Performing under Pressure; on the Biology, Psychology and Sociology of stress in high-performance professions

VI – STRESS MANAGEMENT

Stress management and reduction/elimination are NOT the same thing! Without stress you would quickly become bored and nothing would happen

“Good” stress

- Limited timespan
- Predictability
- Retrospective reflection
- A feeling of control

Today's program: preparation for stressful events

- Next week: Stress and Performance
  - Managing the acute stress response
  - Optimising physical and cognitive output

- The week after: Team-performance under stress
  - Communal coping and stress management
  - Manipulating the acute stress response in others

Social support!! (see lecture 4)

Sleep and rest (See lecture 10)

Regulated exposure to limited physiological stress

- Short term exposure to mild physiological stressors
  - Controlled or simulated psychological stressors
    - Play & competition
    - Controlled passive experience
      - Fiction (horror, thriller, etc)
      - Safe stressors (rollercoasters, harmless “scary stimuli”)
  - Cold
  - Hunger (fasting)

How exercise affects the stress response

- Exercise enhances
  - Mood
  - Energy
  - Memory
  - Attention

- A single workout can raise dopamine, noradrenaline and serotonin for at about 2 hours
- Repeated exercise
  - neuroplasticity
    - Hippocampus (memory)
    - Frontal cortex (attention)
  - Brain health

Suzuki, W. (2017). *The brain-changing benefits of exercise*.
Basso, J. C., Shang, A., Elman, M., Karmouta, R., & Suzuki, W. A. (2015). *Acute Exercise Improves Prefrontal Cortex but not Hippocampal Function in Healthy Adults*. 791–801. https://doi.org/10.1017/S135561771500106X
Basso, J. C., & Suzuki, W. A. (2017). *The Effects of Acute Exercise on Mood , Cognition , Neurophysiology , and Neurochemical Pathways : A Review*. 2, 127–152. https://doi.org/10.3233/BPL-160040

Cold exposure: we evolved for uncomfortable climates

- We migrated from Africa to places that were significantly colder while many places in Africa itself are not necessarily nice and warm either Evolutionary pressure for adaptation.
  - Adaptations for elevated metabolic rate and blood pressure
  - Adaptations related to fat storage and usage

Cardona, A., Pagani, L., Antao, T., Lawson, D. J., Eichstaedt, C. A., Yngvadottir, B., … Kivisild, T. (2014). Genome-wide analysis of cold adaptation in indigenous Siberian populations. *PLoS ONE*, 9(5). https://doi.org/10.1371/journal.pone.0098076
Makinen, T. M. (2010). Different types of cold adaptation in humans. *Frontiers in Bioscience*, 1047–1067.

One important note to make!!!!

- The effects of climate (i.e. cold adaptation), interbreeding with other hominins (most commonly Neanderthals or Denisovans) and other evolutionary influences are often misused by bigots to argue for a qualitative evolved difference between human ethnicities.

- I want to be very clear that there is no evidence of a meaningful evolved difference with regard to quality of character!!!!! Minor differences, which may affect isolated physiological functions do NOT!!! equate to identifiable differences in morality, work ethic, intellectual capacity, etc.

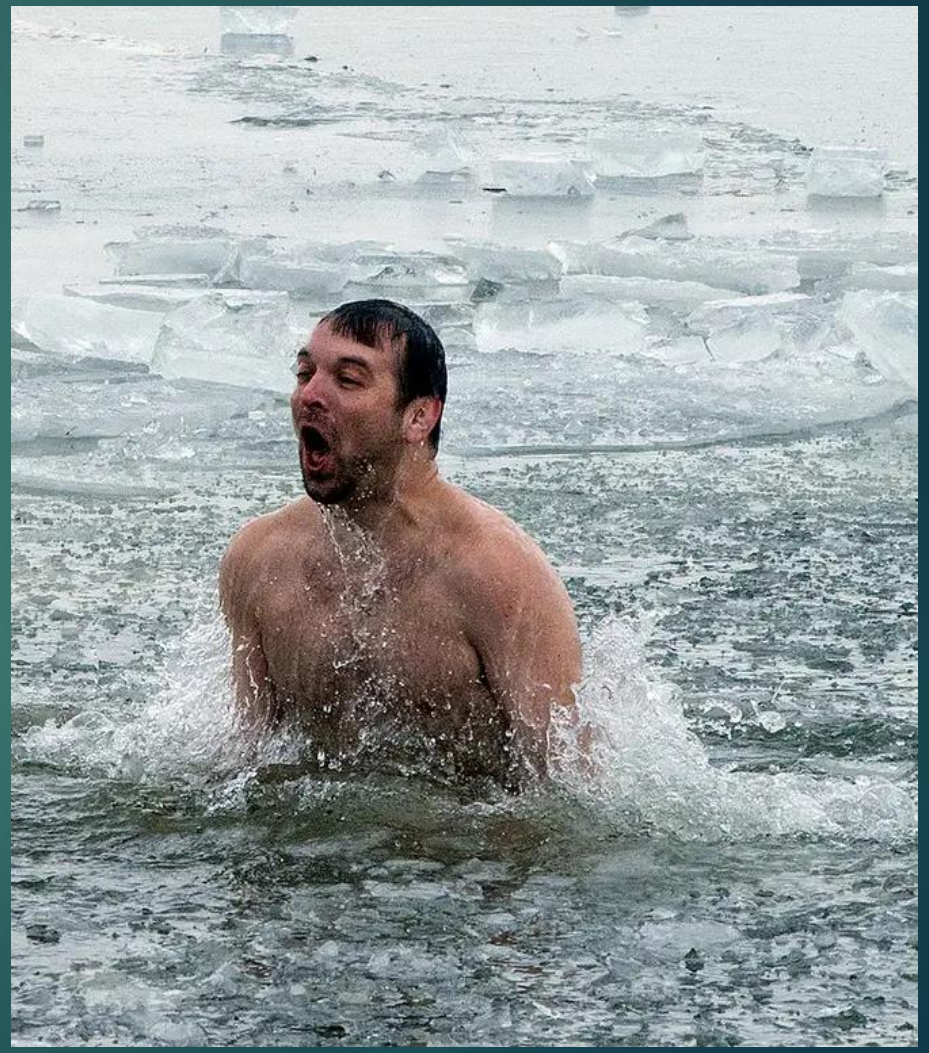
On the epigenetics

- The expression of approximately 20 mammalian genes is effected by cold exposure.
  - Metabolism. In fact, there is an argument to be made that the current rise in metabolic disease can be, in part, attributed to diminished metabolic rates due to a reduction in cold adaptation.
  - Brown fat regulation

Makinen, T. M. (2010). Different types of cold adaptation in humans. Frontiers in Bioscience, 1047–1067.

Acute response to cold

- Stress response
  - Vasoconstriction
  - Hyperventilation
  - Shivering
  - Sympathetic activation
    - Immune system
  - Noradrenaline



Secondary response to cold

- Vasodilation
- Thermogenesis (shivering)
- Parasympathetic activation
- Anti-inflammatory Cytokines
- Mood enhancement (probably in response to dopamine outflow)

Repeated cold exposure

- Brown fat activation and production
- Non-shivering thermogenesis
- Improved insulin sensitivity
- Weight loss
- Immune activation

We evolved for hunger

- For most of evolutionary history we went through regular short periods of food deprivation.
  - Storing excess energy
    - Insulin
  - Cleaning out the system

What happens when you stop eating?

- The first 24 hours
  - You burn through your glycogen stores

- After 2/3 days you switch from burning glucose to fat and protein
  - The more fat adapted you are the easier this transition will be
  - Enhanced mood and cognitive function (due to ketone metabolism)

Autophagy: the medicinal qualities of consuming nothing

- During hunger, the body gets a chance to burn off a lot of cells, which do not function optimally.

- During refeeding these cells are reconstituted if necessary

Taylor, P., Alirezaei, M., Kemball, C. C., Flynn, C. T., Wood, M. R., Lindsay, J., … Whitton, J. L. (2014). *Short-term fasting induces profound neuronal autophagy*. (November), 37–41. https://doi.org/10.4161/auto.6.6.12376
Pietrocola, F., Pol, J., & Prof, G. K. (2016). Fasting improves anticancer immunosurveillance via autophagy induction in malignant cells. *Cell Cycle*, *15*(24), 3327–3328. https://doi.org/10.1080/15384101.2016.1224797

Health benefits

- Longevity
- Enhanced cognitive performance
- Stress reduction
- Higher efficiency

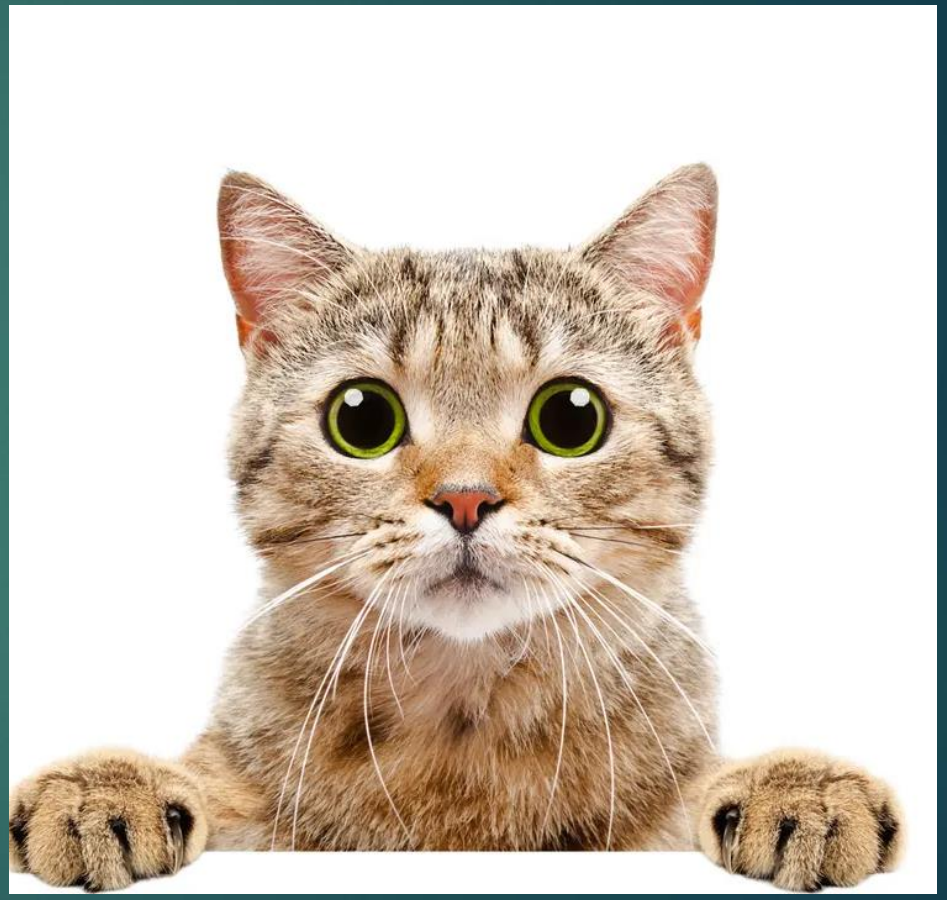
Mattson, M. P., Longo, V. D., & Harvie, M. (2017). Impact of intermittent fasting on health and disease processes. Ageing Research Reviews, 39, 46–58. https://doi.org/10.1016/j.arr.2016.10.005
Gonzalez-Estevez, C., & Flores, I. (2020). Fasting for stem cell Rejuvination. *Aging*, *12*(5), 4048–4049.

Meditation (a great feedback loop?)

- Breath work
- Deliberate focus on slowing down mental function
- Focus of the mind
  - Calm
  - Present
  - Positive aspects of one's life

Toxoplasmosis

- Cat parasite
  - Releases dopamine in the frontal cortex in response to stress
  - In mice it reduces fear of cats
  - In people it increases risk taking behaviour



Omidian, M., Asgari, Q., Bahreini, M. S., Moshki, S., Sedaghat, B., & Adnani Sadati, S. J. (2022). Acute toxoplasmosis can increase serum dopamine level. *Journal of Parasitic Diseases*, *46*(2), 337–342. https://doi.org/10.1007/s12639-021-01447-1
Prandovszky, E., Gaskell, E., Martin, H., Dubey, J. P., Webster, J. P., & McConkey, G. A. (2011). The neurotropic parasite toxoplasma gondii increases dopamine metabolism. *PLoS ONE*, *6*(9). https://doi.org/10.1371/journal.pone.0023866