Mindful Learning: why attention matters in education

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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.”

What is mindfulness?

- Paying attention to the present moment with an attitude of openness, curiosity and acceptance
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

Child abuse and brain development

- The brains of adolescents brought up in hostile and unsupportive environments are predisposed to reproduce anti-social behaviours and aggression because of overstimulation of the amygdala and underdevelopment of the prefrontal cortex

TELOMERES

Embryonic Stem Cell

Telomere Long

Telomerase Active

Telomere is a Repeating DNA Sequence

Adult Stem Cell

Telomere Short

Telomerase Inactive or Absent
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
Stress and ageing in children

- Study on associations b/w autonomic nervous system and adrenocorticoid (cortisol) reactivity to lab stressors and telomere length (TL) in 5-6y/o children
- Heart rate and cortisol reactivity inversely related to TL
- Children with high sympathetic activation and parasympathetic withdrawal and high cortisol reactivity had significantly shorter TL – a marker of early biologic aging

Mind wandering and ageing

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

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
TV, children & executive functioning

- 4-year-olds randomly assigned to watch a fast-paced TV cartoon (Spongebob Squarepants), an educational cartoon or draw for 9 minutes
- 4 tasks on executive function measured pre and post
- Children who watched the fast-paced TV cartoon performed significantly worse on executive function tasks

Falling attention spans

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

Social media and emotional intelligence

- A field experiment 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.

- 51 preteens spent five days at a nature camp where TVs, computers and mobile phones were not allowed c/w 54 school-based matched controls that retained usual media practices.

- Nature camp preteens’ recognition of nonverbal emotion cues improved significantly but not the control group.

Facebook and 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
Treatment group (those who took a break from Facebook)
- 81% are happy
- 34% are sad
- 49% are enthusiastic
- 25% feel lonely
- 56% are decisive

Control group (those who kept using Facebook)
- 88% are happy
- 22% are sad
- 61% are enthusiastic
- 16% feel lonely
- 64% are decisive

54% are worried
20% are angry
33% feel depressed
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

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)
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
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

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.”

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*
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 were the most distracting (28% more likely to make a mistake)
- Students nearly all had their phones set to vibrate and didn't take them out or look at them during the study
Smartphones and learning

- Study explored the use of smartphones to support student learning
- Participants were students that had never used a smartphone
- Reported on their expectations of the value of smartphones to achieve their educational goals before and after 1 year
- The utility of the smartphone to help with education was perceived as favorable prior to use but by the end of the study they viewed their phones as detrimental to educational goals
  - Average response at outset was 3.71 on the survey's 1-5 scale (1 being "strongly disagree" and 5 being "strongly agree") and 1.54 at end of year
  - When asked to rate the statement "My iPhone will distract/distracted me from school-related tasks," the average answer rose from 1.91 at outset to 4.03 at the end
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
Yerkes-Dodson Stress-performance curve

Relaxation without awareness or engagement – inertia, apathy

Higher performance – stress lifts out of apathy and engages

High stress and poor performance
Hassled mindfulness stress-performance curve

**Performance**

- Highest performance (zone / flow) – mindful i.e. relaxed but fully aware and engaged

**Stress**

- Higher performance – stress lifts out of apathy and engages

- Relaxation without awareness or engagement – inertia, apathy
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
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.”
Intergenerational maths anxiety

- Study of children in first and second grade on how parents’ anxiety about math relates to their children’s math achievement
- When parents are more math anxious, their children learn significantly less math over the school year and have more math anxiety by the school year’s end, but only if math-anxious parents report providing frequent help with math homework
- When parents reported helping with math homework less often, children’s math achievement and attitudes were not related to parents’ math anxiety
- Suggests that the effects of parents’ math anxiety are specific to children’s math achievement
- Evidence of an intergenerational transmission of low math achievement and high math anxiety
The Default Brain

- Attentive
  - Tasks associated with paying attention
  - Brain efficient and quiet
- Default state (mode)
  - Mind is inattentive, distracted, idle, recalling past, daydreaming, ruminating, worrying …
  - Areas active in default mode similar to areas affected by Alzheimer’s Disease
“The 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
Murray Rose on mindfulness

- Reporter: Do you have any philosophy on life as an individual?
- MR: 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
Practicing mindfulness

- Formal practice (mindfulness meditation)
- Informal practice (mindful in daily life)
- Cognitive practices
  - Perception, letting go (non-attachment), acceptance, present moment
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
  1. Openness
  2. Curiosity
  3. Acceptance
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**
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.”

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 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
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.”
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

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
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 student wellbeing

- Study investigated relationships among engagement in self-care behaviours, dispositional mindfulness, and psychological distress
  - 207 Australian medical students aged across the 5 years of the Monash University medical course
  - Online survey: demographics, the Five Facet Mindfulness Questionnaire, the Health-Promoting Lifestyle Profile II, and the DASS

- Significant correlations between distress and both mindfulness and self-care

- Dispositional mindfulness a significant moderator of the relationship between self-care and psychological distress

- “The present study points to the potential of self-care and mindfulness to decrease medical student distress and enhance well-being.”

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 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 exam anxiety

- Reduction of anxiety and improved performance of students on high stakes exams through the application of mindfulness training
- Probably because mindfulness frees up working memory sources occupied by anxious preoccupation
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
MBCT and ADHD

- RCT on 50 adult ADHD patients investigating brain activity (event-related potentials ERP) and clinical measures pre-to-post MBCT
- MBCT associated with:
  - Reduced hyperactivity / impulsivity and inattention symptoms
  - Increased act-with-awareness
  - Improved motivational saliency, error awareness and inhibitory regulation
- Comparable effects to pharmacological treatments
Mind-body and autism

- Study assessed the 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).
  - The study outcome was measured using The Behavioral Assessment System for Children, Second Edition (BASC-2) and the Aberrant Behavioral Checklist (ABC)
- Robust changes were found on the BASC-2, primarily for 5-12-year-old children
- Post-treatment scores on the Atypicality scale of the BASC-2, which measures some of the core features of autism, changed significantly
Mindfulness and doctor 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
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
Mindfulness for teachers

- RCT of pilot program of Mindfulness-Based Stress Reduction adapted 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
- Changes in mindfulness correlated with improved outcomes (e.g. psychological symptoms, burnout, and sustained attention)

Mindfulness for teachers

- Study of preschool teachers attending 8-week mindfulness course
- Results showed decreases in the students’ challenging behaviors and increases in their compliance with teacher requests
- Students also showed a decrease in negative social interactions and an increase in isolate play
- “Our results indicate that mindfulness training for teachers was effective in changing teacher-student interactions in desirable ways.”

Emotional Intelligence & mindfulness

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

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

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.”

Mindful Learning
Reduce stress and improve brain performance for effective learning

Mindfulness for Life
Foreword by Ian Gawler OAM
Free 6-week online mindfulness course

- [https://www.futurelearn.com/courses/mindfulness-wellbeing-performance](https://www.futurelearn.com/courses/mindfulness-wellbeing-performance)
- Collaboration between Monash University and FutureLearn (UK)
Applying mindfulness in the school

- **Start with teachers then students and parents**
- **Formal practice**
  - 5-10 minutes to be taken seated b.d. before meals
  - 15-60 seconds p.r.n.
- **Informal practice**
  - The senses are a gateway to the present moment: listening, eating, walking, reading, learning, communicating…
  - Move through the day one step, moment, job at a time
  - Avoid multitasking
  - Use screen-time discerningly
- **Cultivate a mindful attitude**
  - E.g. open, curious, flexible, non-attached…
  - Do things in non-habitual ways
  - Look for novelty / differences
- **Mindfulness-based cognitive practices**
  - Perception
  - Letting go
  - Acceptance
  - Presence of mind
- **Contextualise and integrate it in the curriculum**