The cognitive neuroscience of decision making

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Objectives

- Define decision making as it relates to neuroscientific research and application.
- Describe the neuroanatomical substrates underlying these situations
  - Brain structures
  - Cortico-cortical and cortico-subcortical connections
- Things to consider when hoping to extrapolate to the corporate environment

Types of Decision Making

- Logical analysis in situations of certainty
- Cost-benefit analysis in situations of uncertainty

Cognitive Contributions

- Discriminate between incoming stimuli
  - Habitual actions cued by perceptual information*
  - New incoming stimuli

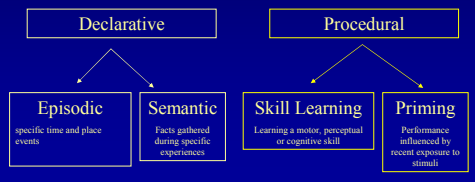
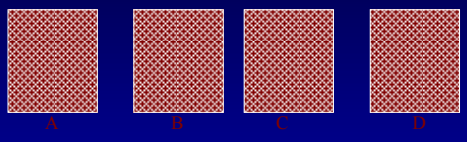


Figure modified from Squires

Cognitive Contributions

- Discriminate between incoming stimuli
  - Habitual actions cued by perceptual information*
  - New incoming stimuli
- Integration of the above stimuli with
  - flexibility in planning
  - values
  - current goals
  - social situation
  - emotions (internal cues & external information)
  - cost-benefit / risk-reward processing

Cost-Benefit Analyses & Static Uncertainty

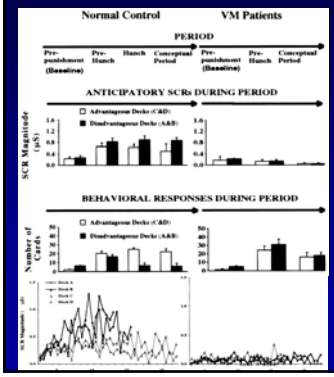


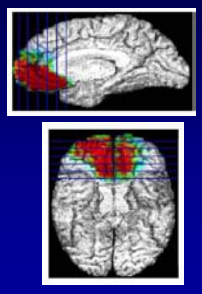
Given a loan of $2000

Told to pick cards with the object of the game being that you should try to win as much money as possible or avoid losing as much money as possible.

Some decks are worse than others. You can win if you avoid the worst decks.

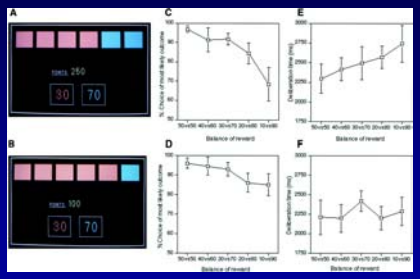
Orbitofrontal Cortex & Skin Conductance Response Testing





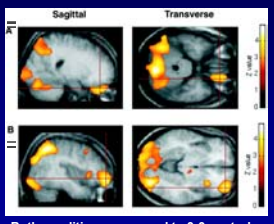
Bechara, A. et al. Cereb. Cortex 2000 10:295-307

Cost-Benefit Analyses & Dynamic Uncertainty



Rogers, R. D. et al. J. Neurosci. 1999:19:9029-9038

rCBF of 4:2 and 5:1 conditions



Both conditions compared to 3:3 control

4:2 vs 5:1

Orbital frontal gyrus	-
Anterior cingulate gyrus	
Ventral putamen region	-

5:1 vs 4:2

Middle frontal gyrus	6

Rogers, R. D. et al. J. Neurosci. 1999:19:9029-9038

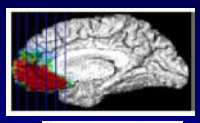
Neuroanatomical Contributions

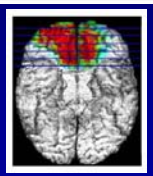
- Orbitofrontal Cortex
  - Processes, evaluates and filters social and emotional information
- Anterior Cingulate Cortex
  - Control and select appropriate behavior, error monitoring

Frontal lobe

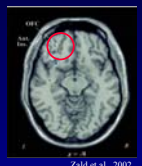
Orbitofrontal Cortex

Frontal lobe

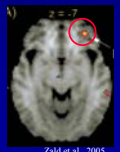




Bechara et al., 2000



Zald et al., 2002



Zald et al., 2005

Anterior Cingulate Cortex

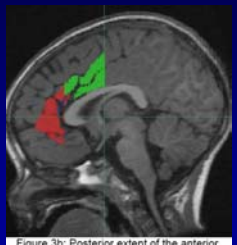
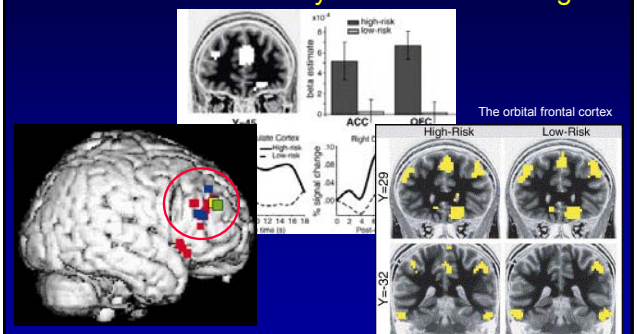


Figure 3b: Posterior extent of the anterior cingulate in the sagittal view

http://www.psychiatry.unc.edu/autismresearch/mri/ROIs/AntCing%20for%20web%20with%20fig.pdf#search='sagittal%20view%20of%20cingulate%20cortex'

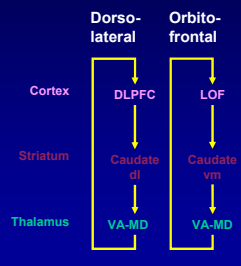
Cortical Connectivity of Decision Making



The orbital frontal cortex

Cohen et al., 2005

Subcortical Connectivity of Decision Making
Basal Ganglia-Thalamocortical Circuits



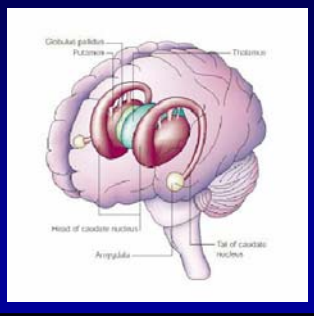


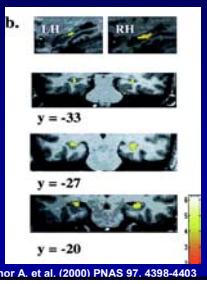
Figure compliments of MRC Human Movement and Balance Unit

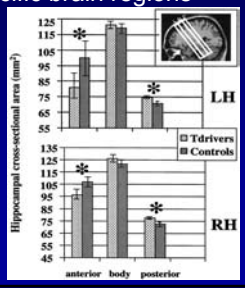
Things to Consider

- Familiarity vs Novel Decision Making
- Element of risk and the role of specific brain regions and their inherent neural connectivity
- Human contributions to consider
  - Most influential in corporate setting

Human Contributions: Expertise

- With expertise comes differences in the structure and recruitment of specific brain regions

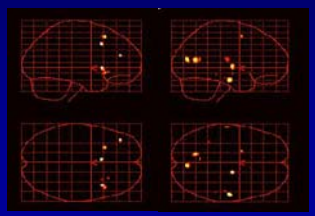




Maguire, Eleanor A. et al. (2000) PNAS 97. 4398-4403

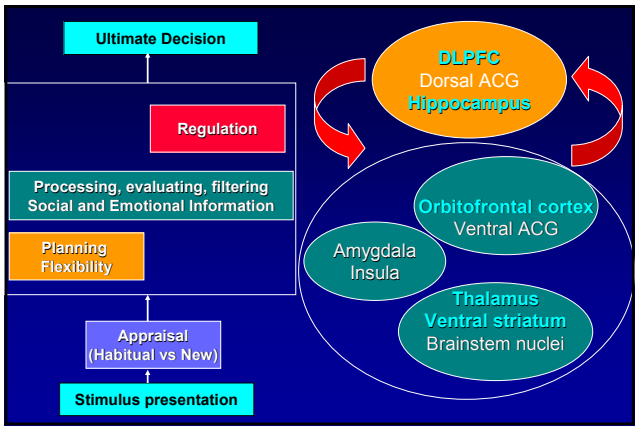
Human Contributions: Age

- With age comes changes in the recruitment of specific brain regions for task completion



Young > Old Old > Young

Lamar et al., 2004



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