Memory, gambling, and planning for the future: Explorations into the avian mind

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Birdbrain

1: Mildly insulting phrase denoting silly behaviour, actions or thoughts usually attributed to a child or immature person
2: scatterbrain
3: a stupid person

Neural Studies

• Memory
• Gambling

Behavioral Studies

• Planning for the future
• Numerical competence

Neural Studies

Background
Grandmother Cells
“Grandmother Cell Studies”
Memory Cells

- Standard Delayed Matching to Sample task
The majesty of the human is owing to the superior faculties [...] that we place in the anterior lobes of the brain."

P. P. Broca, 1861

...of all the processes that fall under the rubric of executive control, one of the fundamental processes is the ability to selectively remember relevant information and discard irrelevant information...
Revised Nomenclature

Classic view

Modern view

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Behavioral Task

• Directed Forgetting version of the Delayed Matching to Sample task

• Cues to remember and forget
  - High tone: Remember the sample (you will be tested)
  - Low tone: Forget the sample (you won't be tested)

Intertrial Interval

Sample

Remember Cue

• Single cell recordings

• Nidopallium caudolaterale considered a functional homologue of the mammalian prefrontal cortex
All delay neurons

The majesty of the pigeon

- The neurons fired when the birds were told to remember and stopped firing when the birds were told to forget.
- Neurons in the NCL participate in one of the fundamental forms of executive control...the control of what should be remembered and what should be forgotten.

“Grandmother Cell Studies”
Gambling Cells

“...[gambling] is a vice which is productive of every possible evil; equally injurious to the morals and health of its votaries. It is the child of avarice, the brother of iniquity, and father of mischief. It has been the ruin of many worthy families, the loss of many a man's honor, and the cause of suicide.”

GEORGE WASHINGTON, 1783

Some General Facts...

- Gambling has been a prominent aspect of social and cultural life since 3000BC.
- In today’s society risky gambling pursuits have become a worldwide epidemic.
- What can be a harmless leisure pursuit or hobby for some can rapidly escalate into a destructive addiction for others causing a myriad of problems that affect psychological, social and physical health.

Do Pigeon Brain Cells Gamble?
Associated Problems

- 70% of pathological gamblers contemplate suicide
- 13-20% of pathological gamblers actually make suicide attempts
- Recent studies indicate that problem gamblers are vulnerable to depression and respond to associated life stressors with suicidal ideation

Over the past 20 years, the accessibility of legal and commercial gambling, such as lotto, horse and dog betting, gaming machines and casino gambling, has rapidly increased worldwide.

Which Type of Gambling is Most Addictive….

- Of all forms of gambling, the one identified as being most problematic and associated with a shockingly high level of gambling addiction is…

Pigeon Pokies

“Reward Proximity” Neurons
Behavioral Studies
Background

“I Won” Neurons

“I Lost” Neurons

"Stimulus, response! Stimulus, response! Don't turn your back on me!"
Behavioral Studies
Planning for the Future

Human beings possess a form of memory (episodic memory) and a form of consciousness ...that no other animals do. They do not exist in insects, in birds, in mice or rats, in cats or dogs, and not even in gorillas and chimps.

Tulving (2005)
Behavioral Studies
Numerical Competence
Algorithms for Rubik’s Cube

1. Fi U Li Ui
2. Ri Di R D
3. U R Ui Ri U F U Fi
4. Ui Li U L U F Ui Fi
5. F R Ui Ri Fi
6. R U Ri U R U Ri
7. U R Ui U Ri U L

The majesty of pigeons

• executive control
• gamble
• plan for the future
• display numerical competence

• code for impulsivity
• hippocampus is a functional homologue
• understand concepts of same and different

“one must then wonder how much of what makes us majestic creatures is present in an organism whose behavior rarely inspires the attribution of high cognitive skills”

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PhD and MSc Students

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