





Hacking the stress system: the stress response as an adaptive trait that can work for or against you

X - Optimising the stress response for greater performance




The three major ways to manipulate the stress response

- Stress reduction
 - Habituation
 - Modulation
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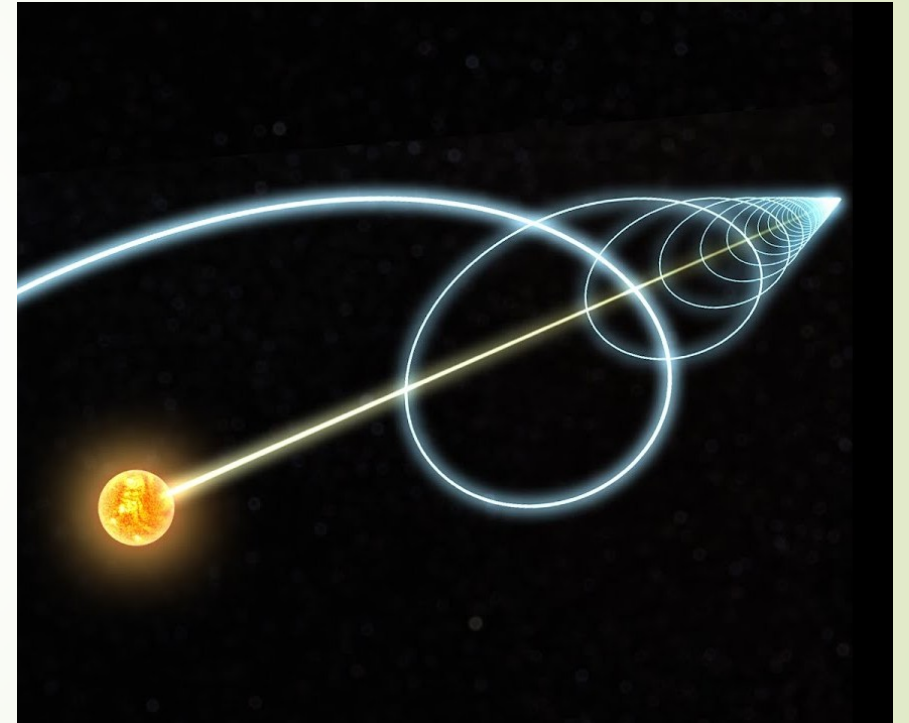


The most effective mechanisms to reduce or control the acute stress response all involve feedback loops

- It is hard to control
 - Thoughts
 - Emotions
 - Physiological states
 - Behaviour is much easier and that will alter all the above
 - Stress often requires an expression to movement (be that physiological or psychological – behaviour is the key!)
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Forward movement: The nucleus reuniens

- A small nucleus in the thalamus
- Secretes dopamine in response to forward movement
- Behaviour effects
 - In rats it increases willingness to fight harder
 - In people... (we are not sure yet. Running or going for a walk seem to calm people down, but I am not aware of any studies which confirm this mechanism. We are awaiting data from a current project though. So, I hope I can confirm this hypothesis soon)



Zimmerman, E. C., & Grace, A. A. (2016). The nucleus reuniens of the midline thalamus gates prefrontal-hippocampal modulation of ventral tegmental area dopamine neuron activity. *Journal of Neuroscience*, 36(34), 8977–8984.
<https://doi.org/10.1523/JNEUROSCI.1402-16.2016>



Acute stress reduction

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- ▶ Breath work
 - ▶ Eyes
 - ▶ Left-brain / right-brain cross talk
 - ▶ Relaxation practices
 - ▶ Meditation
 - ▶ Yoga
 - ▶ Sports

Breath work

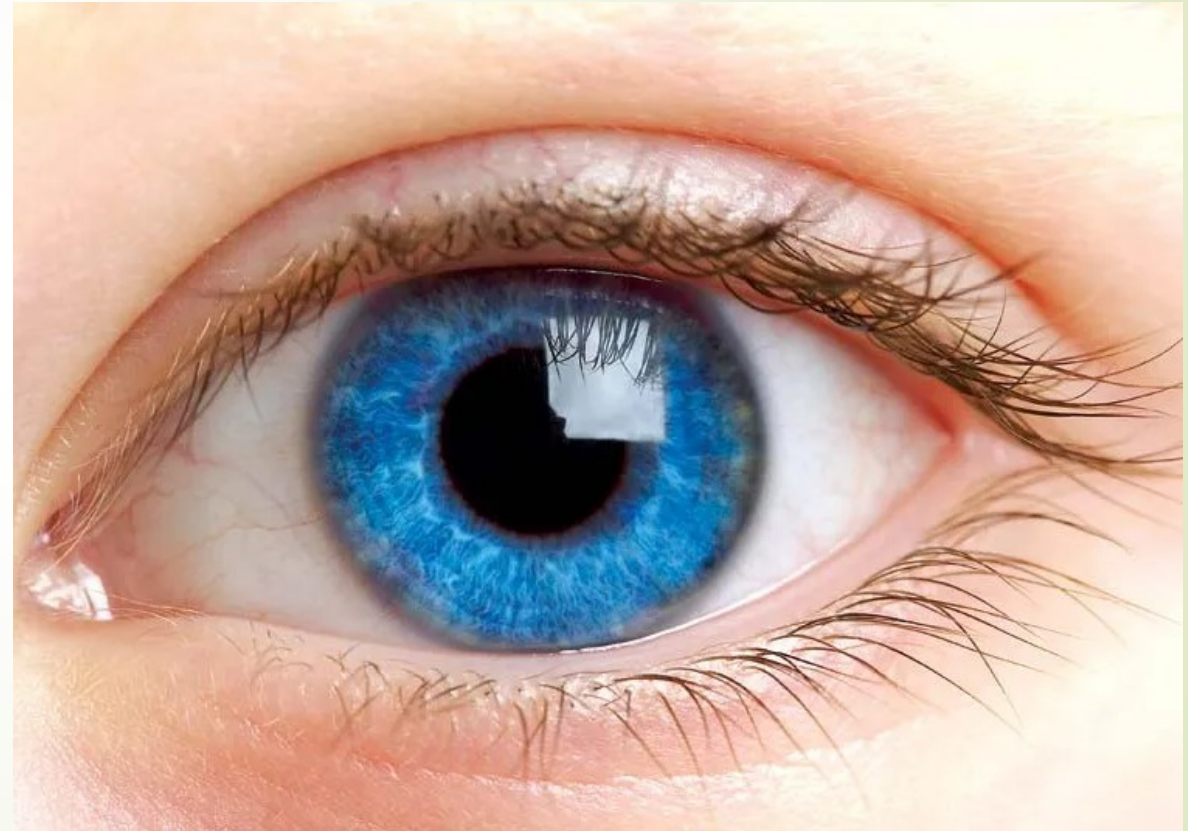
- ▶ Double sigh
 - ▶ Off load much more carbon dioxide
- ▶ Respiratory sinus arrhythmia
 - ▶ Inhales: diaphragm moves down, more space for the heart, brain sends a signal to speed up to keep blood pressure steady.
 - ▶ Basis for Heart Rate Variability (HRV)

Feldman JL. [Neurobiology of breathing control. Where to look and what to look for.](#) Advances in experimental medicine and biology, 1995.



Visual control: Can you use the eyes to control stress?

- ▶ Eyes – 2 functions
 - ▶ Detecting shapes, colours, etc. (vision)
 - ▶ Communicate to the brain – active or inactive (Cues about time of day, stressors, etc.) (YES! Another feedback loop!!)
 - ▶ Relaxed (panoramic vision)
 - ▶ Stressed (focussed vision)



Left-brain / right brain cross talk

- Over activity in the left side of the brain may lead to overthinking
- Activity with the left hand, which cross talks to the right hemisphere, leads to an overall downregulation of brain activity

Mesagno, C., Beckmann, J., Wergin, V. V., & Gröpel, P. (2019). Primed to perform: Comparing different pre-performance routine interventions to improve accuracy in closed, self-paced motor tasks. *Psychology of Sport and Exercise*, 43(January), 73–81.

<https://doi.org/10.1016/j.psychsport.2019.01.001>

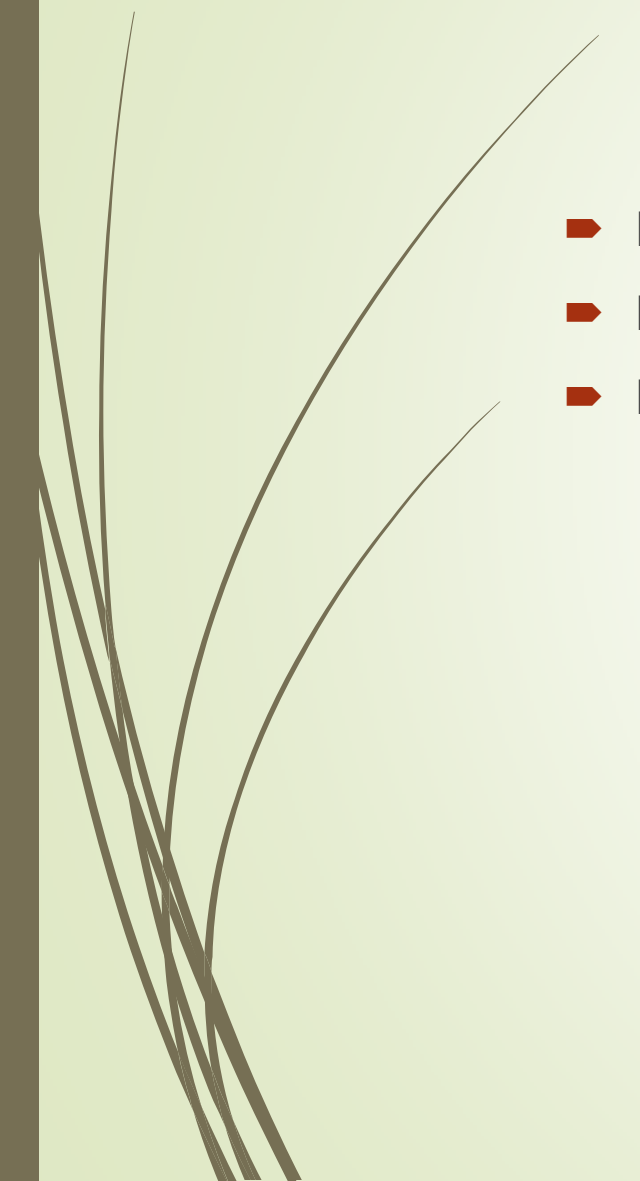
Mesagno, C., & Beckmann, J. (2017). Choking under pressure: theoretical models and interventions. *Current Opinion in Psychology*, 16(June), 170–175.

<https://doi.org/10.1016/j.copsy.2017.05.015>





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
- 



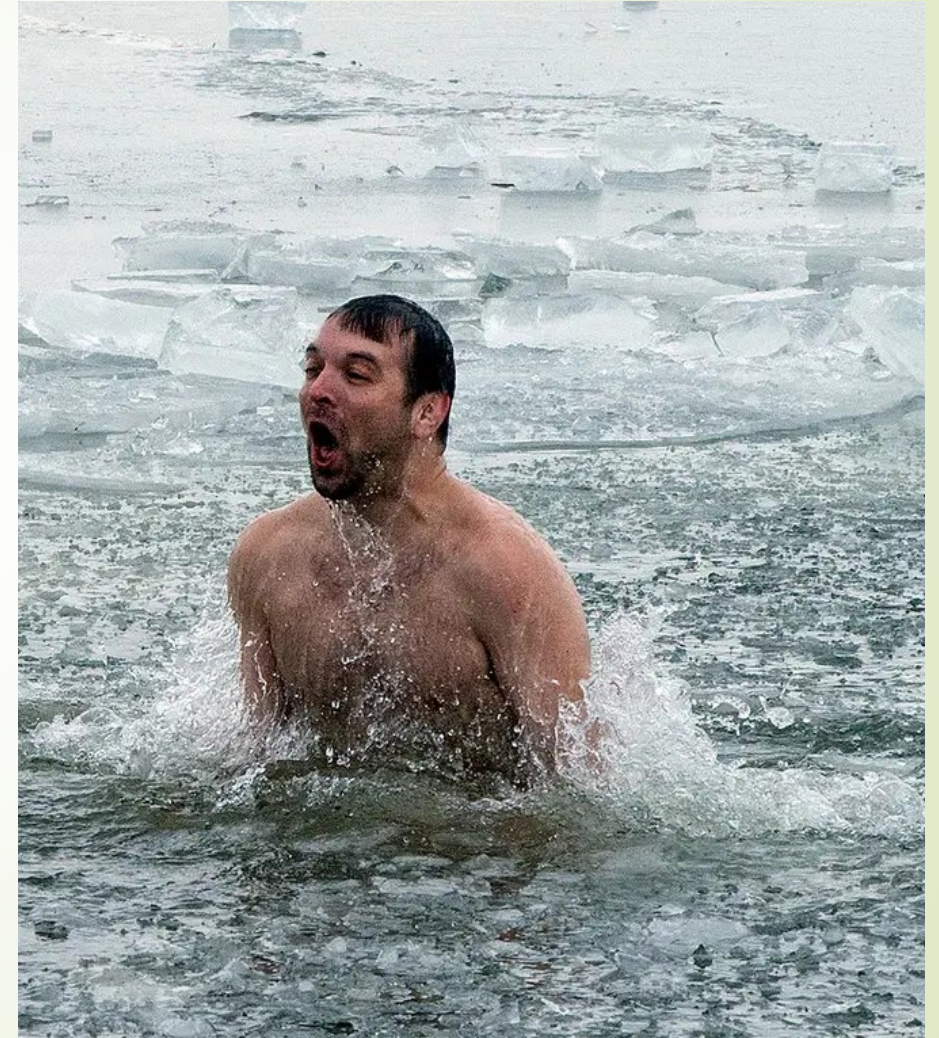
Habituation

Cold exposure: Acute response to cold

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

Šrámek, P., Šimečková, M., Janský, L., Šavlívková, J., & Vybíral, S. (2000). Human physiological responses to immersion into water of different temperatures. *European Journal of Applied Physiology*, 81, 436–442.

Søberg, S., Lo, J., Philipsen, F. E., Pedersen, B. K., Karstoft, K., Philipsen, F. E., ... Ahrens, E. (2021). *Article Altered brown fat thermoregulation and enhanced cold-induced thermogenesis in young, healthy, winter-swimming men II Altered brown fat thermoregulation and enhanced cold-induced thermogenesis in young, healthy, winter-swimming men.*
<https://doi.org/10.1016/j.xcrm.2021.100408>



Cold Exposure: Secondary response to cold

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



Cold exposure: Repeated cold exposure

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





Physical exercise (stress) – see
lecture IX

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>



Modulation



Much less is known about the manipulation of the acute stress response for optimal performance

- ▶ Internal reward generation
 - ▶ Small milestones (micro-slicing activities)
- ▶ The effects of altruism
 - ▶ We handle so much more if we can find the strength to care for others while we struggle
 - ▶ (Oxytocin?)