Mindfulness for Life

Dr Craig Hassed
Week 1
Mindfulness, stress & the brain

Dr Craig Hassed
What is the brain?

- The human brain is thought to be the most complex thing in the universe
- Contains about 80-120 billion neurons each connecting to thousands of other neurons
- Many supporting cells
- Has roughly the consistency of tofu
“The brain doesn’t change”

- It was believed for over a century that the only change that occurs in the brain after childhood development is that it loses cells and ages.
- In truth, the brain never stops changing throughout our whole life.
- It changes (wires itself) according to how we are using it for better or for worse.
Neuroplasticity

- “As a man (woman) thinketh, so he (she) becomes.”
  - James Allen
- “Neurons that fire together, wire together.”
  - Hebbes hypothesis
Neurogenesis

- “For over 100 years a central assumption in the field of neuroscience has been that new neurons are not added to the adult mammalian brain. This perspective examines the origins of this dogma, its perseverance in the face of contradictory evidence, and its final collapse.”

- Neuronal stem cells persist throughout the entire lifespan

- Many factors enhance neurogenesis e.g.:
  - Physical exercise
  - Learning
  - Attention training
Musical training and neuroplasticity

- Musicians show significantly increased Grey Matter volume in the language and sound production (Broca's) area correlating with years of musical performance

- Brain regions activate differently in musicians and non-musicians

Practise Makes Perfect

Pascual-Leone’s 1995 “Piano Experiment”
Practise Makes Perfect
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
Stress, distress & Alzheimer’s Disease

- Study on effect of psychosocial stressors, long-standing distress and incidence of dementia in women followed from midlife to late life
  - 800 women examined in 1968 and re-examined in 1974 – 2005
  - 18 psychosocial stressors (e.g. divorce, widowhood, work problems and illness in relative) obtained at baseline

- Number of psychosocial stressors in 1968 associated with higher incidence of AD (HR 1.20)

- Long-standing distress associated with AD (HR 1.58)
Cynical distrust and dementia

“...those with the highest level of cynical distrust had higher risk of dementia after adjusting for confounders (relative risk 3.13)...”

- Age, sex, systolic blood pressure, total cholesterol, fasting glucose, body mass index, socioeconomic background, smoking, alcohol use, self-reported health, and APOE genotype were considered as confounders

Child abuse and brain development

- Adolescents brought up in hostile and unsupportive environments are predisposed to reproduce anti-social behaviours in later life
  - Overstimulation of the brain regions such as the amygdala
  - Underdevelopment of the prefrontal cortex

- Implications for aggression, particularly young males
Amygdala ‘hijack’

- Term coined by Daniel Goleman (author of Emotional Intelligence)
- Emotional responses which are immediate, overwhelming
- Can be out of measure with the actual stimulus
- Based on memory, perceived threat leads to a fast message sent straight to the amygdala
  - Emotionally-based and physiological response is often irrational
  - Fight, flight or freeze
- Another message sent more slowly sent to the cortex
  - Rational response
- Mindfulness can help to reduce hyperactivity of amygdala and put a space between stimulus and reaction
Epictetus

“Man (woman) is not disturbed by events, but by the view that he (she) takes of them.”
Plato’s 3 aspects of the psyche

- Three aspects of the psyche (soul)
  1. Reasoning (intelligence)
  2. Emotive (passion, courage)
  3. Appetitive (instincts, pleasure)

- The reasoning element is meant to govern (regulate) emotions and appetites
  - E.g. Boticelli’s Pallas and the Centaur

- This is a harmonious soul: necessary for being happy, healthy and just
Three regions of the brain

- Frontal lobes (prefrontal cortex) centre for executive functioning
  - Attention regulation
  - Self-awareness
  - Working memory
  - Reasoning, planning and decision making
  - Emotional regulation
  - Appetite regulation
  - Impulse control
  - Directs immune system
- Limbic system – emotion centre
- Mesolimbic reward system – appetites
- ADHD now recognised as executive functioning disorder
Exam stress and performance

- High math anxiety led to smaller working memory

- “Performance pressure harms individuals most qualified to succeed by consuming the working memory capacity that they rely on for their superior performance.”
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
The Default Brain

- **Active tasks**
  - Tasks associated with paying attention
  - Brain efficient and quiet

- **Default state (mode)**
  - Mind is inattentive, distracted, idle, recalling past, daydreaming
DMN cortical hub regions are affected early during Alzheimer's disease (AD) and exhibit high amounts of Aβ (amyloid) deposits.

Due to their constant activity, DMN neurons produce and release more Aβ than occur elsewhere in the brain.

Changing behaviours

- A little exercise – crossing your arms
- We need to be ADEPT at doing things in non-habitual ways
- Attention
- Decision
- Effort
- Perseverance
- Tolerance of discomfort
“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
Paying attention mindfully

- 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** e.g.
    1. Open
    2. Curious
    3. Accepting
    4. Compassionate
Applications of mindfulness

- **Mental health:** E.g. therapeutic for depression, anxiety, panic disorder, stress, emotional regulation, addiction, sleep problems, eating disorders, psychosis, ADHD, autism, reduced burnout

- **Neuroscience:** E.g. structural and functional changes in the brain, neurogenesis, (dementia prevention), down-regulating the amygdala, improved executive functioning and working memory, reduced default mental activity, improved self-monitoring and cognitive control

- **Clinical:** E.g. pain management, symptom control, coping with chronic illness, metabolic and hormonal benefits, facilitating lifestyle change (e.g. weight management, smoking cessation), improved immunity, enhanced genetic function and repair

- **Performance:** E.g. sport, academic, leadership, mental flexibility

- **Education:** E.g. improved problem-solving, improved executive functioning and working memory, focus, better behaviour

- **Relationships:** E.g. emotional intelligence, communication, empathy

- **Spiritual**
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.”
Stress, mindfulness and brain development

- Changes found in adolescents with significant depression such as smaller hippocampi indicating a reduction the brain's production of brain-derived neurotrophic factor
  - BDNF is important for stimulating and maintaining brain cells
  - Implications for future neurodegenerative conditions such as Alzheimer's Disease
- These changes largely due to the epigenetic effects
- Mindfulness increases BDNF
Prefrontal cortex – ACC

- **Attention regulation:** focusing attention on object
- People learning mindfulness initially show greater activation of anterior cingulate cortex (ACC) and dorsal medial prefrontal cortex (MPFC), i.e. stronger processing of conflict/distraction and more engaged in emotional regulation
- Experienced meditators more efficient at focusing attention, so regulation becomes more natural, i.e. long-term decreased activation of ACC
- The cortical thickness in the dorsal ACC also greater in the of grey matter of experienced meditators
Attention, leisure and dementia

- Leisure and Alzheimer’s Disease risk
  - Lack of diversity
  - Less time on leisure activities
  - Passive leisure activities (principally TV)
- Nearly four times as likely to develop dementia over 40-year f/up
  - Friedland RP et al. Proc Nat Acad Sci USA, 10.1073/pnas. 061002998
Mental stimulation and brain health

- Healthy elderly (av. 76.1yrs) c/w patients with Alzheimer Disease (74.8yrs) and young controls (24.5yrs)
- ‘Brain health’ (amyloid deposits) c/w participation in cognitive activities (e.g. reading, writing, playing games)
- Greater participation in cognitively stimulating activities (particularly in early and middle life) associated with reduced amyloid uptake
  - The top ¼ of older participants for cognitive activity had amyloid uptake comparable to young controls
  - The lowest ¼ for cognitive activity had amyloid uptake comparable to patients with AD
London Taxi drivers

- London taxi drivers show increased grey matter density in the brain’s memory centres
  - Acquiring "the Knowledge" of London's layout drives structural brain changes.
Mindfulness and the brain

- Mindfulness leads to a thickening of the grey matter concentration (GMC) within the hippocampus from the Pre to the Post time-point in the MBSR group (error bars show 95% confidence interval)
Meditation and the brain

- Brain studies on subjects in an 8-week mindfulness program (av. of 27 min/day practice mindfulness exercises)
- Stimulated a major increase in grey matter in the hippocampus and brain associated with memory, self-awareness, compassion, and introspection
- Participant-reported reductions in stress also correlated with decreased size of the amygdala (important in anxiety, anger and stress) – no changes in control group
  - “It is fascinating to see the brain’s plasticity and that, by practicing meditation, we can play an active role in changing the brain and can increase our well-being and quality of life.” Britta Hölzel
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
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
Caring for the brain

1. Learn to manage stress and difficult emotions
2. Lead a healthy lifestyle
   - Healthy diet, exercise, sleep…
3. Choose carefully what you practice
   - What you practice you will get good at
4. Choose carefully the food you feed the mind
5. Exercise the brain regularly
   - Mindfulness, interest, engagement, active leisure activities, creativity, interaction, true happiness
Week 2
Mindfulness for mental health

Dr Craig Hassed
Antidepressants and placebo

- Antidepressants no different to placebo for mild-moderate depression, and a relatively small difference even for patients with severe depression

“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.”

Emotional regulation

- Emotional regulation is not suppressing, wrestling with, denying or ignoring emotions.
- It involves the ability to impartially observe them.
  - i.e. being non-judgmental, non-reactive and non-attached.
- That gives some space to decide in a more discerning way whether to, or how to, express them.
Mindfulness and emotional regulation

- Mindfulness helps internal locus of control
  - Directing attention to particular experiences
  - Changing the response to experiences
  - Reappraisal of experiences – choosing attitude
- Inhibits expression of various behaviors in response to experience
- Helps to regulate emotions
  - Via increased activation of the dorso-medial PFC and rostral ACC
  - Regulate emotion by decreasing the activity of the amygdala which is important for a person's mood/attitude, and decision making and response under stress
Emotional Intelligence & mindfulness

- Mindfulness related to aspects of personality and mental health
  - Lower neuroticism, psychological symptoms, experiential avoidance, dissociation
  - Higher emotional intelligence and absorption

<table>
<thead>
<tr>
<th>EI</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-awareness</td>
<td>Ability to recognise and understand emotions, drives and effects</td>
</tr>
<tr>
<td>Self-regulation</td>
<td>Can control or redirect disruptive impulses, can think before acting</td>
</tr>
<tr>
<td>Motivation</td>
<td>Passion for work that goes beyond money or status, energy and persistence</td>
</tr>
<tr>
<td>Empathy</td>
<td>Ability to understand emotions of others, skill in interacting with others</td>
</tr>
<tr>
<td>Social skill</td>
<td>Can manage relationships and build networks, can find common ground, rapport</td>
</tr>
</tbody>
</table>
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 through disengagement
- Reactivity – non-acceptance of state of thoughts and emotions
- Mindfulness-based Cognitive Therapy aimed at addressing these issues
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
Mindfulness, adolescents and mental health

- “Mindfulness-based stress reduction (MBSR) program for adolescents age 14 to 18 years with heterogeneous diagnoses in an outpatient psychiatric facility.
- Relative to treatment-as-usual control participants, those receiving MBSR self-reported reduced symptoms of anxiety, depression, and somatic distress, and increased self-esteem and sleep quality.”
Default mode network

- High default mental activity in psychopathology (e.g. depression, anxiety, schizophrenia and autism)
- Default activity decreased or deactivated when paying attention (e.g. experienced mindfulness meditators)
- In experienced meditators even when default network active, regions associated with self-monitoring and cognitive control are co-activated: reduced vulnerability to default thinking
**Mindfulness, depression and the stress response**

- Mindfulness negatively correlates with depressive symptoms and reactivity of the amygdala
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.”

Depersonalisation and mindfulness

- Depersonalization (DP) – feelings of being detached from one's own mental processes or body
  - A form of mental escape from the full experience of reality
- Linked with maltreatment during childhood
- Study found a strong inverse correlation between DP severity and mindfulness
- Significant correlations between emotional maltreatment on the one hand and DP severity (positive) and mindfulness (negative) on the other
Mindfulness and child abuse

- Adult survivors of childhood sexual abuse participated in an 8-week MBSR plus 3 refresher classes at final follow-up at 24 weeks
- At 8 weeks, depressive symptoms reduced by 65%
- Significant improvements in all outcomes (mood, anxiety, PTSD) post-MBSR (large effect sizes above 1.0)
- Improvements were largely sustained until 24 weeks
- Of three PTSD symptom criteria, symptoms of avoidance / numbing most greatly reduced
Mind-body and autism

- Study assessed therapeutic effect of an 8-week movement-based yoga, dance, and music therapy program based on the relaxation response (RR) for children with an autism-spectrum disorder (ASD)
  - Outcome measures: The Behavioral Assessment System for Children, Second Edition (BASC-2) and the Aberrant Behavioral Checklist (ABC)
- Robust changes found on the BASC-2
- Significant changes post-treatment on the Atypicality scale of the BASC-2 (measures some of the core features of autism)
Mindfulness and worker wellbeing

- Study on whether a workplace mindfulness program was both practical and efficacious in decreasing employee stress while enhancing resiliency and well-being
- Participants recruited from The Dow Chemical Company randomly assigned to online mindfulness vs. wait-list
- Mindfulness intervention group had significant decrease in perceived stress but increased mindfulness, resiliency, and vigour

Meditation and compassion

- Limbic brain regions implicated in empathic response to another's pain
- Meditators have more active empathic response
  - Activation in insula greater in expert than novices
- Empathy w/o stress reduces carer fatigue
Week 3

Why attention matters in education and performance

Dr Craig Hassed
Mindfulness in schools

- 522 young people aged 12–16 in 12 secondary schools either participated in Mindfulness in Schools Programme (intervention) or usual school curriculum (control)
- Rates of acceptability were high
- Children who participated in the intervention reported:
  - Fewer depressive symptoms post-treatment and at 3 month f-up
  - Lower stress and greater well-being at f-up
- The degree to which students practised the mindfulness skills was associated with better well-being and less stress at follow-up
Mindfulness for teachers

- RCT of pilot program of MBSR for teachers
- Mindfulness group showed significant reductions in:
  - psychological symptoms
  - burnout
- Improvements in:
  - observer-rated classroom organization
  - performance on a computer task of affective attentional bias
  - increases in self-compassion
- Control group showed worse cortisol levels and increased burnout
Essence program and student wellbeing

- Study of 2006 cohort of medical students found that 90.5% of students personally applied strategies.

- Improved student wellbeing noted on all measures of wellbeing even in the pre-exam period:
  - Reduced depression, hostility and anxiety subscale
  - Improved psychological and physical quality of life

Mindfulness and work engagement

- Study on 2013 cohort of year 1 Monash medical students
- Post mindfulness program:
  - Large increases in dispositional mindfulness
  - Increases in study engagement (UWES; medium effect size)
    - Increases in study dedication and vigour
  - No increase in depression, anxiety or stress in pre-exam period c/w early semester prior to mindfulness program
Mindfulness and cognition

- Study on brief meditation training effects on cognition and mood
- Four sessions of either meditation training
- Participants were assessed with measures of mood, verbal fluency, visual coding, and working memory
- Mindfulness training improved mindfulness, mood, and reduced fatigue, anxiety, and increased visuo-spatial processing, working memory, and executive functioning
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.

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.”

Mindsets: fixed and growth (Dwek)

- Implications for how (or if) we learn, stress, perseverance

- Fixed mindset: belief of a fixed ability
  - When confronted by challenge it is seen as potential for failure, a threat to esteem, to be avoided, desire to go back to easy tasks…
  - Attention on default ideas about oneself, doesn’t engage with task
  - Stress, no learning, no enjoyment…

- Growth mindset: belief that ability not fixed but can be developed
  - When confronted by challenge it is seen as potential for learning, to be confronted, desire to extend oneself…
  - Attention on the task, not oneself
  - Learning, enjoyment…

- Mindfulness helps us to develop a growth mindset
Stress
Performance
Relaxation without awareness or engagement – inertia, apathy

Higher performance – stress lifts out of apathy and engages

High stress and poor performance

Yerkes-Dodson Stress-performance curve
Hassed mindfulness stress-performance curve

Performance:
- Highest performance (zone / flow) – mindful i.e. relaxed but fully aware and engaged
- Relaxation without awareness or engagement – inertia, apathy

Stress:
- Higher performance – stress lifts out of apathy and engages
Mindfulness and performance

- Relaxation (calmness) with focus aids performance (fully engaged)
- Relaxation without focus impairs performance (not engaged)
- Present moment orientation hence:
  - Reduced anxiety about the outcome
  - Less tendency to get caught on past errors
- Present moment orientation does not mean:
  - Not planning or preparing for future
  - Not reflecting on and learning from the past
Mindfulness and sport

“Mindfulness is vastly different that the way many athletes conceive it, and it offers many benefits to focusing and athletic performance. Mindfulness teaches athletes to focus on the present rather than dwelling on past mistakes or future results. This present focus enables athletes to be more alert to relevant performance cues and allows them to more easily disregard distracting cues.”

Calmness vs. complacency

“Russell Mark relaxed too early and lost, after leading by three points, over the last ten targets.”

Paul Roos’ and the Swans

- Paul Roos a notable proponent of mindfulness and meditation practices
- Influence has spread to a number of players (e.g. Adam Goodes, Brett Kirk, also an ambassador for Smiling Mind)
- Dan Hanneberry on how Roos and Kirk introduced him to mindfulness

“So the way it (mindfulness practice) relates to AFL football for me is that it helps me not worry about making a mistake or to dwell on it when you do make one. To concentrate on the job, you need to be present.”

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
The zone: Billie-Jean King

“It almost seems as though I’m able to transport myself beyond the turmoil on the court to some place of total peace and calm... I appreciate what my opponent is doing in a detached abstract way. Like an observer in the next room... It is a perfect combination of (Intense) action taking place in an atmosphere of total tranquility.”

Flow state

1. Deep, effortless concentration on the process
2. A sense of self-control
3. An absence of self-consciousness or ego
4. Enjoyment, relaxation, confidence, freedom
5. Focused on the goal, not anxious about it
6. In the present moment
7. The sense of time is altered
8. Peak performance

Roots 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
Mindful practice

Self-monitoring leads to;
1. Early recognition of cognitive biases
2. Avoidance of technical errors
3. Awareness of emotional reactions
4. Facilitation of self-correction
5. Development of therapeutic relationships
   - Epstein R et al, 2008
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
Mindfulness and healthcare quality

- Study of clinicians (physicians, nurse practitioners, and physician assistants) caring for patients
- 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

Mindfulness and ‘sunk-cost bias’

- The sunk-cost bias is the “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
- Explanations include loss aversion, self-justification, and the desire not to appear wasteful
- Sunk-cost bias attenuated by drawing one’s focus away from the future and past and reducing negative affect through mindfulness meditation
Mindfulness and worker wellbeing

- People higher in mindfulness less likely to feel frustration, even in unsupportive managerial environments: a protective factor in controlling work environments

- Mindfulness training led to significant decrease in perceived stress but increased mindfulness, resiliency, and vigour

- Mindfulness enhanced participants’ leadership 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
Self-compassion and performance

- Treating oneself with compassion after making a mistake increases 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

Simple and Complex Multitasking

- **Simple multitasking**: one task simple and the other complex (e.g. stirring pasta while talking to spouse) where one can be safely/effectively done on automatic pilot while the other is given attention.

- **Complex multitasking**: two complex activities which demand cognition (e.g. driving while speaking on phone) where one or both will be done unsafely/ineffectively.
Mobile phone use and motor vehicle accidents

- Drivers more than 4 times more likely to have a crash within 5 minutes of using a mobile phone

- This is an example of complex multi-tasking
- Simple multi-tasking: e.g. Walking and talking at the same time
Multitasking

“In 2005, the BBC reported on a research study, funded by Hewlett-Packard, and conducted by the Institute of Psychiatry at the University of London, that found, workers distracted by e-mail and phone calls suffer a fall in IQ more than twice that found in marijuana smokers.”

Multi-tasking

On the performance levels 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.”

Multitasking and memory

- Learning information while multitasking causes the new information to go to the wrong part of the brain.
  - E.g. if students study and watch TV at the same time the schoolwork information goes into the striatum (a region specialised for storing new procedures and skills, not facts and ideas).
- Without the distraction of TV the information goes into the hippocampus where it is organised and categorised making it easier to retrieve.
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
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)

- **Average of 64 seconds to recover train of thought** after checking email
  - Check every 5 mins = waste 8.5 hours per week

- **Memory impairment**
  - Information stored in the wrong area of the brain
    - Foerde, Knowlton, & Poldrack RA. (2006)
The cost of multitasking

- Reduce performance
- Reduce ability to sift relevant from irrelevant
- Impair memory
- Impair communication and empathy
- Increase stress response
- Fatigue the prefrontal cortex
Week 4
Mindfulness and physical health

Dr Craig Hassed
The mind and body

“You ought not to attempt to cure the body without the soul (psyche) for this is the great error of our day (400BC), in the treatment of the human body, that physicians separate the soul from the body.”

Attributed to Socrates by Plato in Charmides
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
**TELOMEREs**

- **Embryonic Stem Cell**
- **Telomere Long**
- **Telomerase Active**
- **Adult Stem Cell**
- **Telomere Short**
- **Telomerase Inactive or Absent**
- **Telomere is a Repeating DNA Sequence**

Google Image modified by Vitetta and Sali
Stress and telomere shortening

- Study on healthy premenopausal women showed that psychological stress associated with:
  - higher oxidative stress
  - lower telomerase activity (telomerase repairs DNA telomeres) leading to shorter telomere length

- These are known determinants of cell death/longevity

- Women with highest levels of perceived stress c/w low stress women have shorter telomeres
  - Average equivalent at least 9-17 years of additional ageing

- Implications for how, at the cellular level, stress may promote earlier onset of age-related diseases
Work stress and aging

- Study on whether work-related exhaustion (prolonged work stress – Maslach’s Burnout Inventory) is associated with accelerated aging (shorter telomere length)
  - Data from sample of 2911 of the Finnish working-age population aged 30-64
- Individuals with severe exhaustion had telomeres on average 0.043 relative units shorter than those with no exhaustion even after adjustment for other factors

Genetic ageing and pessimism

- The combination of lower optimism and higher pessimism increases risk for disease and early mortality
  - Sample of healthy post-menopausal women

- Pessimism is independently associated with over 10 years accelerated ageing
  - Shorter Telomere length and higher Interleukin-6 concentrations
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.

Patients with major depressive disorder (MDD) have increased risk of aging-related illness (e.g. heart disease, diabetes, obesity, cancer).

Study on whether MDD associated with accelerated aging
- 1095 current MDD patients, 802 remitted MDD patients and 510 control subjects
- TL shorter among remitted MDD patients and current MDD patients
  - Adjustment for health / lifestyle variables did not reduce associations
- Higher depression severity and longer symptom duration in the past 4 years were associated with shorter TL

Depressed patients show accelerated cellular aging according to a 'dose-response' gradient
Telomere length and cancer risk

- Short telomere length at baseline associated with cancer risk independently of other risk factors
- Incidence rates were:
  - 5.1 per 1000 person-years in the longest telomere length group
  - 14.2 in the middle length group
  - 22.5 in the shortest length group
- Short telomere length also associated with high cancer mortality (2.13)
- “There was a statistically significant inverse relationship between telomere length and both cancer incidence and mortality.”
Telomeres and dementia

- Telomere analysis of 82 Alzheimer's disease (AD) patients and cognitively normal age and gender-matched controls
  - Matched controls have significantly different telomere profiles compared to mild, moderate, and severe AD patients
- The shorter the telomeres the greater the risk of AD
The greater the level of mind wandering, the greater the level of telomere shortening (a marker of biological age).

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.”

Meditation, mental health & telomerase

- Study of effect of brief daily yogic meditation on mental health, cognitive functioning, and immune cell telomerase activity in family dementia caregivers (mean age 60) with mild depressive symptoms
  - Randomized to Kirtan Kriya vs. listening to relaxation music for 12 min/d for 8 weeks
- The meditation group showed significantly lower levels of depressive symptoms and greater improvement in mental health and cognitive functioning c/w relaxation group
- Meditation group showed 43% improvement in telomerase activity c/w 3.7% in the relaxation group (p = 0.05)
- Improvement in mental health “is accompanied by an increase in telomerase activity suggesting improvement in stress-induced cellular aging.”
Psychoneuroimmunology

Poor mental and emotional health:
1. Lowered immune markers (WBC and Ig)
2. Increased susceptibility to infections
3. Increased severity and progression of infections
4. Increased relapse of chronic and latent infections
5. Increased activity of inflammatory illnesses
6. Increased activity of autoimmune conditions
7. Poor response to immunisation
8. Effects on the activity of allergic conditions
9. Lowered defences against some cancers
Emotions and inflammation

- Immune dysregulation is a core mechanism for conditions associated with aging
  - E.g. CVD, osteoporosis, arthritis, Type 2 diabetes, certain cancers, and frailty and functional decline

- Production of pro-inflammatory cytokines that influence these conditions can be stimulated directly by negative emotions

- Depression (stress) can down-regulate the immune response, prolong infection and delay wound healing
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 associated with similar self-reported affect

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
Meditation and inflammation

- Novice meditators’ inflammatory markers (serum interleukin (IL)-6 levels) were 41% higher than those of expert meditators.
- The odds of a novice having detectable C-reactive protein (CRP) (a marker of inflammation) were 4.75 times as high as that of an expert.
- Differences in stress responses between experts and novices provided one plausible mechanism for their divergent inflammatory response to stress.

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 training in mindfulness meditation,
  - 8-week training in moderate-intensity sustained exercise
  - control (no intervention)

- 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
  - 67 missed in the control group
  - 32 in the exercise group
  - 16 in the meditation group
Mind-body medicine and fertility

- Study determined if women who were randomized to a mind/body program before starting their first IVF cycle would have higher pregnancy rates than control subjects
  - 143 women aged ≤ 40 years who were about to begin their first IVF cycle
- Subjects randomized to a ten-session mind/body program (MB) or a control group and followed for two IVF cycles
- Pregnancy rates for cycle 1 were 43% for all subjects
- Pregnancy rates for cycle 2 were 52% for MB and 20% for control
- MB program associated with increased pregnancy rates
Does ‘stress’ ‘cause’ cancer?

- Yes and no depending on how you define it, measure it and the person experiencing it

- Meta-analysis to verify association b/w stressful life events and primary breast cancer incidence
  - 618 studies (1982-2007): 8 case control and cohort studies selected and 3 analyses for Relative Risk
  - Widowhood: RR1.04
  - Divorce: RR1.03
  - Self-rated intensity/frequency of stress: RR1.73
Does ‘stress’ ‘cause’ cancer?

- Review evaluated longitudinal associations between stress and cancer using meta-analytic methods (165 studies)
- Stress-related psychosocial factors associated with:
  - higher cancer incidence in initially healthy populations (P = 0.005)
  - Poorer survival in patients with diagnosed cancer
  - Higher cancer mortality
- Stressful life experiences related to:
  - poorer cancer survival and higher mortality
  - but not to an increased incidence
- Stress-prone personality or unfavourable coping styles and negative emotional responses or poor quality of life related to higher cancer incidence, poorer cancer survival and higher cancer mortality
Depression and risk of cancer

- Chronically poor mental health is associated with an increased risk of cancer independent of other risk factors.

- “After adjustment for age, sex, race, disability, hospital admissions, alcohol intake, and smoking, the hazard ratio for cancer associated with chronically depressed mood was 1.88. The excess risk of cancer associated with chronic depression was consistent for most types of cancer and was not specific to cigarette smokers. ... When present for at least 6 years, depression was associated with a generally increased risk of cancer.”

Depression and cancer

- Immune activation and inflammation play a role in the pathophysiology of both depression and cancer

- Cancer patients experience a threefold higher rate of depression within the first five years of diagnosis

- Chronic depression associated with increased (approx. doubled) cancer risk and shortened survival
  - Elevated concentrations of proinflammatory cytokines associated with depression may mediate the neuroendocrine, neural, and immune pathways that account for the relationship
  - Proinflammatory cytokines are known to modulate key neurobiological correlates of depression including hypothalamic-pituitary-adrenal (HPA) axis dysregulation, monoamine neurotransmitter metabolism, and limbic system activity
Depression and breast cancer survival

- Randomized trial of supportive-expressive group therapy on 125 women with metastatic breast cancer (MBC)
- Completed a depression symptom measure [CES-D] at baseline and were randomly assigned to a treatment group or a control group
- Median survival time 53.6 months for women with decreasing CES-D scores over 1 year and 25.1 months for women with increasing CES-D scores
- Significant effect of change in CES-D over the first year on survival out to 14 years
- Neither demographic nor medical variables explained this association.
- “Decreasing depression symptoms over the first year were associated with longer subsequent survival for women with MBC in this sample.”
Depression and breast cancer survival

Kaplan-Meier survival curve for increasing (solid gold line) versus decreasing (dashed blue line) Center for Epidemiologic Studies–Depression Scale (CES-D) symptoms during the initial intervention year in a randomized trial of supportive-expressive group therapy. Breast cancer was the cause of death for 94.4% of the patients.

Decrease in Depression Symptoms Is Associated With Longer Survival in Patients With Metastatic Breast Cancer: A Secondary Analysis

Mindfulness and cancer

- Controlled trial demonstrated:
  - Significantly lower scores on Total Mood Disturbance and subscales of Depression, Anxiety, Anger, and Confusion but more Vigor
  - Fewer overall physical and stress symptoms
  - 65% reduction in mood disturbance and a 31% reduction in stress
- Associated with decrease in afternoon cortisol level
  - Cortisol one of the stress hormones: a prognostic factor for outcomes for cancer patients
Mindfulness and immunity

- Cancer patients: significant improvements seen in overall quality of life, symptoms of stress, and sleep quality
  - Results are consistent with a shift in immune profile from one associated with depressive symptoms to a more normal profile
  - Lower levels of inflammatory hormones (interleukins) which can accelerate cancer growth

Melatonin and cancer

- Hormone produced by pineal gland
- Highest concentration at night
- Biologic effects:
  - Setting the body clock
  - Antioxidant
  - Immunomodulator
  - Antitumor, anticytokine, anti-insomnia, anticachexia
  - Improves survival in advanced cancer
  - Reduces radiation and chemotherapy-induced toxicity

- Taking (high dose) supplements may not be advisable
Melatonin and cancer

- Produced by pineal gland
  - Setting the body clock
  - Antioxidant
  - Immunomodulator
  - Antitumor, anticytokine, anti-insomnia, anticachexia
  - Improves survival in advanced cancer
  - Reduces radiation and chemotherapy-induced toxicity

- Enhanced by:
  - meditation
  - sunlight
  - subdued lighting after sunset
  - calorie restriction
  - exercise
  - foods rich in Ca, Mg, B6, niacinamide
  - tryptophane rich foods

Mindfulness and cancer

- At the first assessment (i.e., before MBSR start), reductions in peripheral blood mononuclear cell NK cell activity (NKCA) and IFN-gamma production with increases in IL-4, IL-6, and IL-10 production and plasma cortisol levels were observed for both the MBSR and Non-MBSR groups of breast cancer patients.

- Women in the MBSR group
  - Re-established their NKCA and cytokine production levels
  - Reduced cortisol levels
  - Improved QOL, and increased coping effectiveness

- Breast cancer patients in the Non-MBSR group exhibited continued reductions in NKCA and IFN-gamma production with increased IL-4, IL-6, and IL-10 production
Mindfulness, telomeres and breast cancer

- Telomere length (TL) associated with breast cancer prognosis
- RCT compared effects of a mindfulness program and Supportive Expressive Therapy with a control intervention on TL in 88 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
- “Psychosocial interventions providing stress reduction and emotional support resulted in trends toward TL maintenance in distressed breast cancer survivors, compared with decreases in usual care.”
Chronic pain

- Significant reduction in pain, fatigue, and sleeplessness; and improved function, mood state, and general health following an 8-week intervention for people with fibromyalgia

- Both groups registered statistically significant improvements in pain management and depression for Fibromyalgia patients
Mindfulness and craving

- Study on the effectiveness of suppression vs. mindfulness-based strategy for coping with cigarette cravings
- 61 participants randomly assigned
- Both groups reported significantly reduced amount of smoking and increased self-efficacy in coping with smoking urges at 7-day follow-up
- Only participants in the mindfulness group demonstrated reductions in negative affect, depressive symptoms, and marginal reductions in their level of nicotine dependence
Weight management and mindfulness

- Participants in mindful eating program showed significant increases in measures of mindfulness and cognitive restraint around eating.
- Significant decreases in weight, eating disinhibition, binge eating, depression, perceived stress, physical symptoms, negative affect, and C-reactive protein.
- “This study provides preliminary evidence that a eating focused mindfulness-based intervention can result in significant changes in weight, eating behavior, and psychological distress in obese individuals.”
Ornish program for cancer

- 92 men with early prostate cancer who chose to watch and wait
- Randomised to lifestyle (experimental) group vs. usual treatment (control) group
Ornish lifestyle intervention

- Vegan diet
  - Fruits, vegetables, whole grains, legumes and soy
  - 10% calories from fat
  - Supplemented by soy (tofu), fish oil (3gm daily), vitamin E (400IU daily), selenium (200mcg daily), vitamin C (2gm daily)

- Exercise
  - Walking 30min 6 times weekly

- Stress management
  - Gentle yoga, meditation, breathing and PMR

- Support group 1 hour weekly
PSA readings

- After 1 year PSA decreased by 4% in experimental group and increased by 6% in control group.
- No patients in the lifestyle group had gone on to have aggressive prostate cancer vs. 6 in the control group.
- The more people applied the program the better their outcome.

Level of lifestyle change and PSA

Ornish lifestyle intervention

- **2-year follow-up**
  - 27% (13/49) patients in control group have gone on to require cancer treatment because of disease progression but only 5% (2/43) patients in lifestyle group

- **Ornish program down-regulated prostate cancer gene expression**

- **Comprehensive lifestyle change increased genetic repair (telomerase activity)**
Lifestyle change and telomeres

- 5 year follow-up investigated long-term effects of lifestyle change (Ornish Program) on telomere length on men who had biopsy-proven low-risk prostate cancer
- Control group underwent active surveillance alone
- Relative TL 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