MØLLER INSTITUTE
CHURCHILL COLLEGE
UNIVERSITY OF CAMBRIDGE

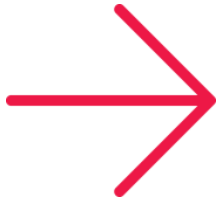
30 YEARS OF EXCELLENCE

Decision making in uncertainty

Dr Kamila Jozwik

Introductions

- cognitive computational neuroscientist
- specialise in object recognition
- research at Cambridge, Freie, MIT
- Churchill By-fellow
- Director of Studies of Psychological and Behavioural Sciences at Churchill



Outline

- Neuroscience of decision making
  - Presentation
  - Reflection (based on your experience)
- Neuroscience of stress and its effect on decision making
  - Presentation
  - Reflection
- Practical implications of neuroscience findings of decision making in uncertainty

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Brain areas – how to study them?

Phineas Gage

Brain damage and brain areas

- specialized parts of the brain -> behaviour is affected after their damage

Phineas Gage

Brain activity measurements

- How do we measure brain activity?
  - WHERE brain activity happens -> fMRI
  - WHEN brain activity happens -> EEG / MEG

fMRI

- uses magnetic fields
- fMRI measures the oxygen change in the blood (correlated with brain activity)

fMRI and brain areas

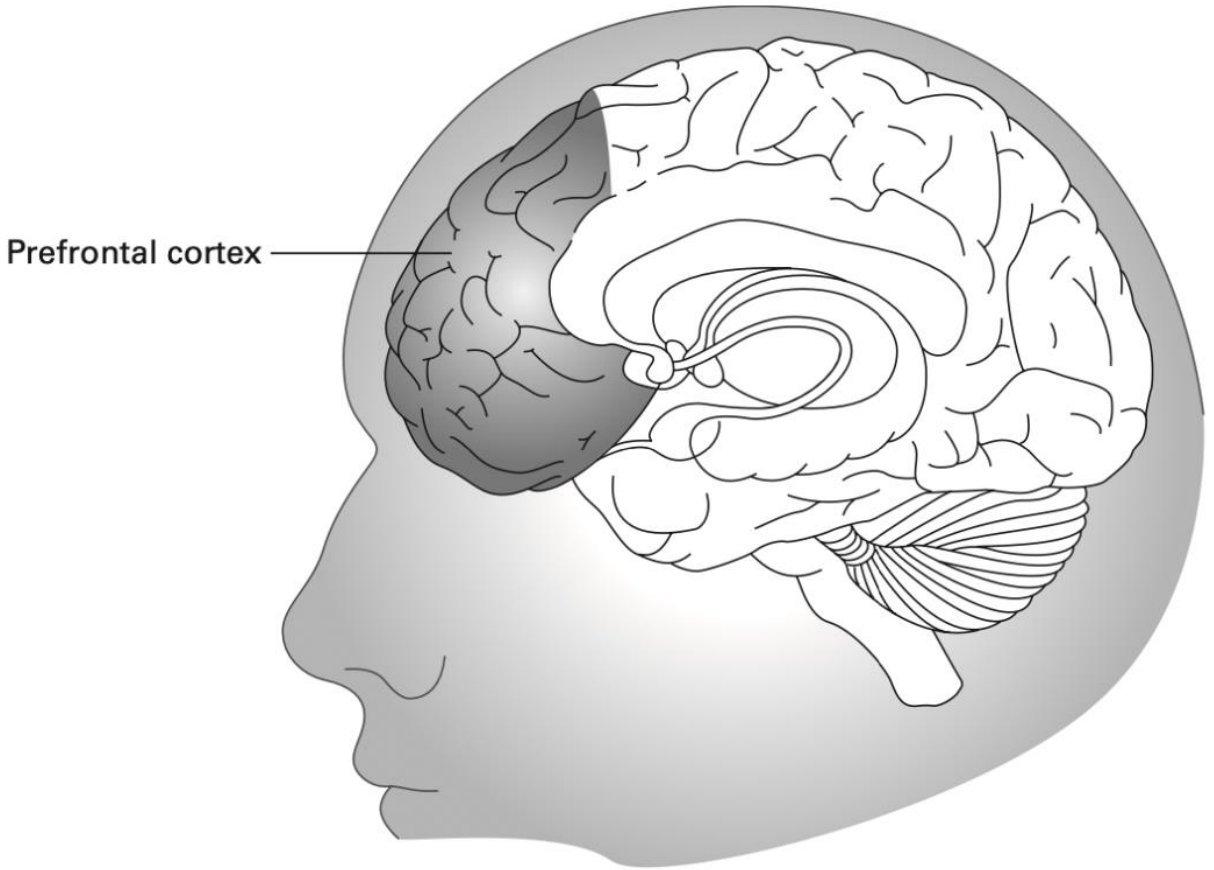
- size
- increase in activity
- change of patterns of activity

Decision making and brain areas

- not one but multiple brain areas involved in decision making
- decisions when there is a lot of uncertainty are the result of both rational and emotional drives

Prefrontal cortex

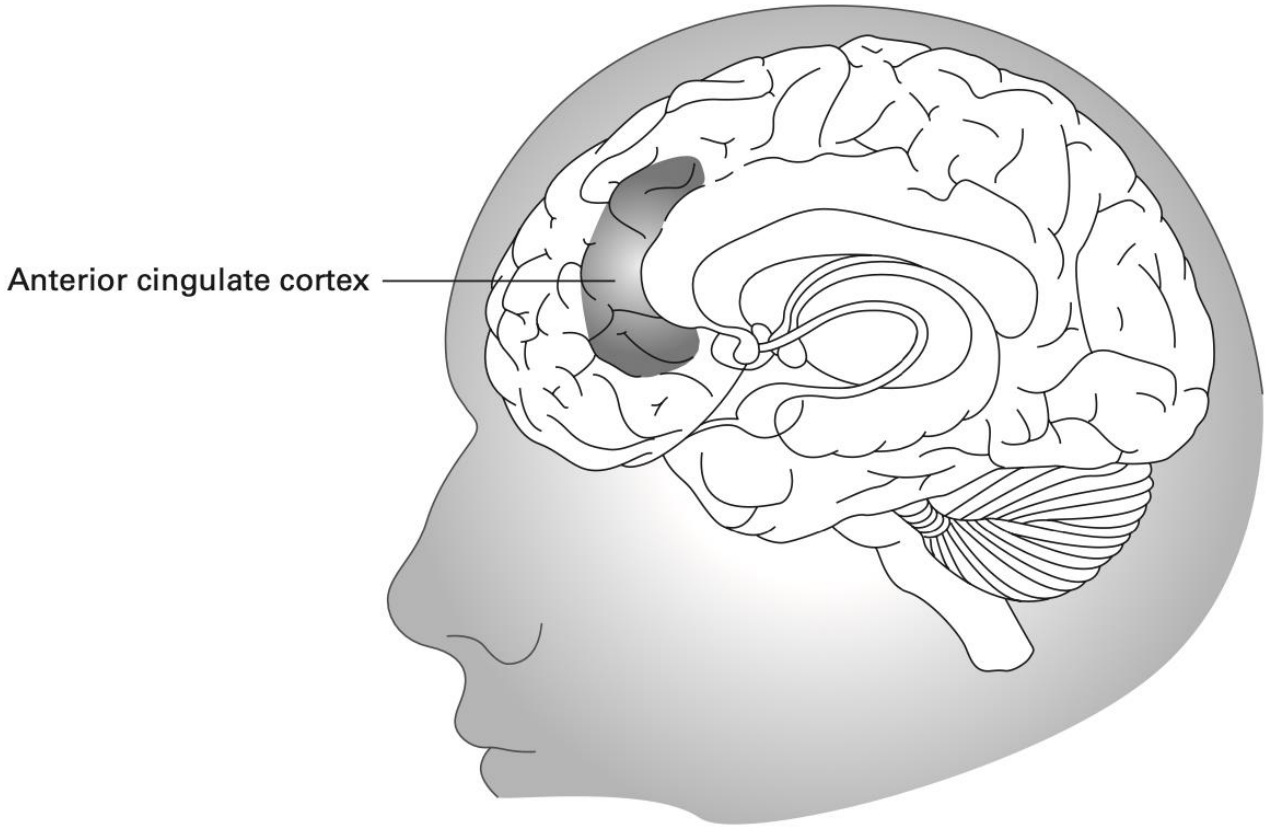
- higher-level cognitive functions, e.g. decision making, attention



Brann, 2022

Anterior cingulate cortex

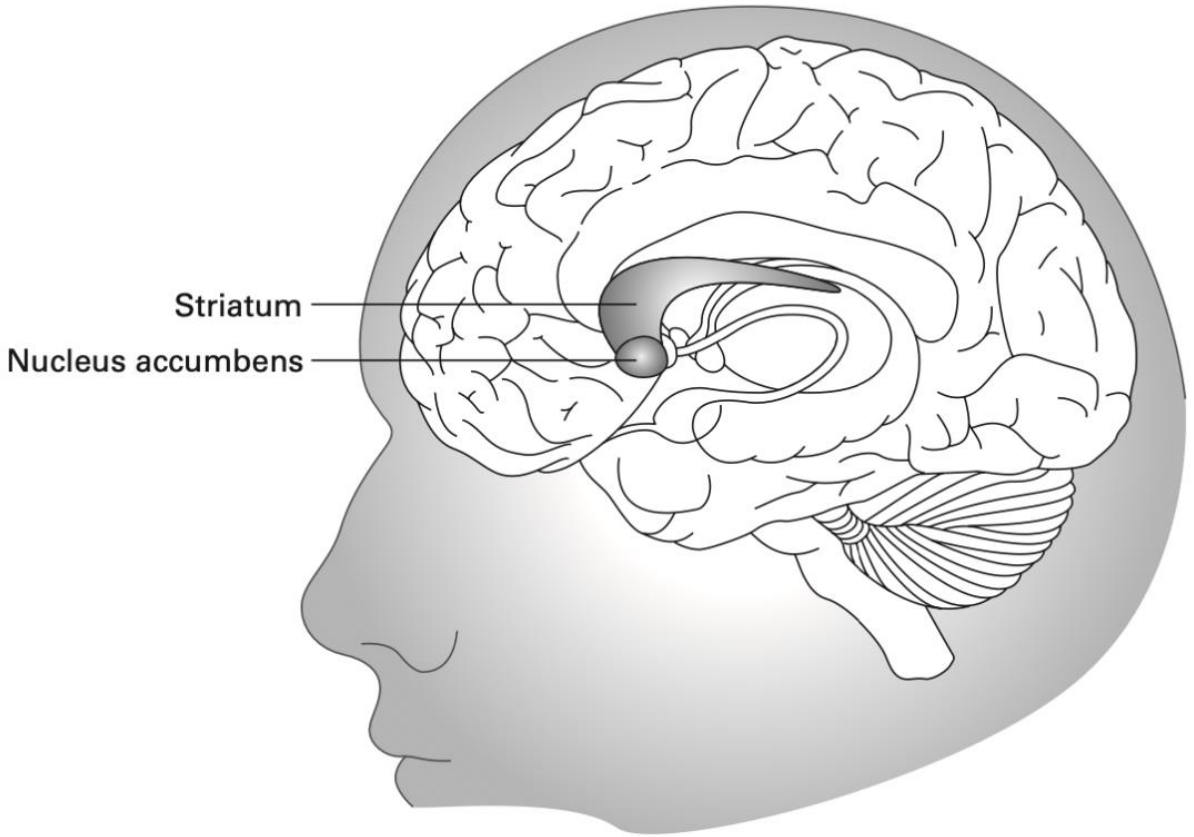
- error detection and self-correction, cost-benefit calculation, social judgement and decision making



Brann, 2022

Striatum and nucleus accumbens

- reward, motivation, fear, pleasure, dealing with uncertainty



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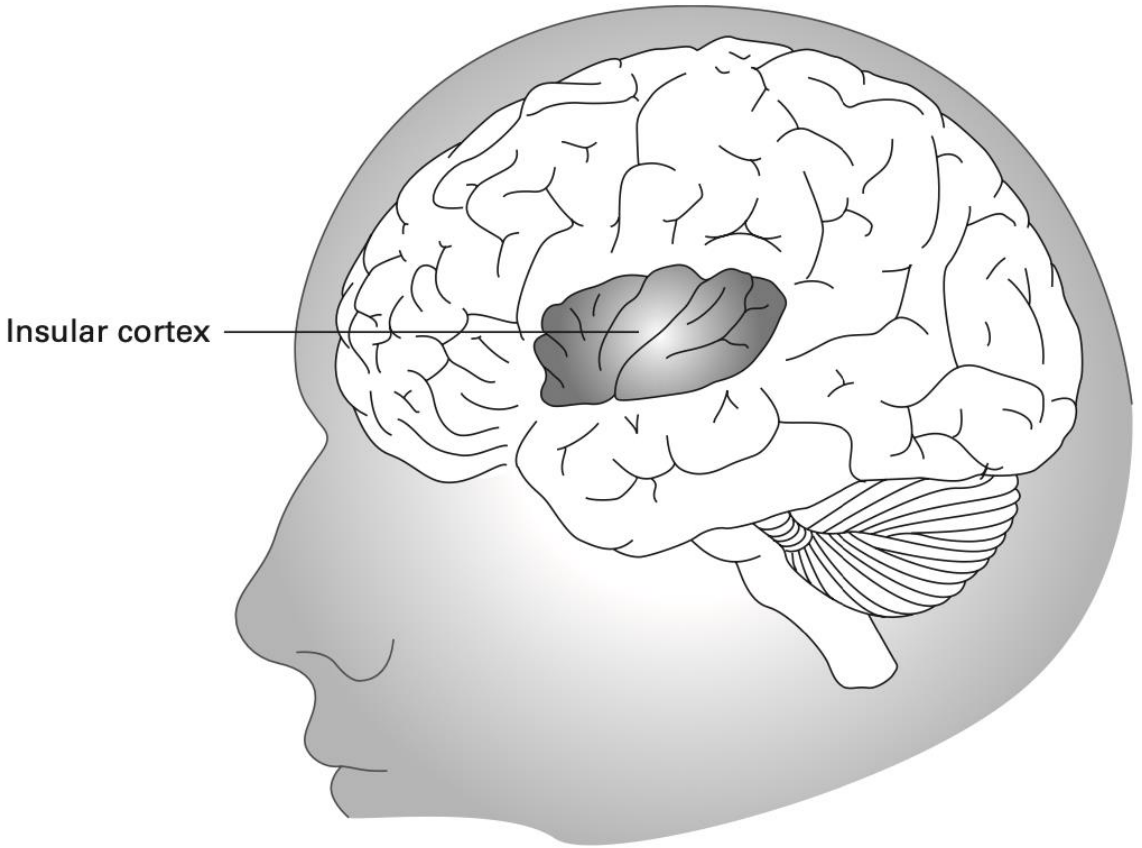
Insular cortex

- subjective feelings, risky decision making



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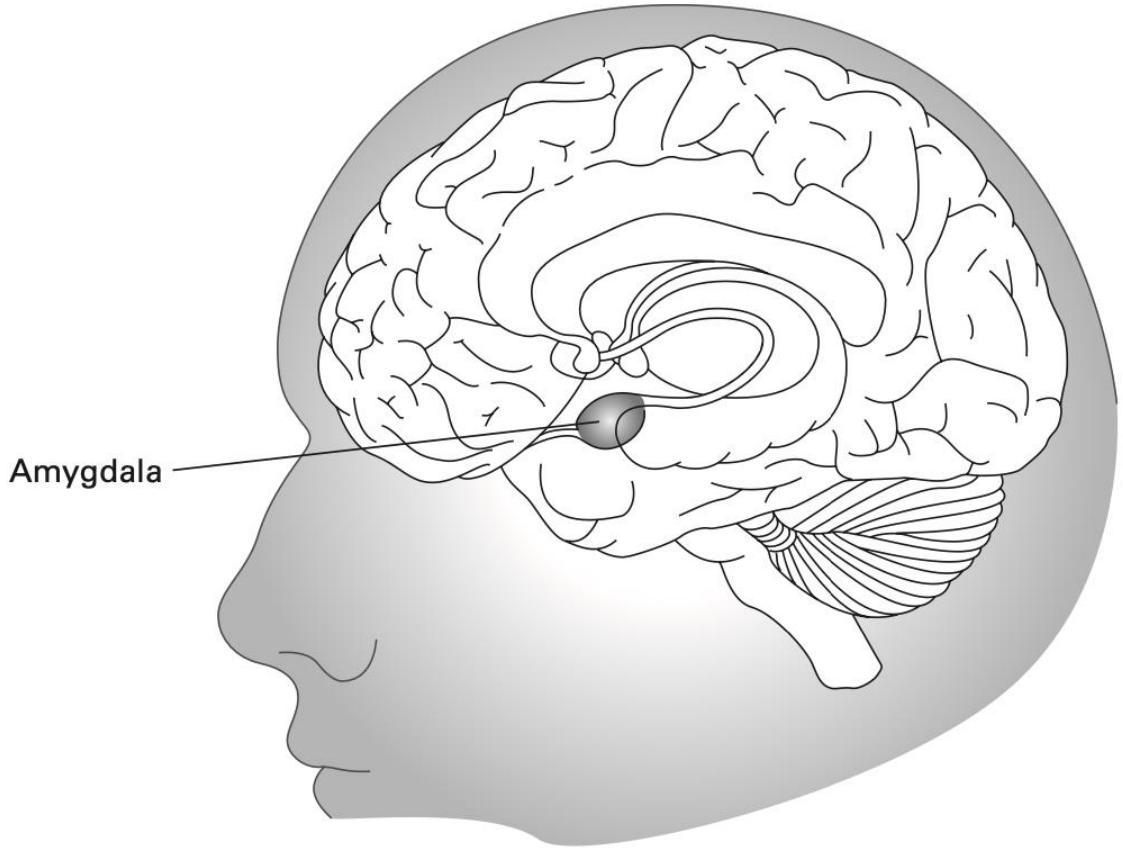
Amygdala

- emotions, social decision making



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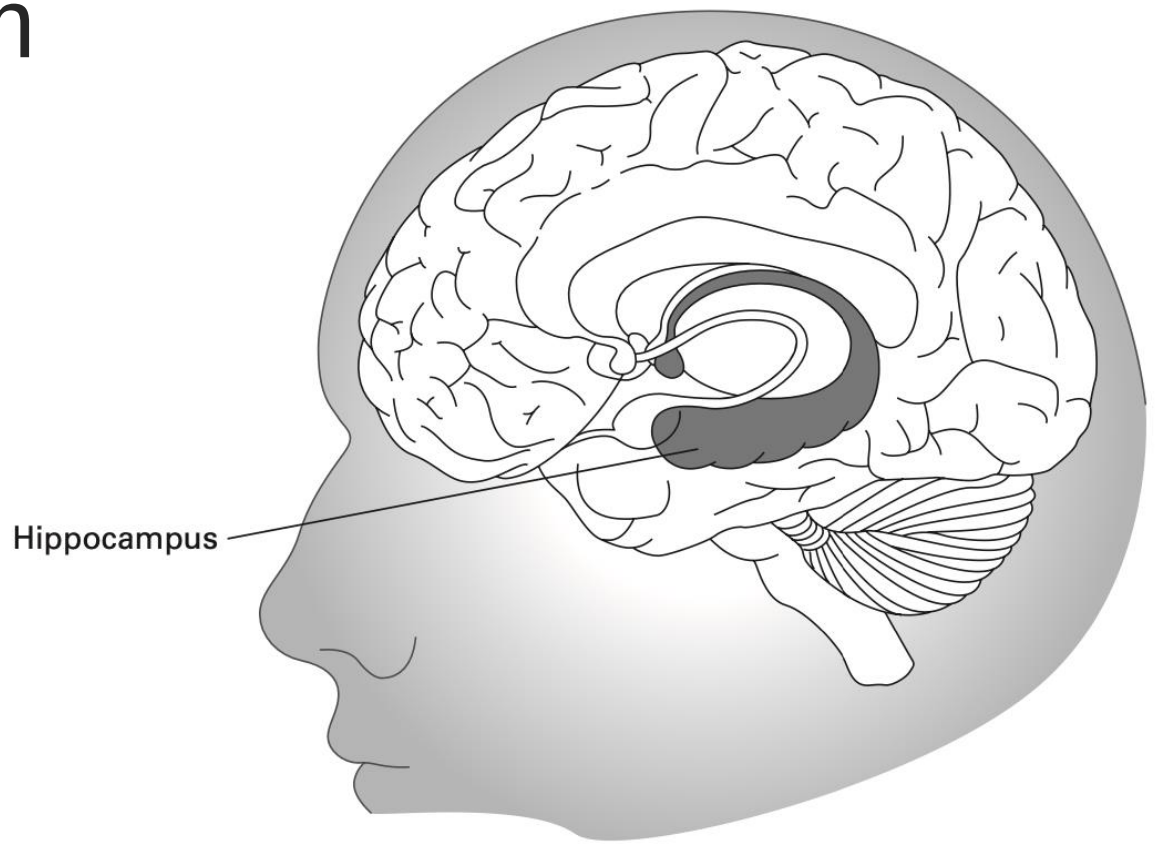
Hippocampus

- short- and long-term memory, memory guided decision making



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Reflection – group table discussion

- What approaches to decision making did/did not work and did they involve emotions?
  - for you, as a leader
  - for your organisation

  (Are they related to functions of specific brain areas?)

Prefrontal cortex

- higher-level cognitive functions

Amygdala

- emotions

Hippocampus

- short- and long-term memory

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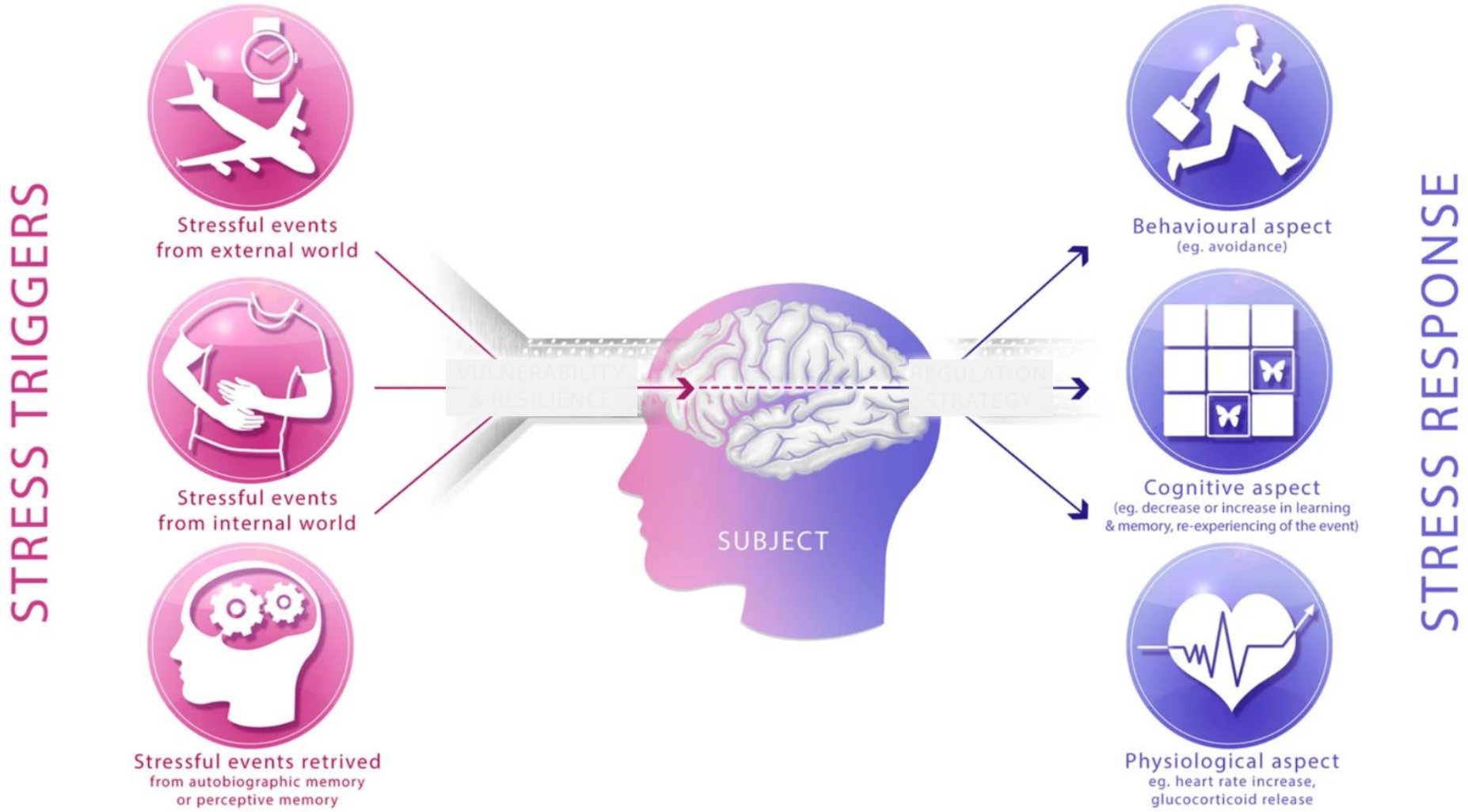
Stress

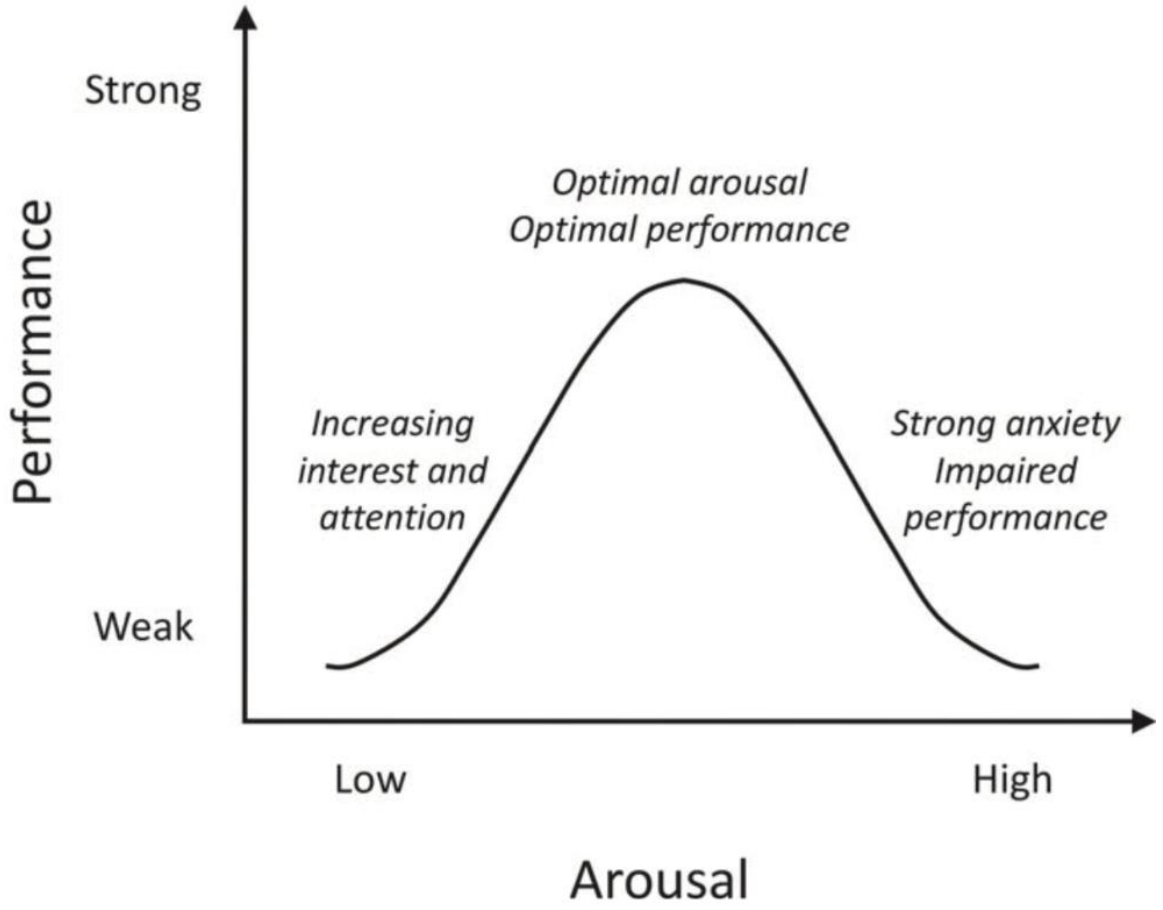
adapted from Surget et al., 2022

Stress

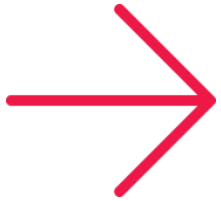


adapted from Surget et al., 2022

Stress and performance



Whiting et al., 2021

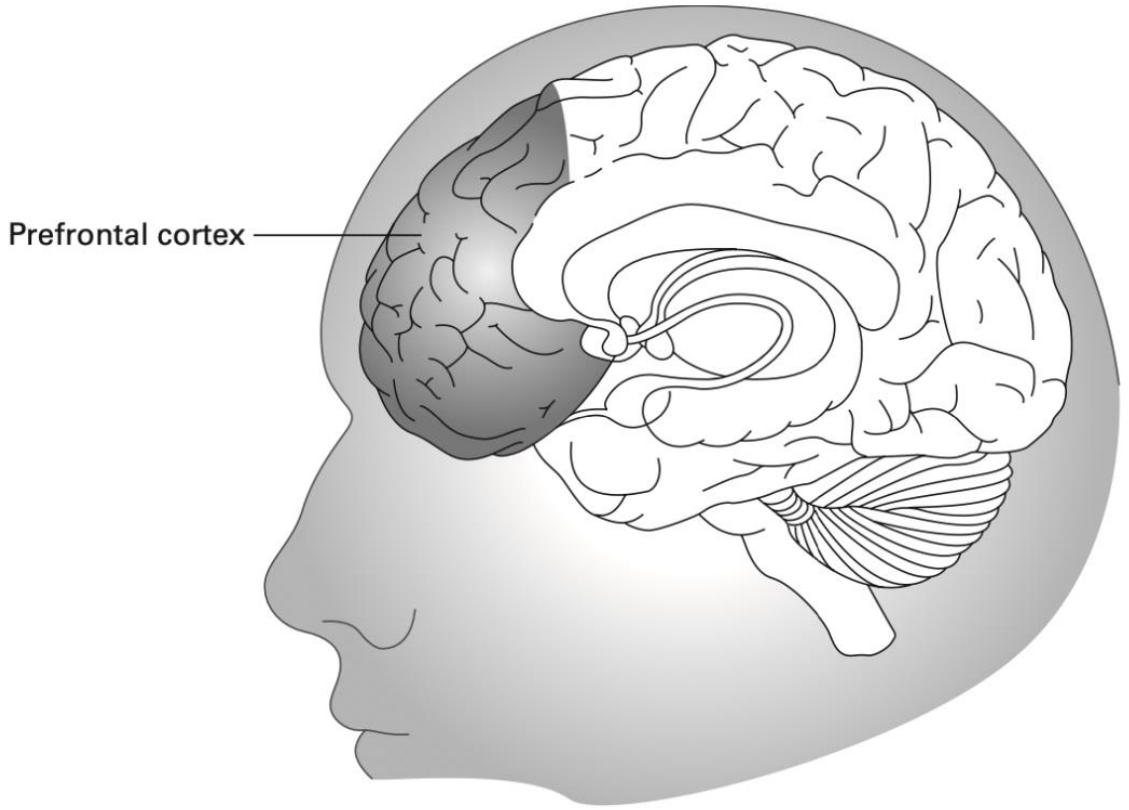


Perfectionism

- often induces anxiety and compromises performance

Prefrontal cortex

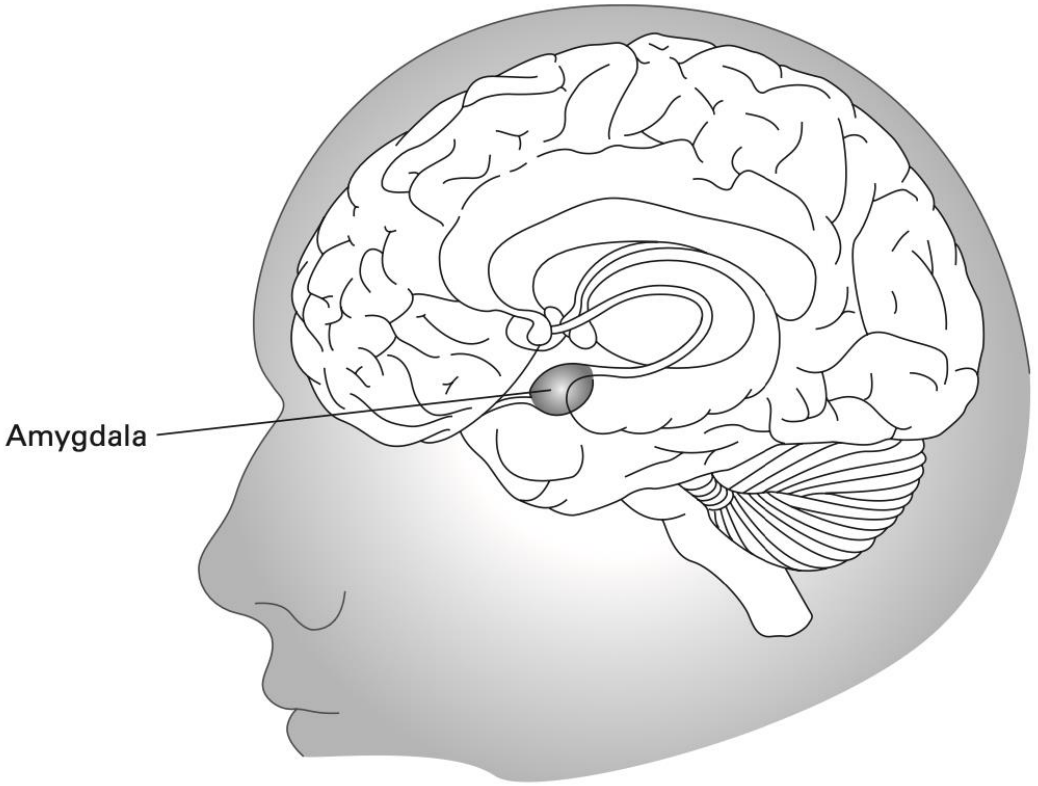
- Stress negatively impacts decision making, flexible problem solving, working memory, and energy use by prefrontal cortex



Surget et al., 2022

Amygdala

- Anxiety activates amygdala that communicates with prefrontal cortex affecting it negatively



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Mindfulness

- one way to reduce stress

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Reflection – group table discussion

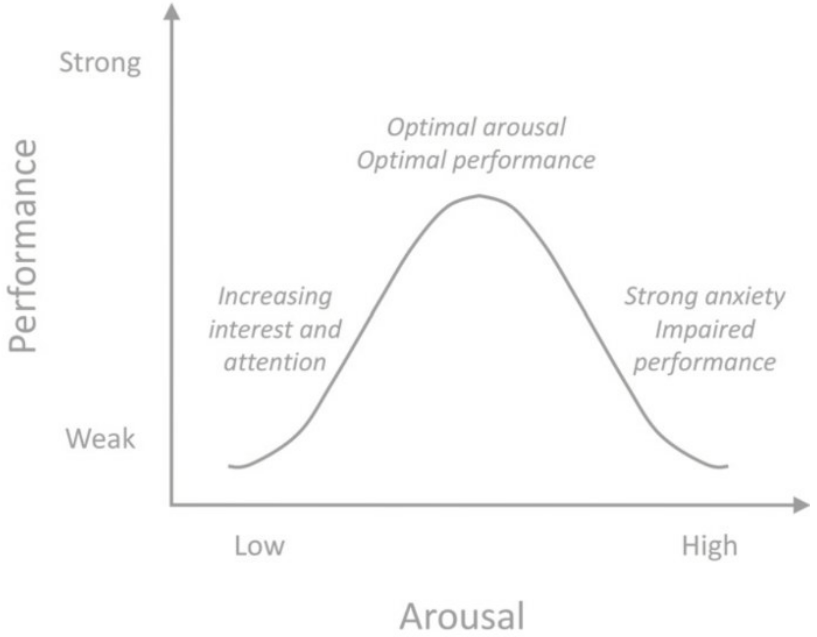
- How has stress affected decision making?
  - yours, as a leader
  - your team or your organisation

Prefrontal cortex

- Stress negatively impacts flexible problem solving, working memory, and energy use by prefrontal cortex

Amygdala

- Anxiety activates amygdala that communicates with prefrontal cortex affecting it negatively



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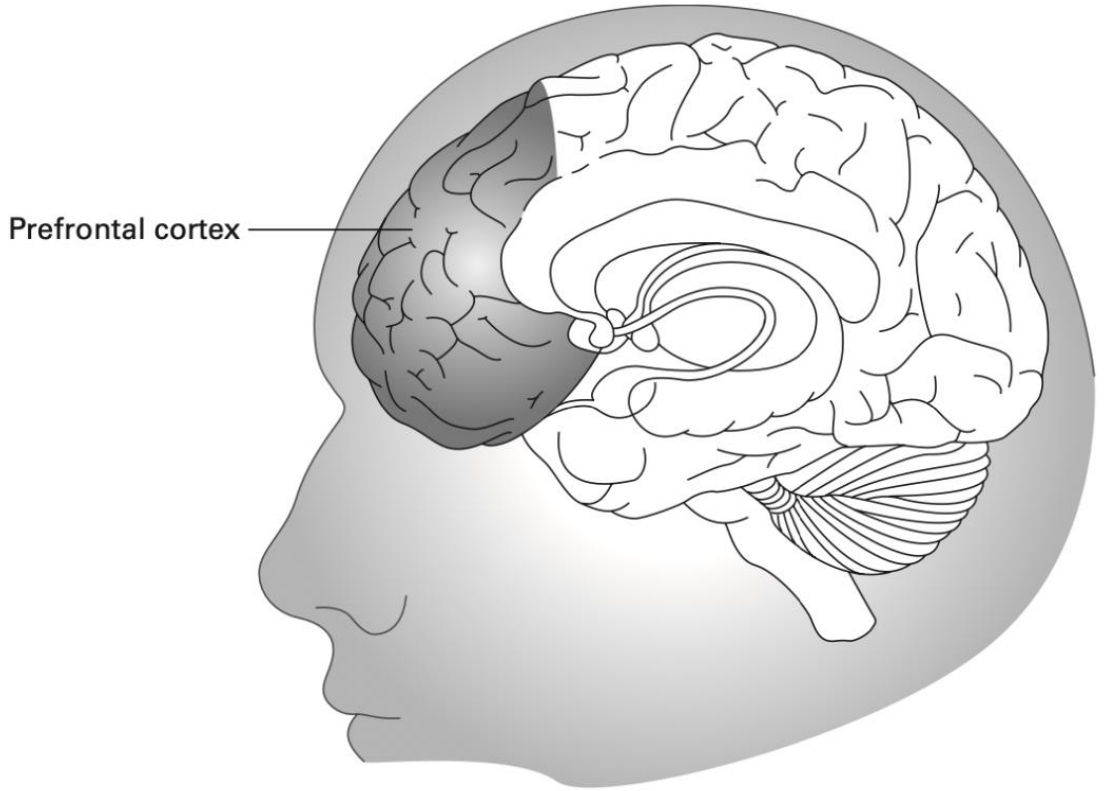
PFC

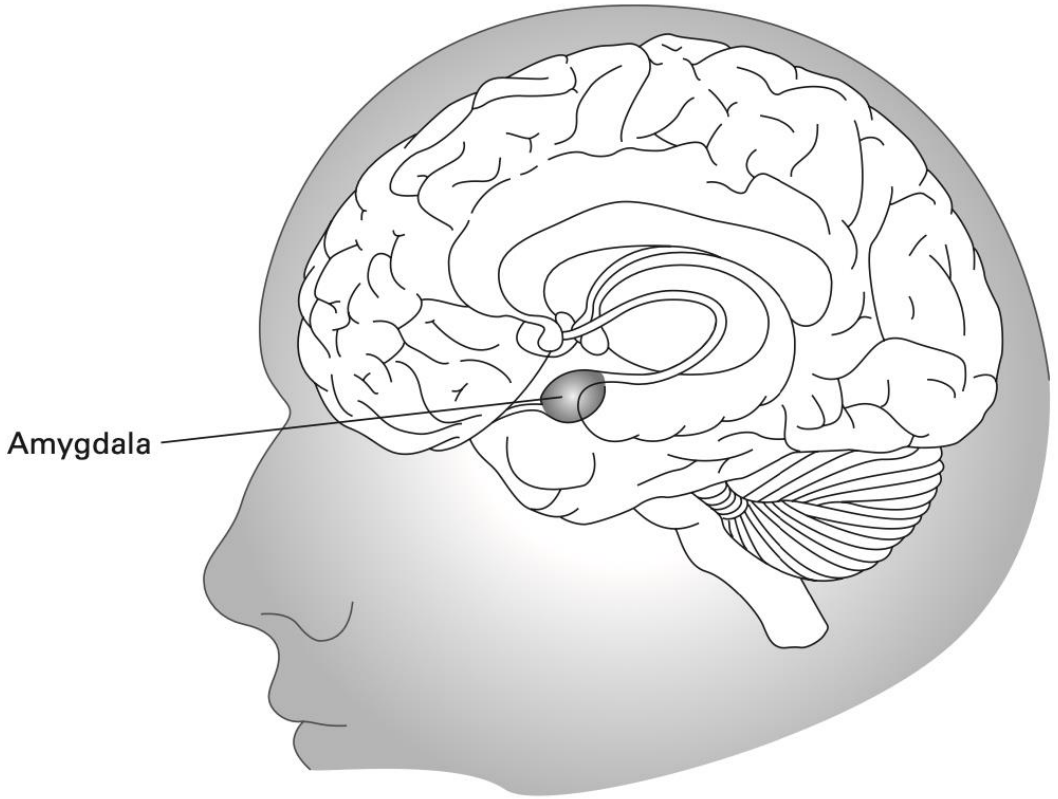
- Focus on one decision and one aspect of uncertainty at a time to encourage focus and not overload prefrontal cortex



Surget et al., 2022

Amygdala

- Ensure that you bring yourself to calm state and acknowledge emotions, so that amygdala does not disrupt prefrontal cortex



Surget et al., 2022

Summary

- decision making is associated with several brain areas and also involves emotions
- too much stress negatively impacts function of these brain areas
- -> work on one decision at a time
- -> reduce stress and acknowledge emotions at the beginning of decision making