Lecture 8

Attention and Emotion

Professor Ian Robertson
Why do civil engineers build bends in roads where there is no physical need to do so?
Mattarella-Micke et al (2011) *Emotion*

![Graphs showing the relationship between working memory and accuracy with low and high math anxiety](graph.png)
Question 2

Why is higher cortisol associated with *better* performance in low maths anxiety students and with *worse* performance in high maths anxiety students?
A Wandering Mind is an Unhappy Mind

Matthew A. Killingsworth, and Daniel T. Gilbert Science 2010;330:932

SART and Emotional Function

![Graphs showing the relationship between TUT rate and various emotional measures.](image-url)
What is sustained attention?
Failures of sustained attention in life, lab, and brain: Ecological validity of the SART

SART predicts everyday mind-wandering
Sustained Attention is strongly linked to Noradrenaline/Norepinephrine.

Noradrenergic Upregulation Selectively Activates Right Prefrontal Regions


• Grefkes et al (2009) Cerebral Cortex

• Chamberlain et al (2009) Biological Psychiatry
Human noradrenergic Markers?

Rajowski et al 1993

Murphy, Robertson and O’Connell 2012
Question 1

Why do civil engineers build bends in roads where there is no physical need to do so?
Because the brain needs *challenge* to sustain attention in the absence of external demand.
Looking up phone numbers

Sorting the charity collection.

Compiling individual bills based on till rolls

Proof-reading the new hotel leaflet

Sorting conference delegate labels into alphabetical order

Hotel task: ‘un-cued’ performance

- **Tasks Attempted**
  - Control grp
  - TBI group
  
  $P < 0.01$

- **Time Deviation**
  
  $P < 0.001$
Hotel task: ‘cued’ performance

- Tasks attempted
  - Control grp: ~4.5
  - TBI group: ~5

- Time deviation
  - Control grp: ~200
  - TBI group: ~150

P = 0.49

P = 0.21
Effects of External Alerting on SART performance – REDUCES right dorsolateral prefrontal cortex activation

significant activations associated with SART condition compared to Control condition, including (A) right middle frontal gyrus (B) bilateral thalamus.

During SART, irrelevant alerting tone DECREASES RIGHT FRONTAL ACTIVATION

O’Connor, Robertson and Levine, under review
**Experimental Design**

- 8 min tDSC-EEG
- 25 s tDSC-EEG

**Enhanced N1 component during real stimulation**

- Real v Sham $p < 0.0005$
- $r = 0.59$

**Reduction in Commission Errors during SART\textsuperscript{fixed} and not SART\textsuperscript{random}**

- Bar charts showing commission errors for SART\textsuperscript{fixed} and SART\textsuperscript{random}

**Neurobehaviour relationship**

- Scatter plot showing change in N1 amplitude block 1 vs. change in percentage of commission errors block 1
- $r = 0.59$
- $p = 0.009$
O’Connell et al, 2008, Neuropsychologia

3A Generalized Self Efficacy Scale (GSES)

3B Elevator Counting with Distraction (TEA)

3C Beck Depression Inventory (BDI)

3D Total Deviation Time (Hotel Task)

- Self-Alert Training (SAT)
- Control Training (CT)
Question 2

Why is higher cortisol associated with *better* performance in low maths anxiety students and with *worse* performance in high maths anxiety students?
Roozendaal et al (2006) PNAS

- Blockade of Noradrenergic Activity Prevents Corticosterone Effects on Memory Enhancement

- Pharmacologically Induced Noradrenergic Activation Mimics the Effect of Emotional Arousal in Enabling Corticosterone Effects on Memory Enhancement
Optimal NA levels needed – too high may disrupt as much as too low.
Comjis et al (2011) The Journals of Gerontology 70–somethings who have more stressful life events over the next 3 years show less cognitive decline.
Results – Follow up

- High and Low Terciles of asymmetry were compared using ANCOVA with same covariates.

**Corresponding Baseline Scores:**
- IR = 10.5
- DR = 10.3
- FR = 35.7
- Rec = 81.7%
Hemispheric Contributions

Figure 3: Contributions of frontal hemispheres at leads (F3 and F4) to performance in memory tests

- **Delayed Recall**
  - Standardized Beta (S.D.): Left ≈ 0.6, Right < 0.1

- **Free Recall**
  - Standardized Beta (S.D.): Left ≈ 0.6, Right < 0.1

- **Recognition**
  - Standardized Beta (S.D.): Left ≈ 0.8, Right ≈ 0.2

Note: Regression models based on full follow up sample. One tailed significance.
Oh the temptation.. video

See: http://vimeo.com/5239013
Delay of Gratification in Children

Walter Mischel, Yuichi Shoda, Monica L. Rodriguez

• Marshmallow test – one now or two later – how long do they wait before cracking?
• Harder when marshmallow present in front of them
• Children used different strategies
• Eg thinking about eating the two marshmallows – or distracting themselves
• Distraction was more effective than thinking about the marshmallow
• But creating a symbolic representation of the marshmallow (‘making a picture of it’) was equally effective
• Control of attention in the interval was crucial in determining delay
• 10 year follow up as teenagers, parent ratings
• Children able to wait longer at 4 or 5
  – more academically and socially competent
  – verbally fluent
  – rational, attentive
  – planful, and able to deal well with frustration and stress
  – Better scores on standardised scholastic tests
Attentional Control as a Gateway to Self–Control?

• Self–control as a gateway to cognitive, social and emotional development?

• See Lecture 10 on lifespan development and control
• attention plays key role in self-control (Baumeister, et al 1994).

• Focusing attention on the self, the repository of personal standards, leads to successful self-control.

• Predicts conditions that take attention away from the self (e.g., becoming anonymous in a large crowd) will lead to loss of self-control.

• prediction that has been borne out in many research studies.
Poor vigilant attention – poor self-awareness in normals

- Self and close other ratings on FRSBE –
- eg I tend to speak only when spoken to”
- “I tend to mix up a sequence, getting confused when doing several things in a row.”
- Hoerold et al Exp Br Research, 2008
Impaired error processing TBI and ADHD

Post-error GSR amplitude difference significantly correlated with total number of vigilant attention errors on SART

O’Connell, Bellgrove and Robertson, 2004; O’Keeffe and Robertson 2004)