
Mindfulness: the science

A/Prof Craig Hassed
Monash University

Mind wandering and happiness

- “In conclusion, a human mind is a wandering mind, and a wandering mind is an unhappy mind. The ability to think about what is not happening is a cognitive achievement that comes at an emotional cost.”
 - Killingsworth MA, Gilbert DT. A Wandering Mind Is an Unhappy Mind. *Science* 12 November 2010: Vol. 330. no. 6006, p. 932 DOI: 10.1126/science.1192439
-

What is mindfulness?

- Paying attention to the present moment with an attitude of openness, curiosity, acceptance, self-compassion...
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Stressful events and heart attacks

■ **Football**

■ FIFA World Cup (Germany 2006)

■ On days of matches involving the German team the incidence of cardiac emergencies was higher than usual

- Men 3.26 times higher

- Women 1.82 times

- Incidence higher in those with pre-existing heart disease

- Wilbert-Lampen U, Leistner D, Greven S, et al. NEJM 2008; 358 (5):475-483.
-

Epictetus

- “Man is not disturbed by events but by the view he takes of them.”

Worrying about things that never happened

- Study at Cornell examined how many imagined calamities never materialize
 - Subjects wrote down their worries over an extended period of time then identified which imagined misfortunes didn't actually happen
 - 85% of what subjects worried about never happened
 - For the 15% that did happen 79% of subjects discovered either they could handle the difficulty better than expected or they learned a lesson worth learning
 - i.e. 97% of what we worry over is fearful based on exaggerations and misperceptions
 - Cited in Robert L. Leahy, PhD, *The Worry Cure: Seven Steps to Stop Worry from Stopping You* (New York: Random House, 2005), 109.
-

“The body is the shadow of the soul.”
Marsilio Ficino (1433-99)



Allostatic load

- Prolonged stress leads to wear-and-tear on the body (allostatic load)
 - Mediated through the Sympathetic Nervous System
 - Allostatic load leads to:
 - Impaired immunity, atherosclerosis, metabolic syndrome, bone demineralization
 - Atrophy of nerve cells in the brain
 - **Hippocampal formation:** learning and memory
 - **Prefrontal cortex:** working memory, executive function
 - Growth of **Amygdala** mediates fear response
 - Many of these processes are seen in chronic depression and anxiety
 - McEwen BS. Ann N Y Acad Sci. 2004;1032:1-7.
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TELOMERES

Embryonic Stem Cell

Adult Stem Cell

Telomere Long

Telomere Short

Telomerase Active

Telomerase Inactive or Absent

A — T
A — T
T — A
C — G
C — G
C — G

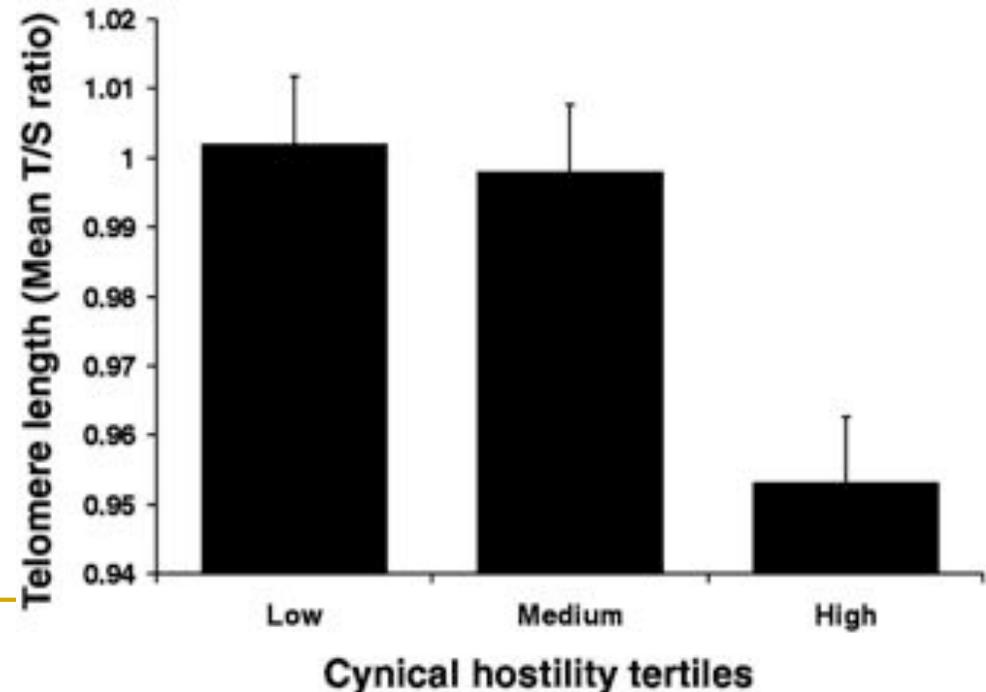
Telomere is a Repeating DNA Sequence



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.



Work stress and aging

- Study on whether work-related exhaustion (prolonged work stress – Maslach’s Burnout Inventory) associated with accelerated biological aging (telomere length)
 - Data from sample of 2911 of the Finnish working-age population aged 30-64
 - Individuals with severe exhaustion had telomeres significantly shorter than those with no exhaustion
 - Association remained significant after adjustment for other factors
 - “...work-related exhaustion is related to the acceleration of the rate of biological aging.”
 - Ahola K, Sirén I, Kivimäki M, et al. Work-related exhaustion and telomere length: a population-based study. PLoS One. 2012;7(7):e40186. Epub 2012 Jul 11.
-

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.
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Mind wandering and ageing

- The greater the level of mind wandering, the greater the level of telomere shortening (a marker of biological age)

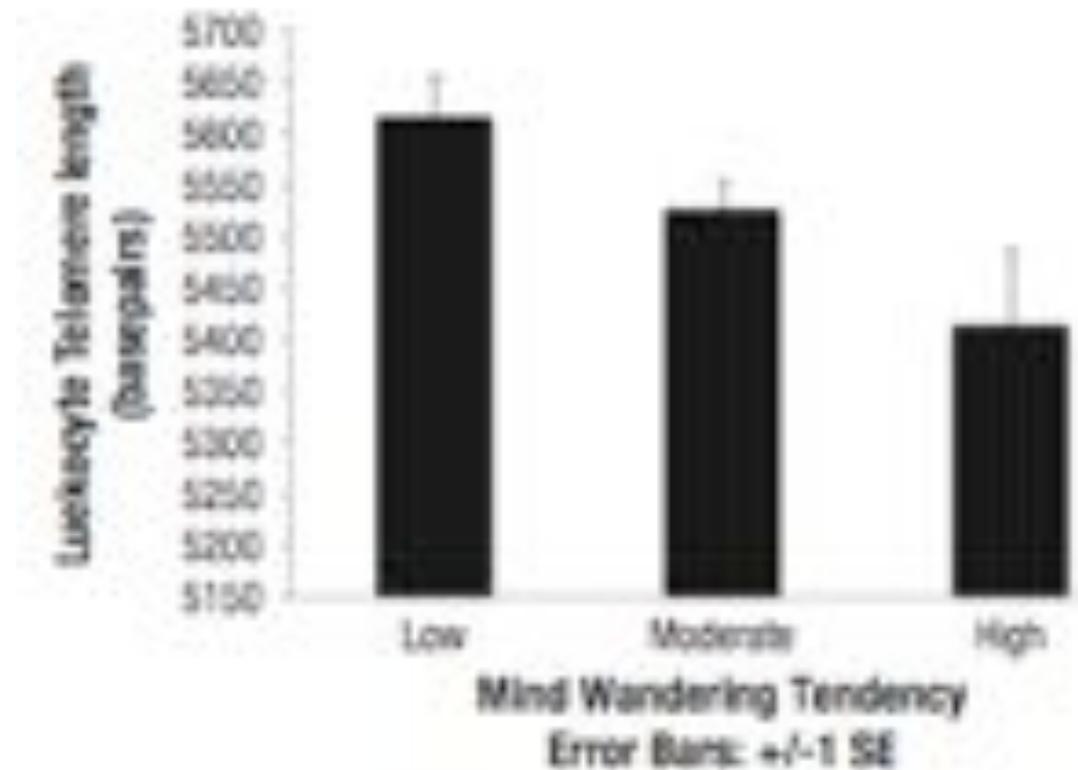
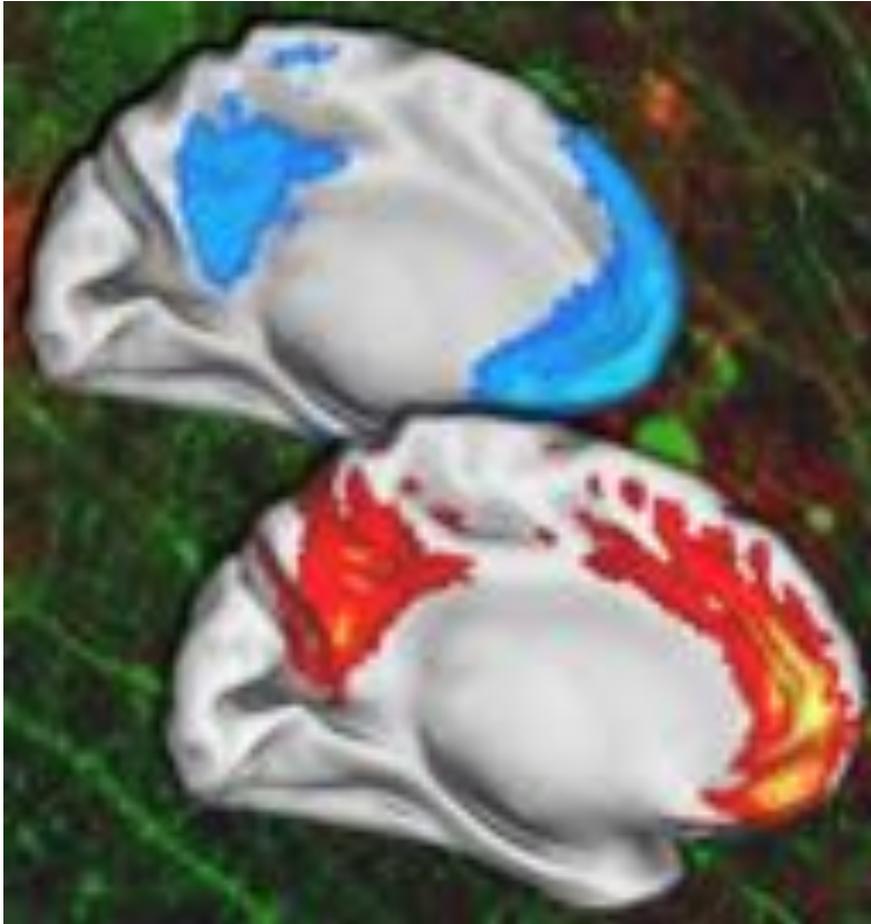


Fig. 1. Leukocyte telomere length by greater mind-wandering group.

Epel ES, Puterman E, Lin J, Blackburn E, et al. Wandering Minds and Aging Cells. *Clinical Psychological Science* 2012, in press.

The Default Brain



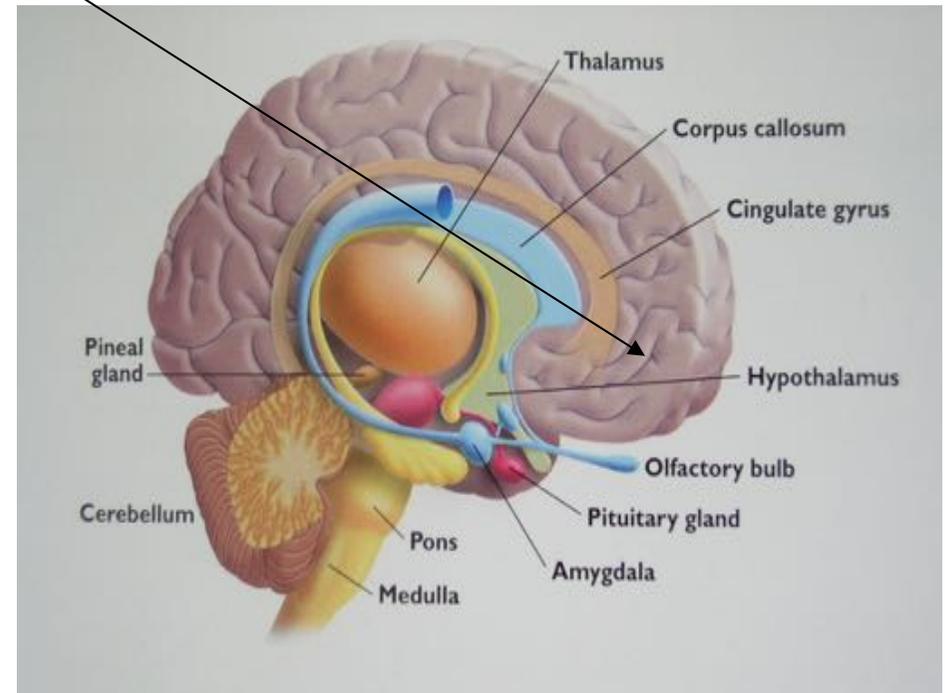
- Focused (mindful)
 - Tasks associated with paying attention
 - Brain efficient and quiet
- Default state (mode)
 - The default-mode network (DMN) is a major resting-state network that supports most of the baseline brain activity
 - Mind is inattentive, distracted, idle, recalling past, daydreaming

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)
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Three regions of the brain

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



Plato's 3 aspects of the (psyche) soul

- “Human behavior flows from three main sources: desire, emotion, and knowledge.”
 - Reason (intelligence)
 - Emotive element (passion, courage)
 - Appetitive element (desire, instincts, pleasure)
- Health of body and mind are based upon the right alignment of these elements
- Reason governs/regulates emotions and appetites



Botticelli's "Pallas and the Centaur"

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:///microsoft-attention-spans-research-report.pdf>
-

Screen time and attention

- Higher TV watching at 3 y/o associated with higher ADHD at age 7
 - Friedland RP et al. Proc Nat Acad Sci USA, 10.1073/pnas.061002998
 - Scarmeas N et al. Neurology 2001;57(12):2236-42.
 - Swing EL, Gentile DA, Anderson CA, Walsh DA. Television and video game exposure and the development of attention problems. Pediatrics. 2010 Aug;126(2):214-21. doi: 10.1542/peds.2009-1508. Epub 2010 Jul 5.
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Children's attention span and academic achievement

- Study on relation b/w preschool children's attention span-persistence (ability to stay with a task or form of play for long period) and later school achievement and college completion
 - Children's age 4 attention span-persistence significantly predicted:
 - Math and reading achievement at age 21
 - Odds of completing college by age 25
 - Children who were rated one standard deviation higher on attention span-persistence at age 4 had 48.7% greater odds of completing college by age 25.
 - McClelland MM, Acock AC, Piccinin A, Rhea SA, Stallings MC. Relations between Preschool Attention Span-Persistence and Age 25 Educational Outcomes. *Early Child Res Q.* 2013 Apr 1; 28(2): 314–324. Published online 2012 Aug 3. doi: 10.1016/j.ecresq.2012.07.008
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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.
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Attention Deficit Trait

- Newly recognized neurological phenomenon: attention deficit trait (ADT)
 - Response to hyperkinetic environment
 - Trying to deal with too much input, results in:
 - Black-and-white thinking; perspective and shades of grey disappear
 - Difficulty staying organized, setting priorities, and managing time
 - Feel a constant low level of panic and guilt
 - Hallowell EM. Overloaded circuits: why smart people underperform. Harv Bus Rev. 2005 Jan;83(1):54-62, 116.
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On the performance of extreme multi-taskers

- “These are kids who are doing 5, 6, or more things at once all the time. ... It turns out multi-taskers are terrible at every aspect of multitasking! They get distracted constantly. Their memory is very disorganized. Recent work we’ve done suggests that they’re worse at analytic reasoning. We worry that it may be we’re creating people who may not be able to think well, and clearly.”
 - Dr. Clifford Nass of Stanford University. From Dretzin R, Rushkoff D. “digital_nation life on the virtual frontier.” pbs.org Frontline. Feb. 2010. Web. 14 Apr. 2011.
-

Mobile phone use and motor vehicle accidents

- 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. Epub 2007 Apr 9.
 - Texting / emailing / internet while driving increased the risk 164-fold
 - Hickman JS, Hanowski RJ. [An assessment of commercial motor vehicle driver distraction using naturalistic driving data.](#) *Traffic Inj Prev.* 2012;13(6):612-9. doi: 10.1080/15389588.2012.683841.
-

Multitasking or task-switching?

- Multitasking is an illusion (misnomer)
 - Switching happens so fast that it appears we are performing multiple tasks simultaneously like the concurrent performance of several jobs by a computer
 - Reality is that we are switching back and forth between tasks
 - <http://ucsdcfm.wordpress.com/2011/07/01/our-brains-are-evolving-to-multitask-not-the-illusion-of-multitasking/>
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The Illusion Of Multitasking

■ Attention switching

- So fast it *appears* we are doing multiple things simultaneously

■ Attentional blink

- **Lag time** of 200 to 500 milliseconds (0.5 second)
- Increased by **stress**
 - Slatger, Lutz, Greishchar et al. (2007)



The distraction of notifications

- Undergraduate university students performed a simple task
 - On the second run through, they were split into three groups
 1. Called on the phone
 2. Received a text
 3. Not interrupted
 - Participants didn't know they were being contacted as part of the study
 - Phone calls caused 28% increase in mistakes even though had their phones set to vibrate and didn't take them out or look at them during the study
 - Stothart C, Mitchum A, Yehnert C. The Attentional Cost of Receiving a Cell Phone Notification.. *Journal of Experimental Psychology: Human Perception and Performance*, 2015; DOI: 10.1037/xhp0000100
-

Multitasking vs. efficient attention switching

- Multitasking is a myth – the human brain does not pay attention to multiple complex tasks at the same time
 - Efficient attention switching is useful – focus on one thing at a time
 - Manage the environment – remove unnecessary inputs
 - Avoid interrupting complex tasks
 - Don't multitask
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Interrupting the flow

- Average of **64 seconds** to **recover train of thought** after checking **email**
 - Check **every 5 mins** = waste **8.5 hours per week**
 - Jackson, Dawson & Wilson. (2002)

Social media use and depression

- Study assessed association between SM use and depression in 1,787 adults ages 19-32
 - SM use was assessed by self-reported total time per day spent on SM, visits per week, and a global frequency score
 - Compared to lowest quartile of total time per day spent on SM, participants in the highest quartile had significantly increased odds of depression (AOR = 1.66) after controlling for all covariates
 - Compared with those in the lowest quartile, individuals in the highest quartile of SM site visits/wk and those with a higher global frequency score had significantly increased odds of depression (2.74; 3.05, respectively)
 - Strong, linear, dose-response trends
 - Lin LY, Sidani JE, Shensa A, et al. Association between social medial use and depression among U.S. young adults. *Depress Anxiety*. 2016 Apr;33(4): 323-31. doi: 10.1002/da.22466.
-

Social Media and academic performance

- Study addresses whether use of social media affects educational achievement in mathematics, reading, and science
 - Used OECD 2012 Program for International Student Assessment data set
 - Using online social networks reduces academic achievement
 - Teenagers who use Facebook or chat sites every day scored 20 points worse in maths than students who never used social media
 - The more they use SM the poorer their academic achievement
 - Skipping school, failing an academic year in the past, and being indigenous are also important predictors of underachievement
 - Posso A. Internet Usage and Educational Outcomes Among 15-Year-Old Australian Students. *International Journal of Communication* 10(2016), 3851–3876. doi: 1932–8036/20160005
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Week away from Facebook improves happiness

- Study by Happiness Research Institute on 1,095 people in Denmark
 - Measured life satisfaction and then asked half of the people to stop using Facebook for one week
 - After a week, participants asked to re-evaluate level of life satisfaction: those who had taken a break from Facebook were more satisfied with life
 - On the last day of the experiment, all participants were asked what moods they experienced that day
 - Facebook-removed group said they felt happier, less sad and lonely, more decisive, less angry or worried, more enthusiastic, and less depressed and experienced an increase in satisfaction with social lives, and 18% more likely to be present in the moment
 - People on Facebook 55% more likely to feel stressed than their unplugged counterparts, and 39% more likely to feel less happy than their friends
 - <http://www.happinessresearchinstitute.com/publications/4579836749>
-

■ Treatment group (those who took a break from Facebook)
■ Control group (those who kept using Facebook)

81% 88%
are happy

34% 22%
are sad

54% 41%
are worried

20% 12%
are angry

75% 84%
enjoy life

49% 61%
are enthusiastic

33% 22%
feel depressed

25% 16%
feel lonely

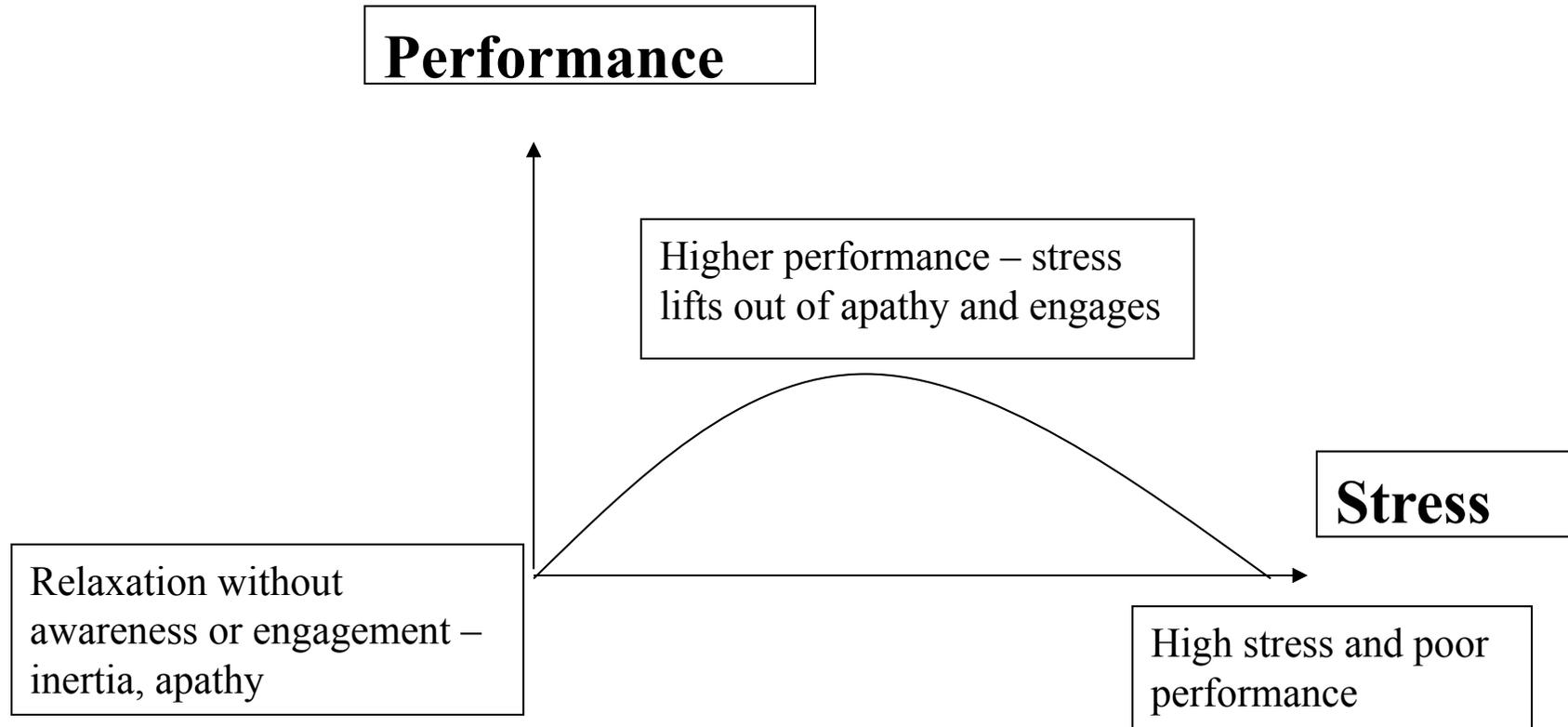
56% 64%
are decisive

- <http://www.happinessresearchinstitute.com/publications/4579836749>

Social media and emotional intelligence

- Study examined whether increasing opportunities for face-to-face interaction while eliminating the use of screen-based media and communication tools improved nonverbal emotion cue recognition in preteens
- Preteens spent 5 days at a nature camp where TVs, computers and mobile phones were not allowed c/w school-based matched controls that retained usual media practices
- Nature camp preteens' recognition of nonverbal emotion cues improved significantly but not the control group
 - Uhlsa YT, Michikyanb M, Morris J, et al. Computers in Human Behavior 2014;39:387–392. DOI: 10.1016/j.chb.2014.05.036
 - <http://newsroom.ucla.edu/releases/in-our-digital-world-are-young-people-losing-the-ability-to-read-emotions>

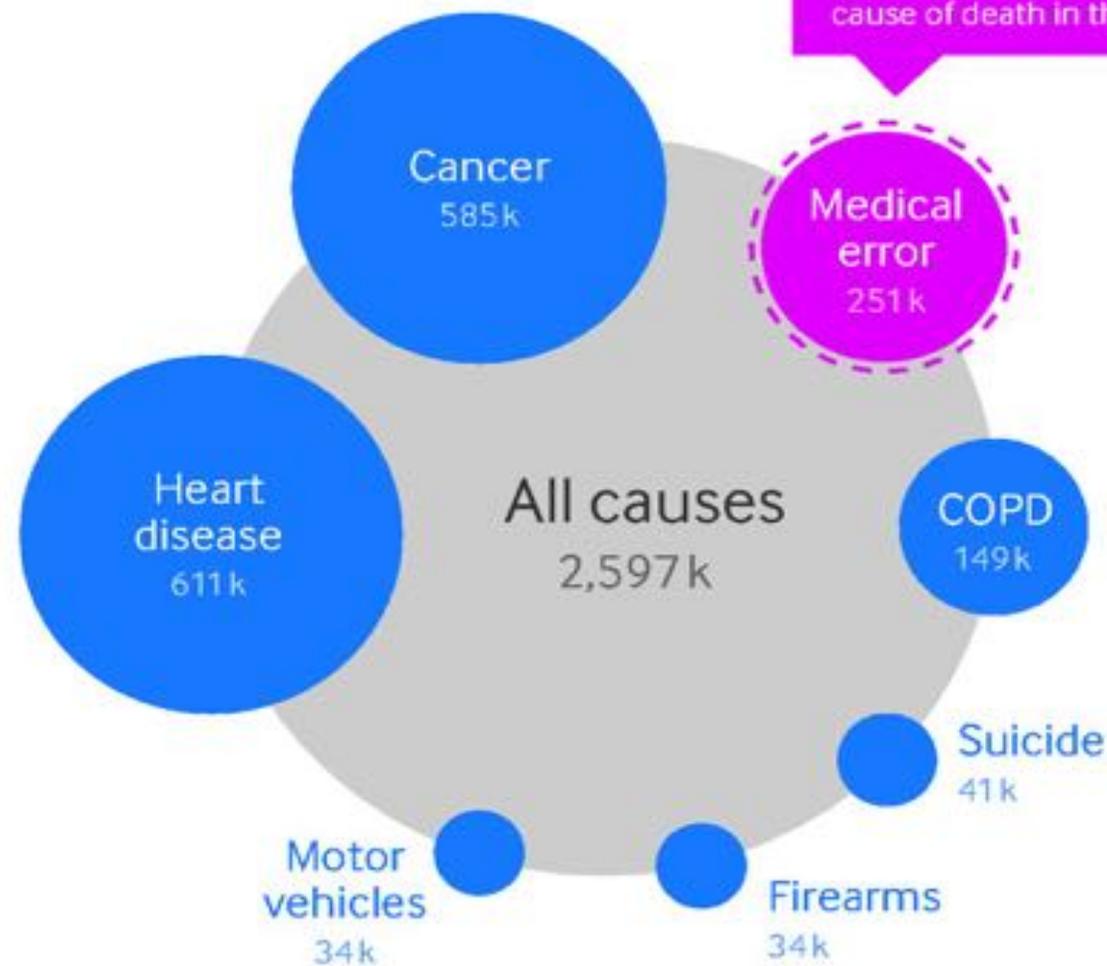
Yerkes-Dodson Stress-performance curve



Doctor health and medical errors

- Study determined prevalence of depression and burnout among residents medical staff in 3 US hospitals
 - 20% of residents met criteria for depression
 - 74% met the criteria for burnout
 - Depressed residents made 6.2 times as many medication errors as residents who were not depressed
 - Fahrenkopf AM, Sectish TC, Barger LK, et al. Rates of medication errors among depressed and burnt out residents: prospective cohort study. *BMJ*, doi:10.1136/bmj.39469.763218.BE (published 7 February 2008)
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Causes of death, US, 2013



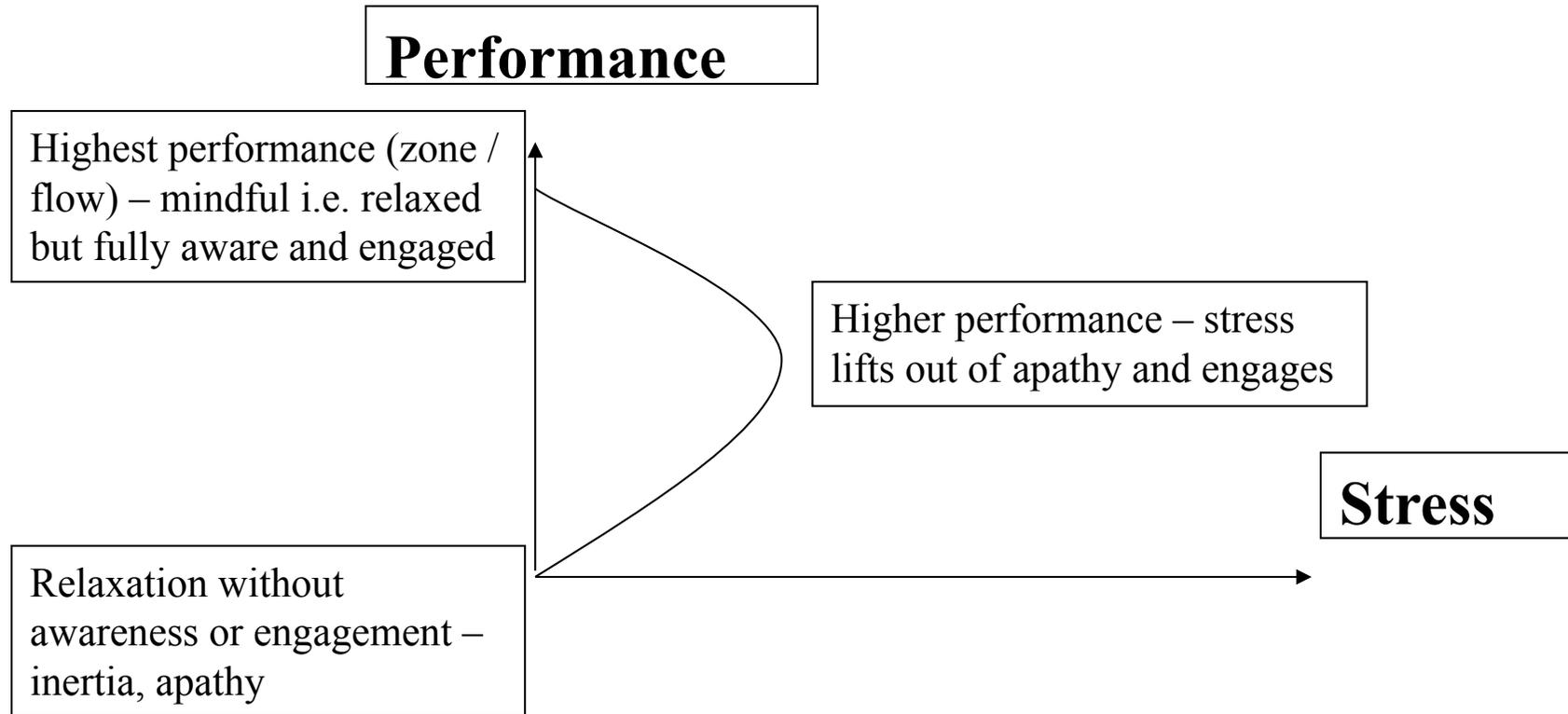
However, we're not even counting this - medical error is not recorded on US death certificates

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Data source:

http://www.cdc.gov/nchs/data/nvsr/nvsr64/nvsr64_02.pdf

Mindfulness stress-performance curve



Murray Rose on mindfulness

- REPORTER: Do you have any philosophy on life as an individual?
 - MURRAY ROSE: I think it revolves around this perhaps secret of concentration on one thing. When you're eating, you do nothing else but eat. And when you're swimming, you do nothing else but swim, and I think that by doing that you achieve the greatest satisfaction by devoting your whole self, your whole energies, your whole thoughts to just one activity at a time. And I think that perhaps would be the essence of my personal philosophy.
 - <http://www.abc.net.au/austory/content/2012/s3893380.htm>
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- “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



Practicing mindfulness

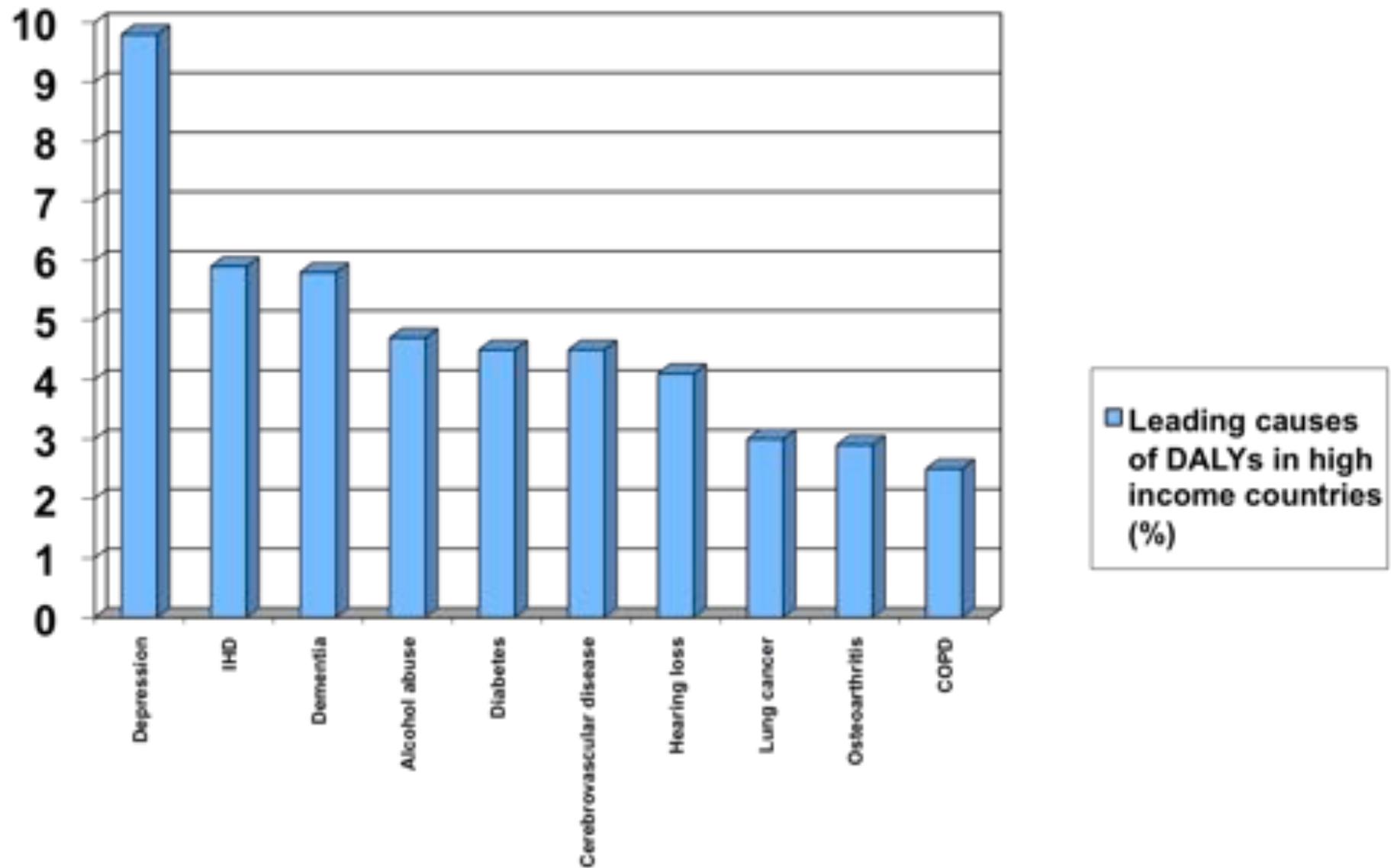
- Formal practice
 - Mindfulness meditation
 - Informal practice
 - Mindful while engaged in daily activities and work
 - Cognitive practices
 - Perception
 - Letting go (non-attachment)
 - Acceptance
 - Presence of mind
-

Mindfulness and attention regulation

- Mindfulness 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 includes:
 1. Openness
 2. Curiosity
 3. Acceptance
 4. Self-compassion
-

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**
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Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med. 2006 Nov;3(11):e442.

Antidepressants and placebo

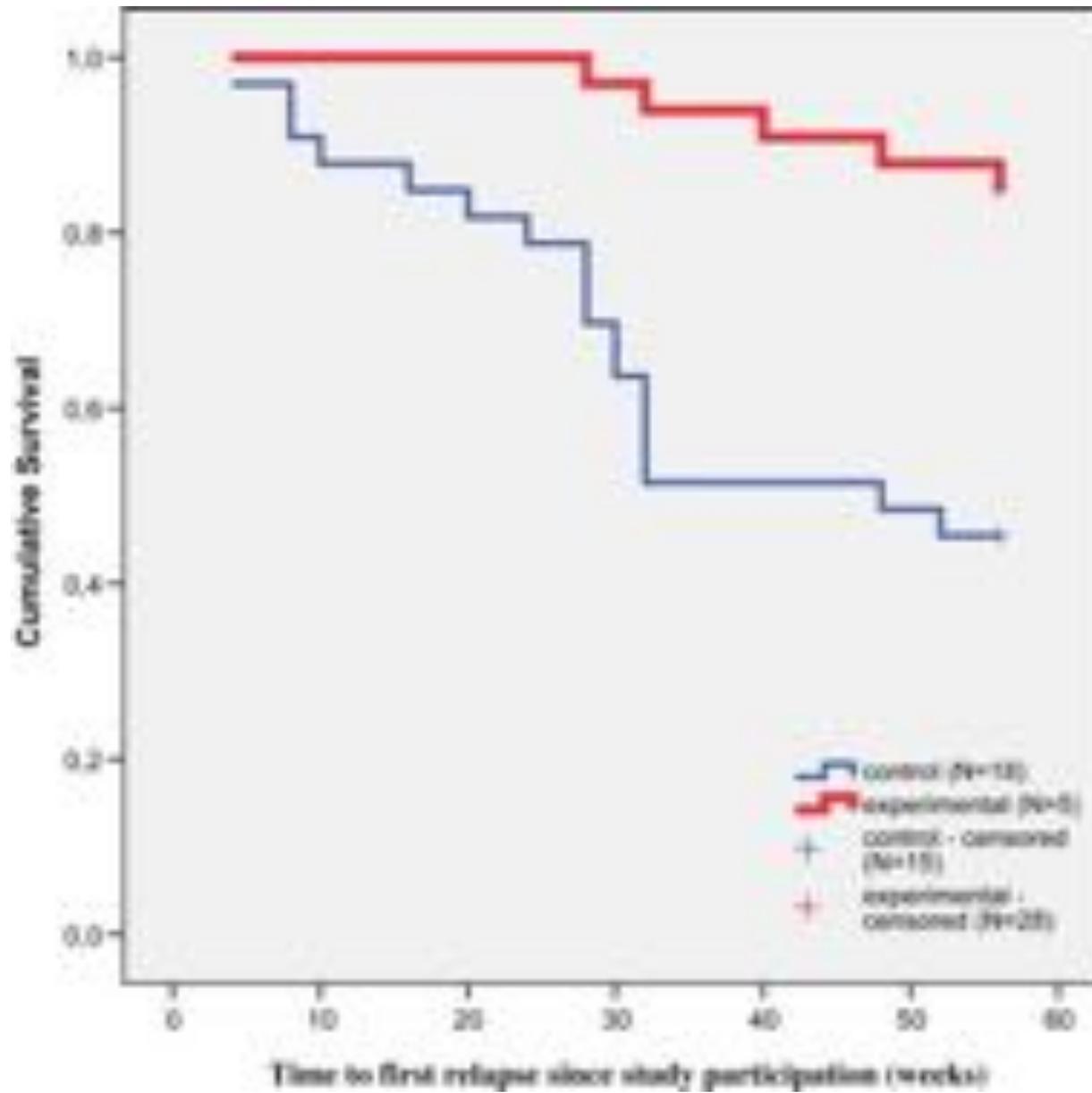
- Antidepressants no different to placebo for mild-moderate depression
 - Relatively small difference even for severe depression
 - Publication bias makes studies look better than they are
 - Kirsch I et al. PLoS Medicine 2008 Feb;5(2):e45 doi: 10.1371/journal.pmed.0050045
 - Fournier JC, DeRubeis RJ, Hollon SD, et al. Antidepressant drug effects and depression severity: a patient-level meta-analysis. JAMA. 2010 Jan 6;303(1):47-53.
 - Turner EH, Matthews AM, Linardatos E, et al. Selective publication of antidepressant trials and its influence on apparent efficacy. N Engl J Med. 2008 Jan 17;358(3):252-60.
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Symptoms of depression

- Depression can be understood as a disorder of attention
 - Depressive rumination – default mode
 - Not present – foreboding about future and reliving past
 - Poor functioning – distracted
 - Anhedonia – lack of pleasure / enjoyment
 - Reactivity – non-acceptance of state of thoughts and emotions
 - High allostatic load – poor health
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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 1 year 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.
-



Godfrin KA, van Heeringen C. Behav Res Ther. 2010 Aug;48(8):738-46.

Mindfulness in mundane activities

- Study investigated whether washing dishes could be used as an informal contemplative practice, promoting the state of mindfulness, emotional wellbeing
 - College students engaged in either a mindful or control dishwashing practice
 - Mindful dishwashers had greater state mindfulness, more enjoyment, increase in positive affect (i.e., inspiration), decrease in negative affect (i.e., nervousness), and overestimations of dishwashing time
 - Hanley AW, Warner AR, Dehili VM, Canto AI, Garland EL. Washing Dishes to Wash the Dishes: Brief Instruction in an Informal Mindfulness Practice. *Mindfulness* (2015) 6:1095–1103. DOI 10.1007/s12671-014-0360-9
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Default mode network

- Default mental activity flourishes in various forms of psychopathology including depression, anxiety, schizophrenia and autism
 - Default activity decreased or deactivated when paying attention (e.g. experienced meditators)
 - In experienced meditators but not novices, even when the default mode network is active, brain regions associated with self-monitoring and cognitive control are co-activated
 - Reduces 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.
-

Mindfulness in schools

- 2012 systematic review of evidence regarding the effects of school-based mindfulness interventions on psychological outcomes
 - 24 studies identified with a total of 1348 students and 876 serving as controls, ranging from grade 1 to 12
 - Overall effect sizes were Hedge's $g = 0.40$ between groups and $g = 0.41$ within groups ($p < 0.0001$)
 - Between group effect sizes for domains were: cognitive performance $g = 0.80$, stress $g = 0.39$, resilience $g = 0.36$, (all $p < 0.05$), emotional problems $g = 0.19$ third person ratings $g = 0.25$ (both $p > 0.05$)
 - “Mindfulness-based interventions in children and youths hold promise, particularly in relation to improving cognitive performance and resilience to stress.”
 - More and larger studies needed to confirm results
 - Zenner C, Herrnleben-Kurz S, Walach H. Mindfulness-based interventions in schools—a systematic review and meta-analysis. *Front Psychol.* 2014 Jun 30;5:603. doi: 10.3389/fpsyg.2014.00603.
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Mindfulness and student performance

- Three studies examined the effects of mindfulness meditation on the knowledge retention of tertiary students
 - Participants from three introductory psychology courses randomly received either brief meditation training or rest
 - Then listened to a class lecture and took a post-lecture quiz that assessed students' knowledge of lecture material
 - Results indicated that meditation improved students' retention of the information conveyed during the lecture in each of the three experiments
 - Jared T. Ramsburg, Robert J. Youmans. Meditation in the Higher-Education Classroom: Meditation Training Improves Student Knowledge Retention during Lectures. *Mindfulness*, 2013; DOI: [10.1007/s12671-013-0199-5](https://doi.org/10.1007/s12671-013-0199-5)
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Mindfulness and practitioner wellbeing

- An 8-week mindfulness program: improvements on all measures of wellbeing including:
 - Mindfulness
 - Burnout (emotional exhaustion; depersonalization; personal accomplishment)
 - Empathy and responsiveness to psychosocial aspects
 - Total mood disturbance
 - Personality (conscientiousness; emotional stability)
 - Improvements in mindfulness correlated with improvements on other scales
 - Krasner MS, Epstein RM, Beckman H, et al. JAMA. 2009;302(12):1338-40.
-

Mindfulness and the workplace

- 8 week mindfulness program for ANU staff
 - Key findings include:
 - Increased self-rated performance (ECDP)
 - Improved wellbeing (PANAS)
 - Improved eudaimonic wellbeing (meaningfulness) (PWB)
 - Increase in work engagement (vigour and dedication) (UWES)
 - Increased authenticity (self-awareness, authentic behaviour, open relationships) (AI3)
 - Increased satisfaction with life (SWLS)
 - Improvements sustained at 6 month f/up
 - Atkins PWB, Hassed C, Fogliati VJ. (2015) Mindfulness Improves Work Engagement, Wellbeing and Performance in a University Setting. In Burke, RJ, Cooper, CL & Page, KM. Flourishing in Life, Work, and Careers, pp 193-209. Elgar, Cheltenham.
-

Mindfulness, management and work

- Randomized study of the effect of mindfulness on senior managers **found** enhanced participants' self-perception of leadership skills as a bundle of all five skills, and some individual skills
 - Amar AD, Hlupic V, Tamwatin T. Effect of meditation on self-perception of leadership skills: a controlled group study of CEOs. 10.5465/AMBPP.2014.300 ACAD MANAGE PROC January 2014
 - People higher in mindfulness less likely to feel need frustration, even in unsupportive managerial environments: a protective factor in controlling work environments
 - Schultz PP, Ryan RM, Niemiec CP, Legate N, Williams GC. Mindfulness, Work Climate, and Psychological Need Satisfaction in Employee Well-being. Mindfulness September 25, 2014.
 - Mindfulness intervention group had significant decrease in perceived stress but increased mindfulness, resiliency, and vigour
 - Aikens KA, Astin J, Pelletier KR, et al. Mindfulness Goes to Work: Impact of an Online Workplace Intervention. Journal of Occupational & Environmental Medicine. July 2014;56(7): 721–731. doi: 10.1097/JOM.0000000000000209
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Mindfulness and job stress

- RCT evaluated the effectiveness of 8-week mindfulness-based intervention (MBI) on mental illness risks (including psychological distress, prolonged fatigue, and perceived stress) and job strain (job control and job demands) for 144 employees with poor mental health
 - MBI group significantly lower on psychological distress, prolonged fatigue, and perceived stress
 - Job strain: job demands showed a significant decline but the significance disappeared when the demographic variables were controlled for
 - Huang SL, Li RH, Huang FY, Tang FC. The Potential for Mindfulness-Based Intervention in Workplace Mental Health Promotion: Results of a Randomized Controlled Trial. PLoS One. 2015 Sep 14;10(9):e0138089. doi: 10.1371/journal.pone.0138089. eCollection 2015.
 - Interventions for enhancing workplace resilience for individuals should not be divorced from the need to create work environments and systems sympathetic to wellbeing and being mindful
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Mental overload and creativity

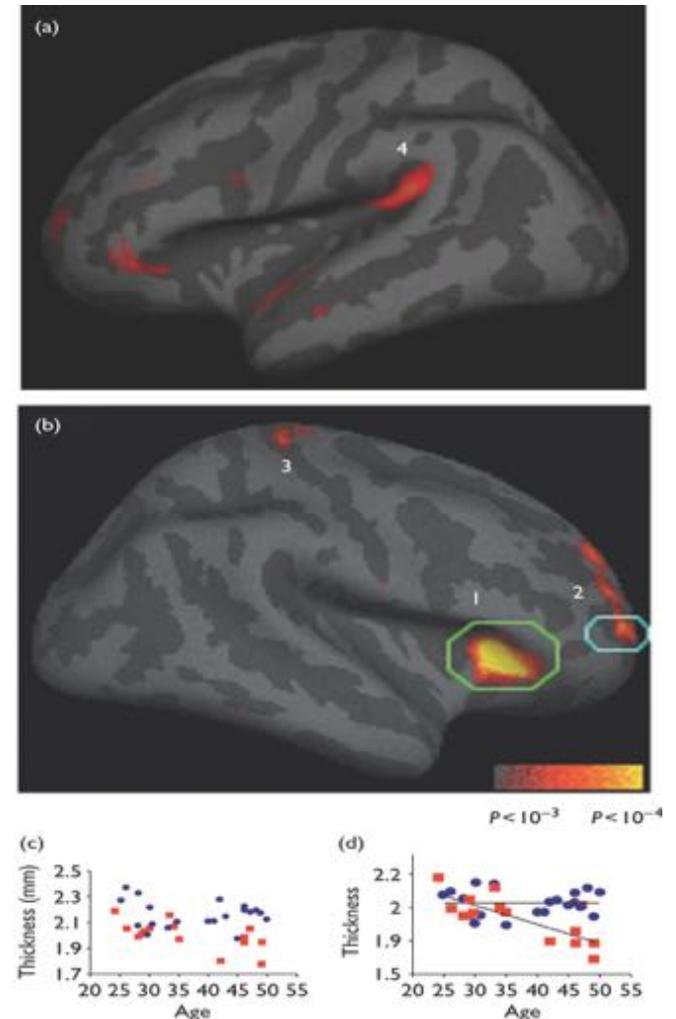
- Three experiments: subjects performed a free-association task while the level of mental load was manipulated in various ways
 - Subjects with low-load provided significantly more diverse and original associations compared with subjects in the high-load conditions, who exhibited high consensus (predictable, unimaginative, uncreative...)
 - Findings imply that activation of associations is narrowed under conditions of high mental load
 - Baror S, Bar M. Associative Activation and Its Relation to Exploration and Exploitation in the Brain. *Psychol Sci.* 2016 Jun;27(6):776-89. doi: 10.1177/0956797616634487.
-

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.
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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.



Meditation and the brain

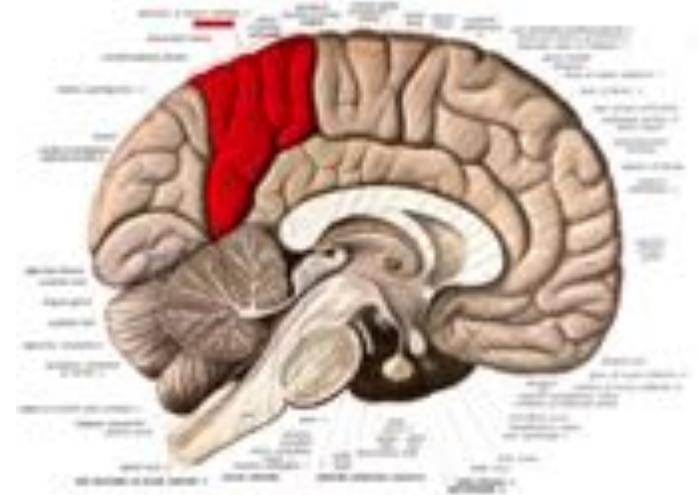
- Review and meta-analysis of 123 brain morphology differences from 21 neuroimaging studies examining ~300 meditation practitioners
 - Eight brain regions consistently altered in meditators including areas key to:
 - meta-awareness (frontopolar cortex/BA 10)
 - exteroceptive and interoceptive body awareness (sensory cortices / insula)
 - memory consolidation and reconsolidation (hippocampus)
 - self and emotion regulation (anterior / mid cingulate; orbitofrontal cortex)
 - intra- and interhemispheric communication (superior longitudinal fasciculus; corpus callosum)
 - Fox KC, Nijeboer S, Dixon ML, et al. Is meditation associated with altered brain structure? A systematic review and meta-analysis of morphometric neuroimaging in meditation practitioners. *Neurosci Biobehav Rev.* 2014 Jun;43:48-73. doi: 10.1016/j.neubiorev.2014.03.016. Epub 2014 Apr 3.
-

Mindfulness and pain

- Study of mindfulness vs. placebo for standardised pain
 - Mindfulness meditation group reported pain intensity reduced by 27% and by 44% for the emotional aspect of pain
 - Placebo cream reduced sensation of pain by 11% and emotional aspect by 13%
 - Mindfulness meditation also produced patterns of brain activity different than those produced by the placebo cream: activating brain regions (orbitofrontal and anterior cingulate cortex) associated with the self-control of pain
 - Placebo cream lowered pain by reducing brain activity in pain-processing areas (secondary somatosensory cortex)
 - Thalamus deactivated during mindfulness but activated during all other conditions
 - A gateway that determines if sensory information is allowed to reach higher brain centres: may have caused signals about pain to simply fade away
 - Zeidan F, Emerson NM, Farris SR, et al. Mindfulness Meditation-Based Pain Relief Employs Different Neural Mechanisms Than Placebo and Sham Mindfulness Meditation-Induced Analgesia. *J Neurosci*. 2015 Nov 18;35(46):15307-25. doi: 10.1523/JNEUROSCI.2542-15.2015.
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Precuneus

- A brain region that becomes active when experiencing:
 - consciousness, wakefulness, self-awareness
 - attention, episodic memory retrieval, working memory and conscious perception
 - visuospatial processing
- Impaired by default mental activity
- Larger in happy people
 - Sato W, Kochiyama T, Uono S, et al. The structural neural substrate of subjective happiness. *Scientific Reports*, 2015; 5: 16891 DOI: 10.1038/srep16891
- 6-week mindfulness program on the grey matter: a significant grey matter increase identified within the precuneus
 - Kurth F, Luders E, Wu B, Black DS. Brain Gray Matter Changes Associated with Mindfulness Meditation in Older Adults: An Exploratory Pilot Study using Voxel-based Morphometry. *Neuro*. 2014; 1(1): 23–26. Published online 2014 Nov 12. doi: 10.17140/NOJ-1-106

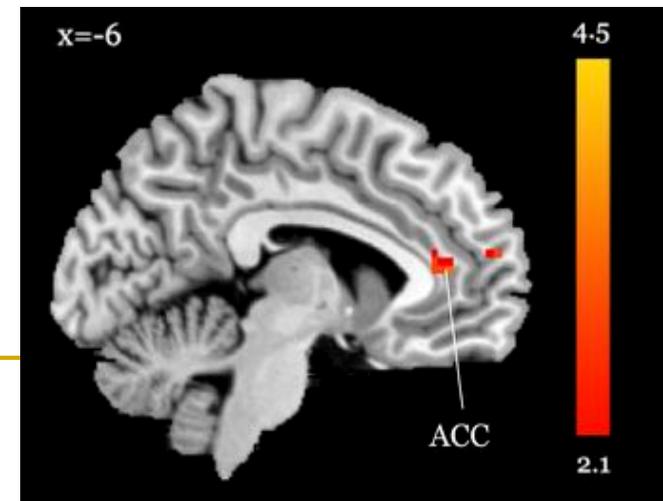


Mindfulness and gambling

- Systematic review of 13 mindfulness-based interventions for gambling behavior and symptoms, urges, and financial outcomes
 - Effects moderate to large for gambling behaviors / symptoms, gambling urges, and financial outcomes
 - “The findings provide support for mindfulness-based interventions in the treatment of disordered gambling.”
 - Maynard BR, Wilson AN, Labuziński E, Whiting SW. Mindfulness-Based Approaches in the Treatment of Disordered Gambling: A Systematic Review and Meta-Analysis. *Research on Social Work Practice* Published online October 16, 2015. doi: 10.1177/1049731515606977
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Meditation and smoking

- Attempts to help people either quit or reduce their smoking often fail: the intention to quit activates brain networks related to craving
- Study on the effect of meditation training vs. relaxation training
- Among smokers, 2 weeks of meditation training produced a 60% reduction in smoking but no reduction in the relaxation control
- Resting-state brain scans showed increased activity for the meditation group in the anterior cingulate and prefrontal cortex, brain areas related to self-control
 - Tang YY, Tang R, Posner MI. Brief meditation training induces smoking reduction. Proc Natl Acad Sci U S A. 2013 Aug 20;110(34):13971-5. doi: 10.1073/pnas.1311887110.



Mindfulness and smoking cessation

- RCT comparing a mindfulness-based smoking cessation to matched control (American Lung Association's Freedom From Smoking program)
 - 175 low socioeconomic status smokers
 - 6-month smoking abstinence rates were mindfulness=25.0%, control=17.9%
 - Differences favouring mindfulness found on measures of urges, changes in mindfulness, perceived stress, and experiential avoidance
 - Davis JM, Manley AR, Goldberg SB, Smith SS, Jorenby DE. Randomized trial comparing mindfulness training for smokers to a matched control. *J Subst Abuse Treat.* 2014 Sep;47(3): 213-21. doi: 10.1016/j.jsat.2014.04.005.
 - “The Non-judging subscale (i.e., accepting thoughts and feelings without evaluating them) uniquely predicted better odds of abstinence up to 26 weeks postquit.”
 - Spears CA, Houchins SC, Stewart DW, et al. Nonjudging Facet of Mindfulness Predicts Enhanced Smoking Cessation in Hispanics. *Psychol Addict Behav.* 2015 May 11. [Epub ahead of print]
-

Bias: the root of diagnostic errors

- Confirmation bias: the pursuit of data that support a diagnosis over data that refute it
 - Anchoring bias: a resistance to adapting appropriately to subsequent data that suggest alternative diagnoses
 - Sibinga EM, Wu AW. Clinician Mindfulness and Patient Safety. JAMA 2010;304(22):2532-3.
-

Mindfulness and ‘sunk-cost bias’

- Sunk-cost bias: “tendency to continue an endeavour once an investment in money, effort, or time has been made”
 - Often underlies escalation of commitment or entrapment
 - Large scale: disastrous military campaigns and over-budget public-works projects are publicly visible examples
 - Small scale: difficulty selling stock that has fallen in value, ignoring bad advice that one has paid for, deleting carefully written text from a manuscript, overstaying in dysfunctional relationships or jobs, gambling
 - Sunk-cost bias attenuated by drawing one’s focus away from the future and past and reducing negative affect through mindfulness meditation
 - Hafenbrack AC, Kinias Z, Barsade SG. Debiasing the Mind Through Meditation: Mindfulness and the Sunk-Cost Bias. *Psychological Science* 2014, Vol. 25(2) 369–376.
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Self-compassion and performance

- Can treating oneself with compassion after making a mistake increase self-improvement motivation?
 - Self-compassion intervention compared to a self-esteem control group, no intervention or a positive distraction control group
 - Self-compassion associated with:
 - Greater belief that a personal weakness can be changed for the better
 - Greater motivation to make amends and avoid repeating a moral transgression
 - More time studying for a difficult test following an initial failure
 - A preference for upward social comparison after reflecting on a personal weakness
 - Greater motivation to change the weakness
 - Breines JG, Chen S. Self-Compassion Increases Self-Improvement Motivation. Pers Soc Psychol Bull published online 29 May 2012 DOI: 10.1177/0146167212445599
-

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.

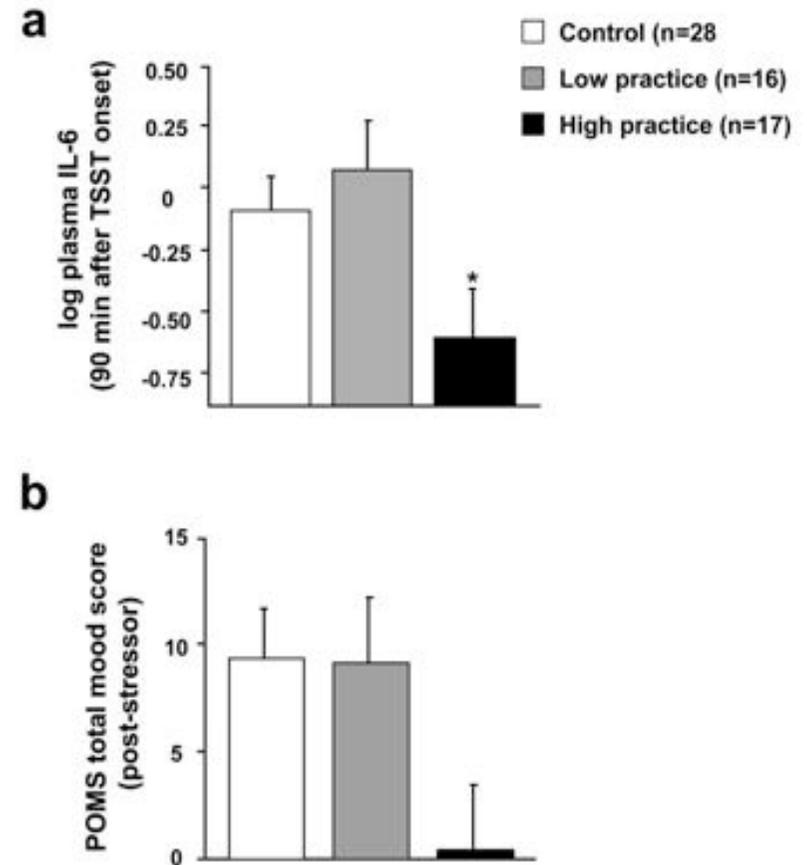
| EI | Definition |
|------------------------|--|
| Self-awareness | Ability to recognise and understand emotions, drives and effects |
| Self-regulation | Can control or redirect disruptive impulses, can think before acting |
| Motivation | Passion for work that goes beyond money or status, energy and 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 communication

- Comparing clinicians with highest and lowest mindfulness scores: high-mindfulness clinician consultations:
 - Patient-centered pattern of communication (OR 4.14)
 - Both patients and clinicians 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.
-

Compassion, stress & 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)
- 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.



Purpose, happiness, self-gratification, genetics and immunity

- Immune cells in individuals with high levels of hedonic wellbeing (pleasure seeking / gratification) were 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 were associated with similar self-reported affect

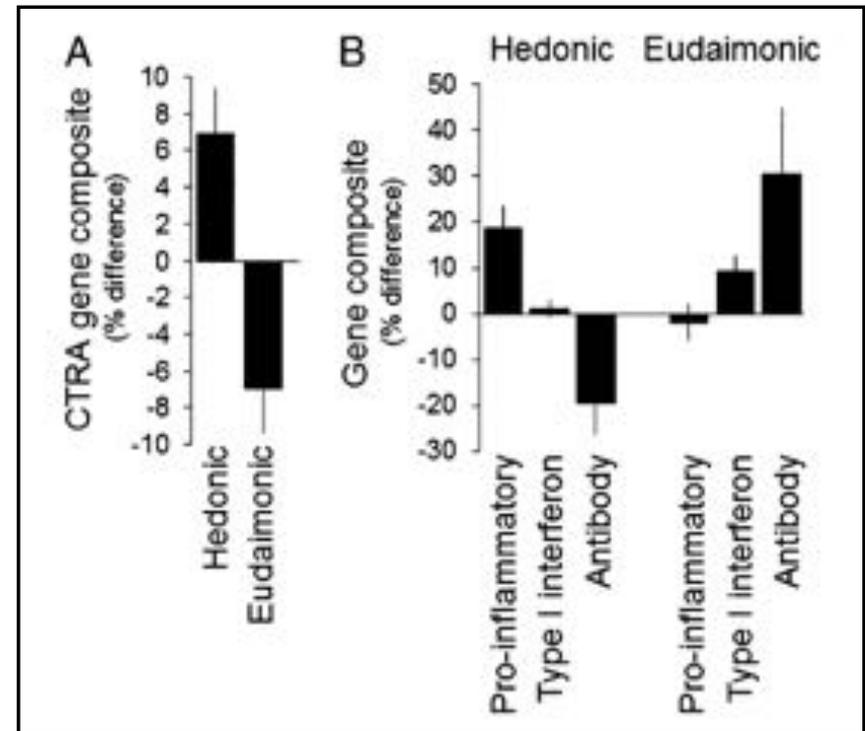


Fig. 2. Expression of the CTRA gene set. (A) Linear model-based estimates of mean difference (\pm SEM) in expression in a 53-gene CTRA contrast score in PBMCs from individuals with low levels (-2 SD relative to sample mean) vs. high levels ($+2$ SD) of hedonic well-being and eudaimonic well-being (each 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]

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.
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Mindfulness, exercise & the cold

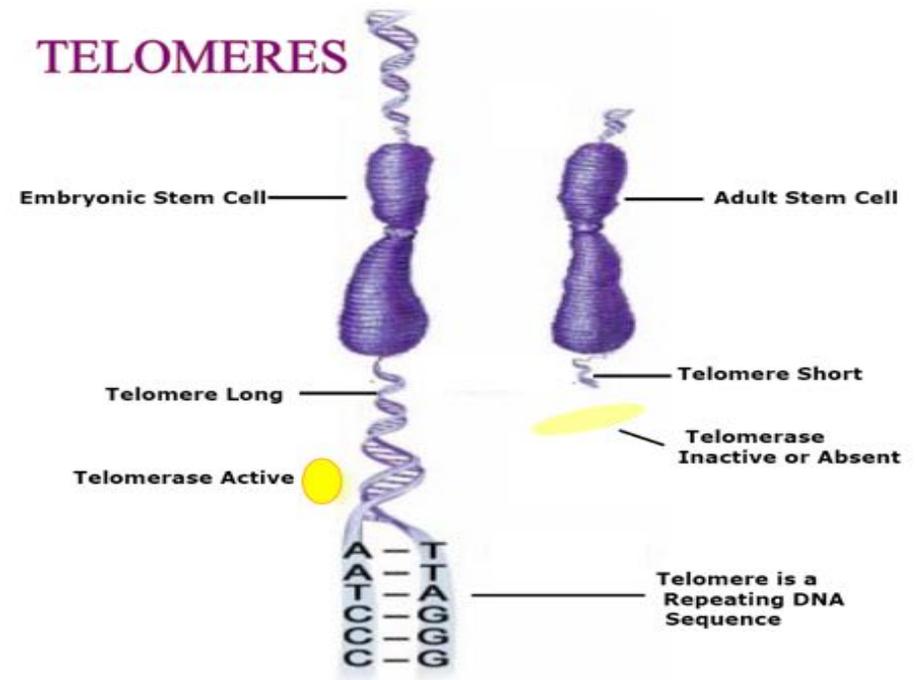
- RCT evaluating effects of meditation or exercise on incidence, duration, and severity of acute respiratory infection (ARI)
- Adults >50 years randomized to 1 of 3 study groups:
 - 8-week mindfulness training
 - 8-week moderate exercise training
 - control (no intervention)
 - Barrett B, Hayney MS, Muller D, et al. Meditation or Exercise for Preventing Acute Respiratory Infection: A Randomized Controlled Trial. *Ann Fam Med* 2012;10:298-299.
- ARIs and days of illness:
 - Control group: 40 ARIs and 453 illness days
 - Exercise group: 26 ARIs and 241 illness days
 - Meditation group: 27 ARIs and 257 days of ARI illness
- ARI symptom severity
 - 358 for control
 - 248 for exercise
 - 144 for meditation
- Days off work with illness
 - 67 missed in the control group
 - 32 in the exercise group
 - 16 in the meditation group

The Relaxation Response and genetics

- Epigenetics: gene expression modified by many factors including mental state and lifestyle
 - “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.
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Mindfulness and cellular ageing

- Meditation may slow genetic ageing and enhance genetic repair
 - “...we propose that some forms of meditation may have salutary effects on telomere length by reducing cognitive stress and stress arousal and increasing positive states of mind and hormonal factors that may promote telomere maintenance.”
 - Epel E, Daubenmier J, Moskowitz JT, Folkman S, Blackburn E. Can meditation slow rate of cellular aging? Cognitive stress, mindfulness, and telomeres. *Ann N Y Acad Sci.* 2009 Aug; 1172:34-53.



Lifestyle change and telomeres

- At 5 years relative telomere length increased from baseline in the mind-body-based 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
 - “Our comprehensive lifestyle intervention was associated with increases in relative telomere length after 5 years of follow-up, compared with controls, in this small pilot study.”
 - Ornish D, Lin J, Chan JM, Epel E, 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
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co-author of the bestselling *Mindfulness for Life*
DR CRAIG HASSED
& DR RICHARD CHAMBERS

mindful learning

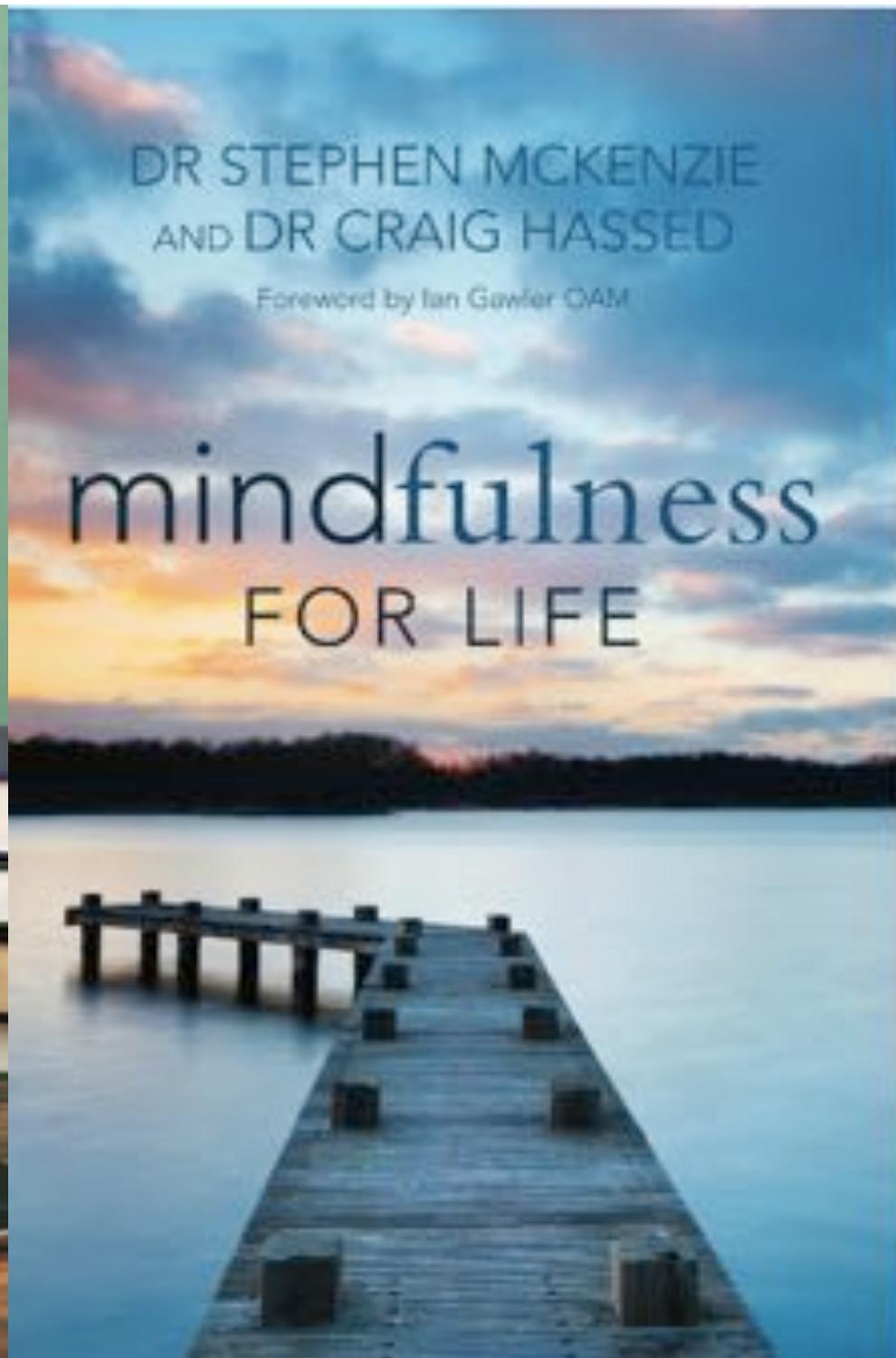
Reduce stress and improve brain
performance for effective learning



DR STEPHEN MCKENZIE
AND DR CRAIG HASSED

Foreword by Ian Gawler OAM

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 - Collaboration between Monash University and FutureLearn (UK)
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