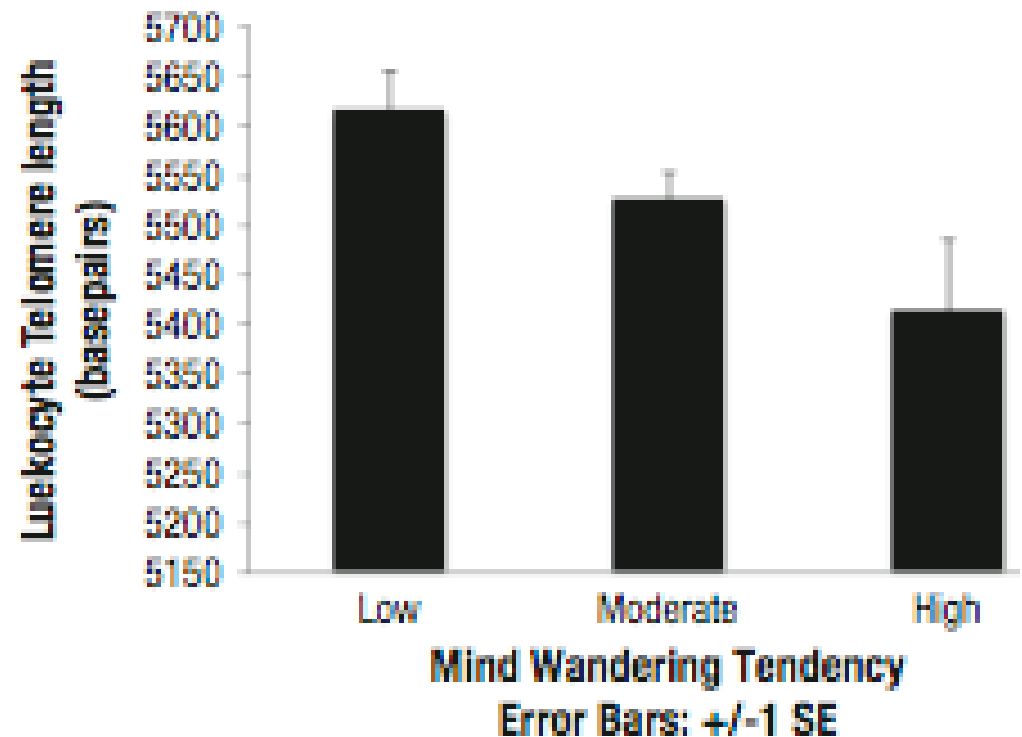


Fig. 1. Leukocyte telomere length by greater mind-wandering group.

Meditation, mental health & telomerase

- Study of effect of meditation on mental health, cognitive functioning, and telomerase activity in caregivers (av. age 60) with mild depression
- Meditation group showed significantly lower levels of depression and improvement in mental health and cognitive functioning c/w relaxation
- 43% improvement in telomerase activity c/w 3.7% in the relaxation group
 - Lavretsky H, Epel ES, Siddarth P, Nazarian N, Cyr NS, Khalsa DS, Lin J, Blackburn E, Irwin MR. A pilot study of yogic meditation for family dementia caregivers with depressive symptoms: effects on mental health, cognition, and telomerase activity. *Int J Geriatr Psychiatry*. 2012 Mar 11. doi: 10.1002/gps.3790.

Mindfulness, telomeres and breast cancer

- Telomere length (TL) associated with breast cancer prognosis
- RCT compared the effects of a mindfulness program and Supportive Expressive Therapy with a minimal intervention control intervention on TL in distressed stage I-III breast cancer survivors
 - Intervention focused on training in mindfulness meditation and gentle Hatha yoga: SET focused on emotional expression and group support
- TL in the intervention group was maintained whereas it was found to decrease for control participants
 - Carlson LE, Beattie TL, Giese-Davis J, Faris P, Tamagawa R, Fick LJ, Degelman ES, Speca M. Mindfulness-based cancer recovery and supportive-expressive therapy maintain telomere length relative to controls in distressed breast cancer survivors. Cancer. 2014 Nov 3. doi: 10.1002/cncr.29063

Yogic meditation, genes and immunity

- Study on effect of Yogic meditation on genetic expression
- 68 genes were found to be differentially expressed (19 up-regulated, 49 down-regulated) after adjusting for potentially confounded differences in sex, illness burden, and BMI
- Up-regulated genes included immunoglobulin-related genes
- Down-regulated genes included pro-inflammatory cytokines
 - Black DS, Cole SW, Irwin MR, et al. Yogic meditation reverses NF- κ B and IRF-related transcriptome dynamics in leukocytes of family dementia caregivers in a randomized controlled trial. *Psychoneuroendocrinology*. 2013 Mar;38(3):348-55. doi: 10.1016/j.psyneuen.2012.06.011.

Relaxation response & genes

- “This study provides the first compelling evidence that the RR elicits specific gene expression changes in short-term and long-term practitioners. Our results suggest consistent and constitutive changes in gene expression resulting from RR may relate to long term physiological effects.”
 - Dusek JA, Otu HH, Wohlhueter AL, et al. Genomic counter-stress changes induced by the relaxation response. PLoS ONE. 2008 Jul 2;3(7):e2576.

Religiosity and telomere length

- Religiosity (an index of religious attendance, prayer frequency, and religious identity) positively associated with leukocyte telomere length
 - Adjusted for religious support, religious coping, age, gender, race, education, employment status, income, financial strain, stressful life events, marital status, family support, friend support, depressive symptoms, smoking, heavy drinking, and allostatic load
- Depressive symptoms, smoking, heavy drinking, and allostatic load failed to explain any of the association between religiosity and telomere length
 - Hill TD, Ellison CG, Burdette AM, Taylor J, Friedman KL. Dimensions of religious involvement and leukocyte telomere length. Soc Sci Med. 2016 Apr 28. pii: S0277-9536(16)30206-4. doi: 10.1016/j.socscimed.2016.04.032.

Purpose, happiness, genetics and immunity

- Immunity in individuals with high levels of hedonic wellbeing (pleasure seeking / gratification) characterized by:
 - an increased expression of genes involved in inflammation (implicated in diseases such as arthritis and heart disease), and
 - decreased expression of genes involved in antiviral responses
- This immune response (known as CTRA) is also associated with chronic stress and uncertainty
- The opposite effect was found for eudaimonic wellbeing (meaning / engagement)
- Both forms of wellbeing associated with similar self-reported affect

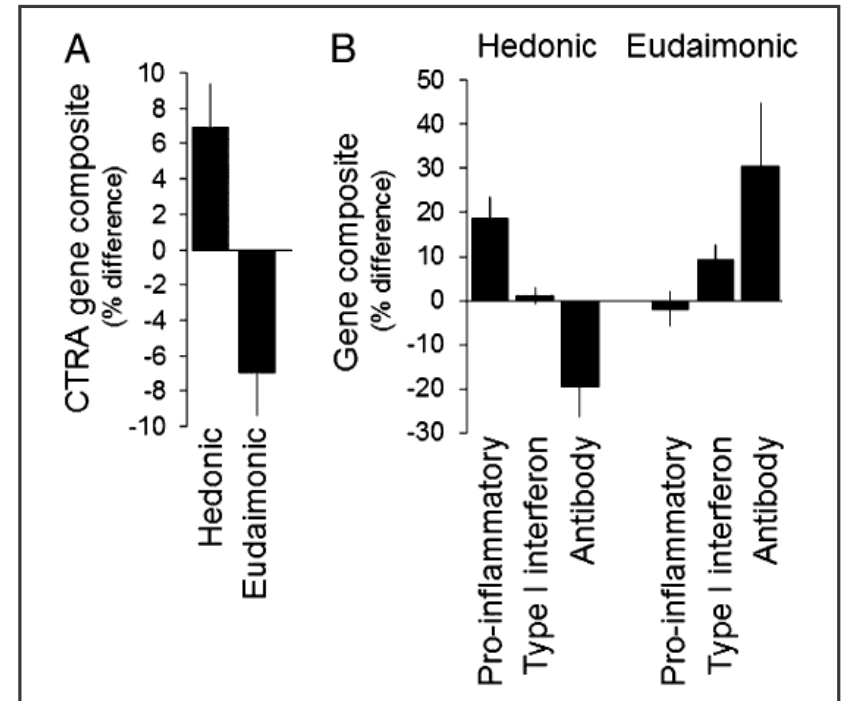


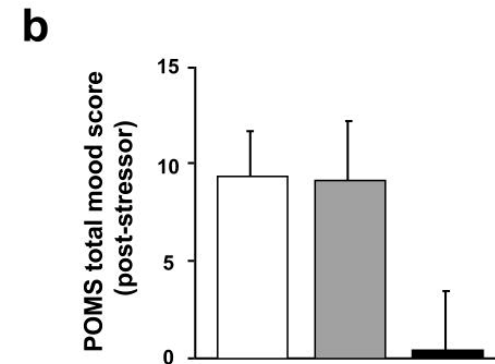
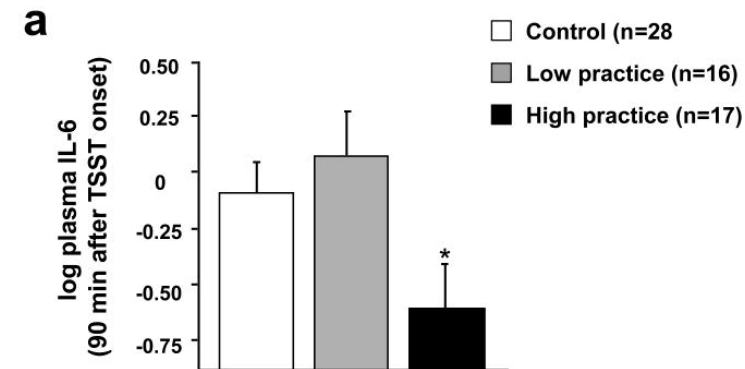
Fig. 2. Expression of the CTRA gene set. (A) Linear model-based estimates of mean difference (\pm SEM) in expression in a 53-gene CTRA contrast score in PBMCs from individuals with low levels (-2 SD relative to sample mean) vs. high levels ($+2$ SD) of hedonic well-being and eudaimonic well-being (each adjusting for the other and for demographic and behavioral covariates). (B) Differential expression of CTRA subcomponents: 19 proinflammatory genes, 31 type I IFN response genes, and three antibody synthesis genes.

Fredrickson BL, Grewen KM, Coffey KA, et al. A functional genomic perspective on human well-being. *Proc Natl Acad Sci U S A*. 2013 Jul 29. [Epub ahead of print]

Compassion meditation and inflammation

- Study of healthy adults randomized to 6 weeks of training in compassion meditation or participation in a health discussion control group followed by exposure to a standardized laboratory stressor (TSST)
- Within the meditation group, increased meditation practice correlated with decreased TSST-induced IL-6 and POMS distress scores
- Individuals with meditation practice times above the median exhibited lower TSST-induced IL-6 and POMS distress scores compared to individuals below the median, who did not differ from controls

- Pace TW, Negi LT, Adame DD, et al. Effect of compassion meditation on neuroendocrine, innate immune and behavioral responses to psychosocial stress. *Psychoneuroendocrinology*. 2009 Jan;34(1):87-98. doi: 10.1016/j.psyneuen.2008.08.011.



Giving, stress and mortality

- Study on whether providing help to others predicts a reduced association between stress and mortality
- Participants completed baseline interviews assessing past-year stressful events and whether they had provided assistance to friends or family
- Participant mortality and time to death monitored for 5 years
- Stress did not predict mortality risk among individuals who provided help to others in the past year (HR = 0.96), but did predict mortality among those who did not provide help to others (HR = 1.30)
- “Helping others predicted reduced mortality specifically by buffering the association between stress and mortality.”
 - Poulin MJ, Brown SL, Dillard AJ, Smith DM. Giving to others and the association between stress and mortality. Am J Public Health. 2013 Sep;103(9):1649-55. doi: 10.2105/AJPH.2012.300876.

Ornish program for cancer

- Men with early prostate cancer (biopsy and raise PSA) who chose not to have treatment (watch and wait)
- 92 patients randomised to lifestyle (experimental) group vs. usual treatment (control) group
 - Ornish D. Weidner G. Fair WR. et al. Intensive lifestyle changes may affect the progression of prostate cancer. Journal of Urology. 2005;174(3):1065-9.

Regrowing telomeres – reversing ageing

- At 5 years relative telomere length increased from baseline in the lifestyle intervention group, but decreased in the control group
- Adherence to lifestyle change significantly associated with relative telomere length after adjustment for age and the length of follow-up
 - Ornish D, Lin J, Chan JM, et al. Effect of comprehensive lifestyle changes on telomerase activity and telomere length in men with biopsy-proven low-risk prostate cancer: 5-year follow-up of a descriptive pilot study. *Lancet Oncol.* 2013 Sep 16. doi:pii: S1470-2045(13)70366-8. 10.1016/S1470-2045(13)70366-8

Free 6-week online mindfulness course

- <https://www.futurelearn.com/courses/mindfulness-wellbeing-performance>
- Collaboration between Monash University and FutureLearn (UK)