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Review for MIDTERM 2

Mary ET Boyle, Ph.D.
Department of Cognitive Science
UCSD

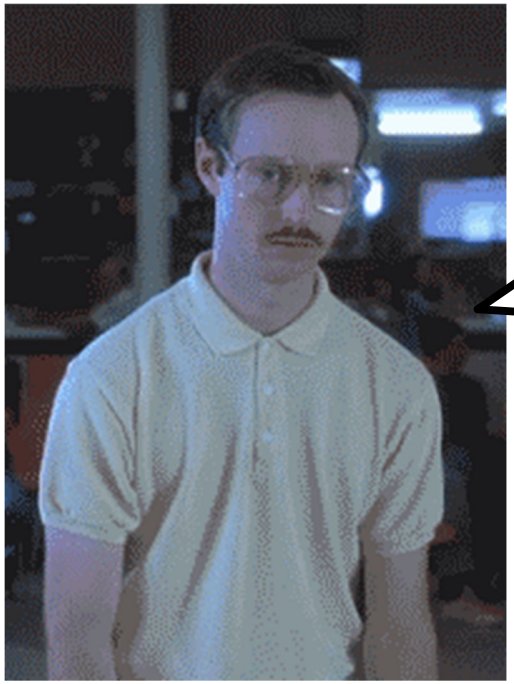
LECTURES...


cogs1
mapping space in the brain
Douglas Nitz – November 20, 2013
4 cm
2 cm


How do we become socially skilled?
Gedeon O. Deák
Department of Cognitive Science
Human Development Program
University of California, San Diego


Thinking with the Body
David Kirsh
Cognitive Science
UCSD


WHAT THE
F
BENJAMIN K. BERGEN



A MIDTERM ON ONLY 4 LECTURES... WOOHOO!

... AND READINGS...

Week 4.

Dr. Doug Nitz -
2014 Nobel Prize Winners-
GPS in the brain.

read

Week 4.

Dr. Doug Nitz -
How do brain cells tell us
where we are going.

read

Week 4.

Dr. Doug Nitz -
Where am I - Where am I
going?

read

... AND READINGS!

Week 5.

Dr. Gedeon Deak -
How Babies Think.

read

Week 6.

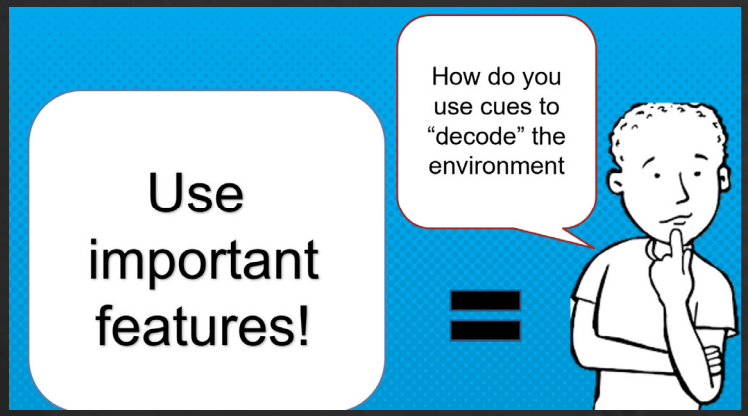
Dr. Ben Bergen -
What Profanity Teaches Us
About Ourselves.

read

Use important features!

How do you use cues to "decode" the environment

=



What rules define space?

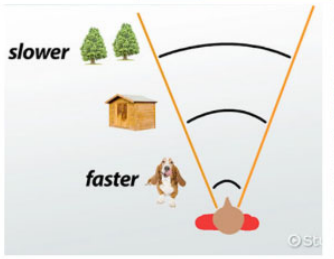
How does your brain know something?

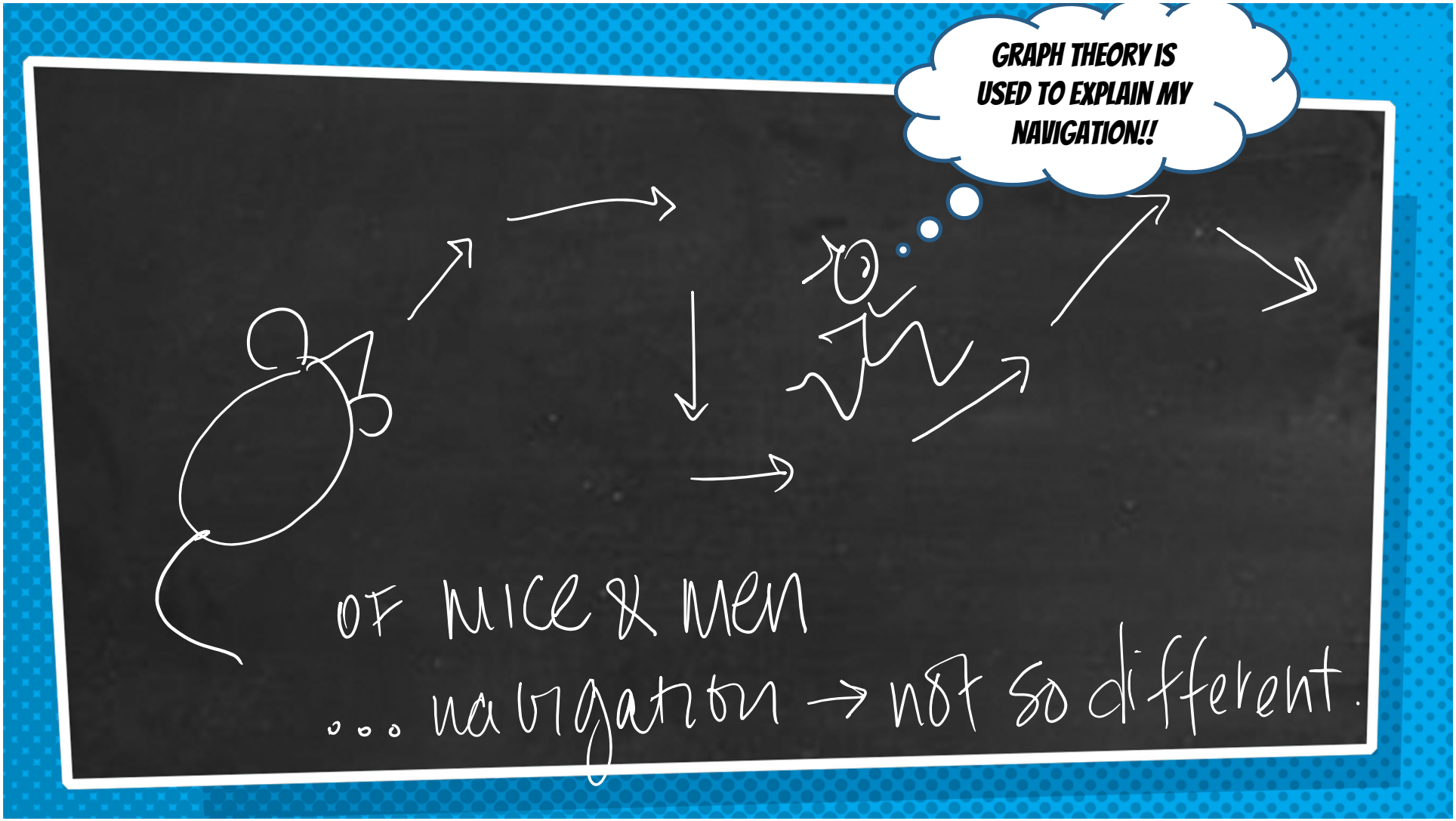
Depth Perception

KEY IDEA: Use of visual cues to "decode" important features of the environment

- Motion Parallax
- Texture Gradient
- Occlusion
- Retinal Disparity

(enables stereopsis)




GRAPH THEORY IS USED TO EXPLAIN MY NAVIGATION!!
OF MICE & MEN
... navigation → not so different.

Strategies:

- Roundworm: Olfactory signals (odor gradient)
- Honey bees: path integration
- Mammals: neural maps

follow the scent

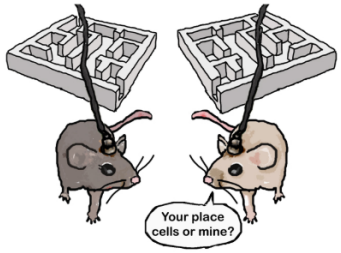
constant monitoring

reflects environment layout & memory


Thank you to our
amazing COGS1 IA/TAs
section slides are GREAT!

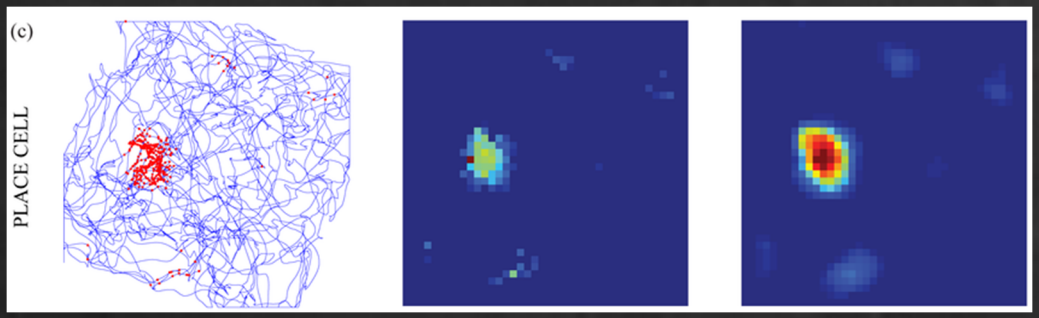
Place Cells

- Tuned to the position of animal in the environment
- Different neurons → different directions (all directions)
- Rotation of the environment = rotation of the place fields



position in the environment

YEP, THAT IS RIGHT!

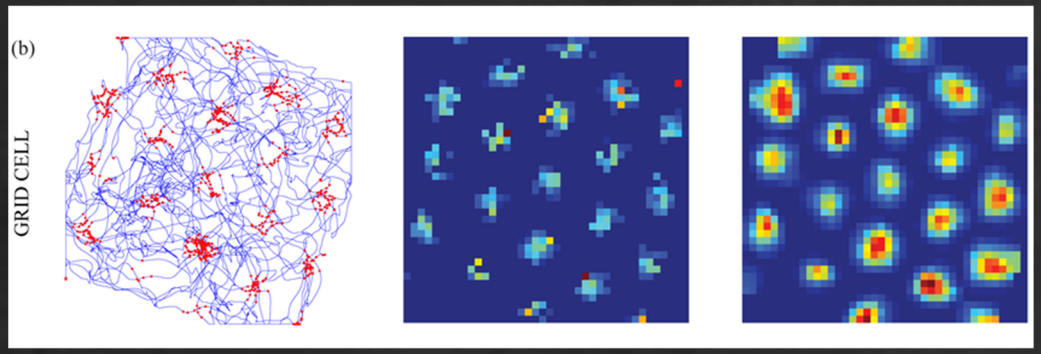


~~environment~~ is important

Grid Cells

- Cells in **medial entorhinal cortex** (MEC)
- Superimpose "coordinate system" onto environment - - nodes arranged in shape of 'tessellated' triangles
- Firing fields ⇒ rotate w/ boundaries of the environment

the pattern of firing remains CONSTANT as environment changes



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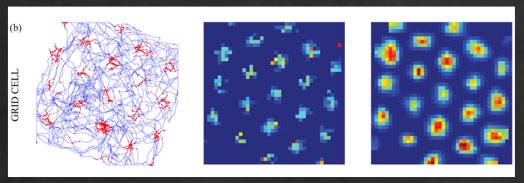


the pattern of firing remains CONSTANT as environment changes

grid cells are constant –

→ in the dark

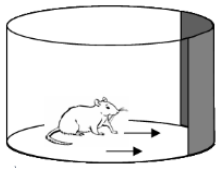
→ independent of speed

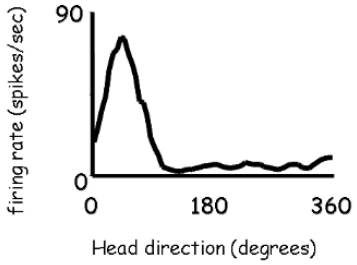
→ independent of direction

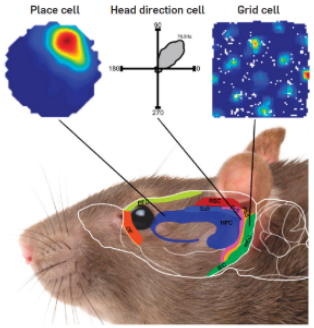
Fire when the animals head is pointing in a particular direction.

E.g: in where the animal is moving.

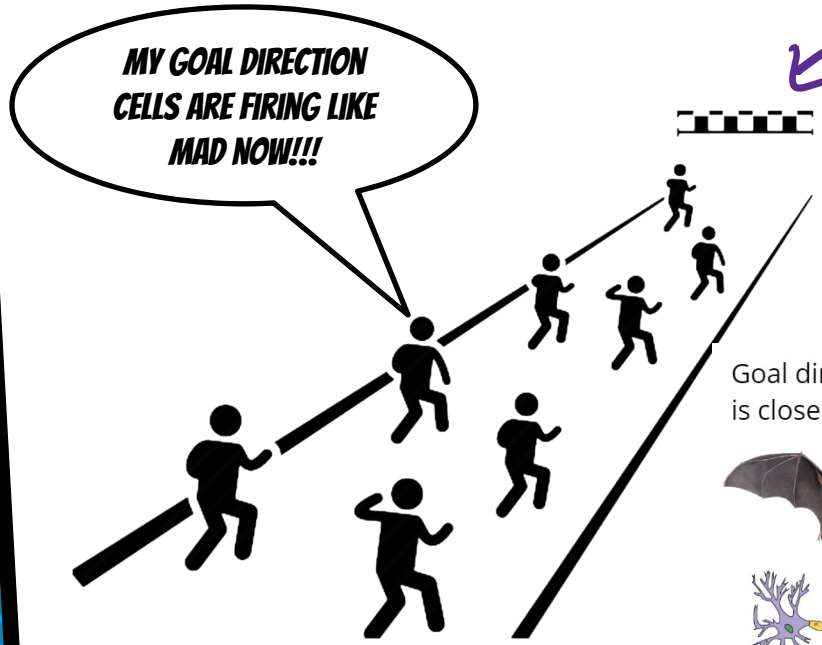
Different neurons → different preferred directions (all directions are represented)





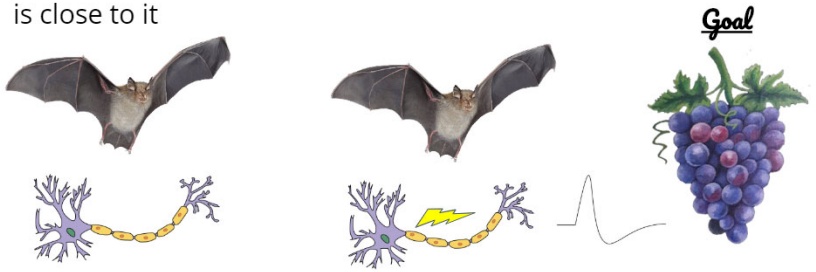


FRAME OF REFERENCE



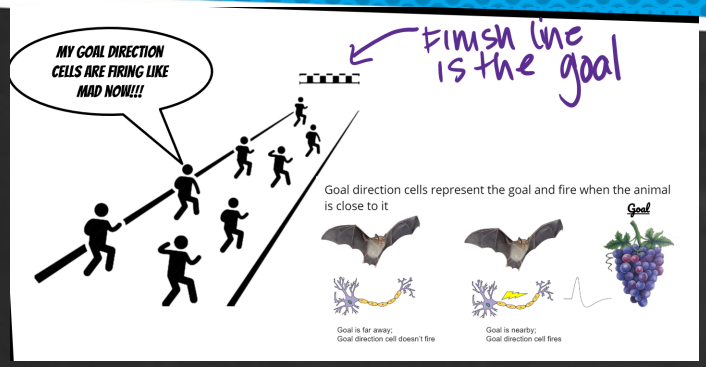
Finish line is the goal

Goal direction cells represent the goal and fire when the animal is close to it



Goal is far away;
Goal direction cell doesn't fire

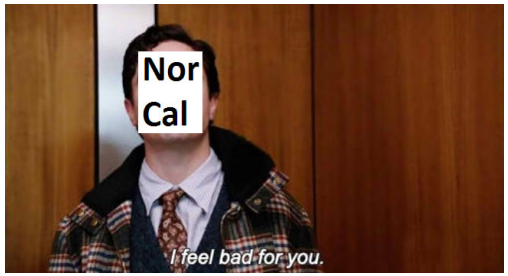
Goal is nearby;
Goal direction cell fires

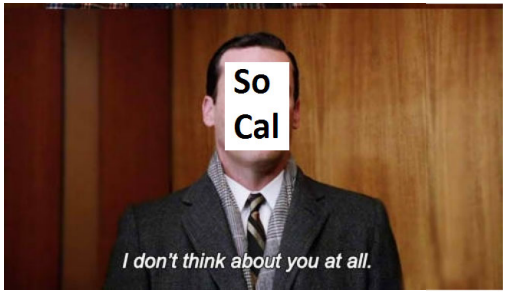


UCSD

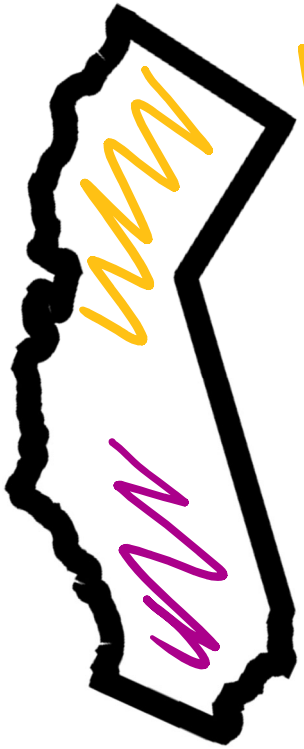
GOAL-DIRECTED are memory based

⊗ do not require sensory info





(Reddit)



NORCAL

Axis tuned cells

SOCAL

AXIS-TUNED CELLS ARE ACTIVE DURING MOVEMENT IN ORIENTATIONS THAT ARE 180 DEGREES APART

Know who did what

	Place cells	Grid cells	Goal Direction cells
Brain area?	**Hippocampus** (O'Keefe & Dostrovsky 1971)	**Entorhinal cortex** (Mosers 2015)	**Hippocampus** (Sarel, Finkelstein, Las, and Ulanovsky 2017)
Animal?			

May-Britt and Edvard Moser

- Discovered grid cells
- Worked in O'Keefe's lab (discoverer of place cells)
- 2014 Nobel Prize in Physiology or Medicine

POWER COUPLE

DISCOVERY SEQUENCE:

1. **Tolman** → cognitive maps
2. **O'Keefe** → place cells in CA1
3. **Ranck and Taube** → head direction cells
4. **Mosers** → grid cells
   a. Entorhinal cortex
   b. Hexagonal pattern of firing
   c. Size of hexagon ↑ moving toward ventral part
5. **Mosers** → speed cells
   a. Firing rates increase in proportion to the speed of movement

WHY STUDY DEVELOPMENT?

It is important for:

Practical Reasons

- Treatment of individuals
- Improve education/parenting
- Help children at risk

Theoretical Reasons

- Understand traits through its emergence

- Kin Recognition
- Parenting
- Communicating
- Hunting/Playing
- Mating
- Aggression/Dominance

Importance of Kin Recognition

- Essential for survival

Evolutionary importance: don't want to misdirect maternal care (high cost, little to no benefit)

- Need to establish:

  Who's my caregiver?
- NOT unique to humans

  Occurs in plants & animals

genes, resources, survival!

PLD

point light display

all about perception!!

Point Light Display Study

- Carried out by Bertenthal et al. (1987)
- 3-month-olds' discrimination of biological motion → walking patterns
- Habituation and dishabituation using canonical vs. scrambled walker

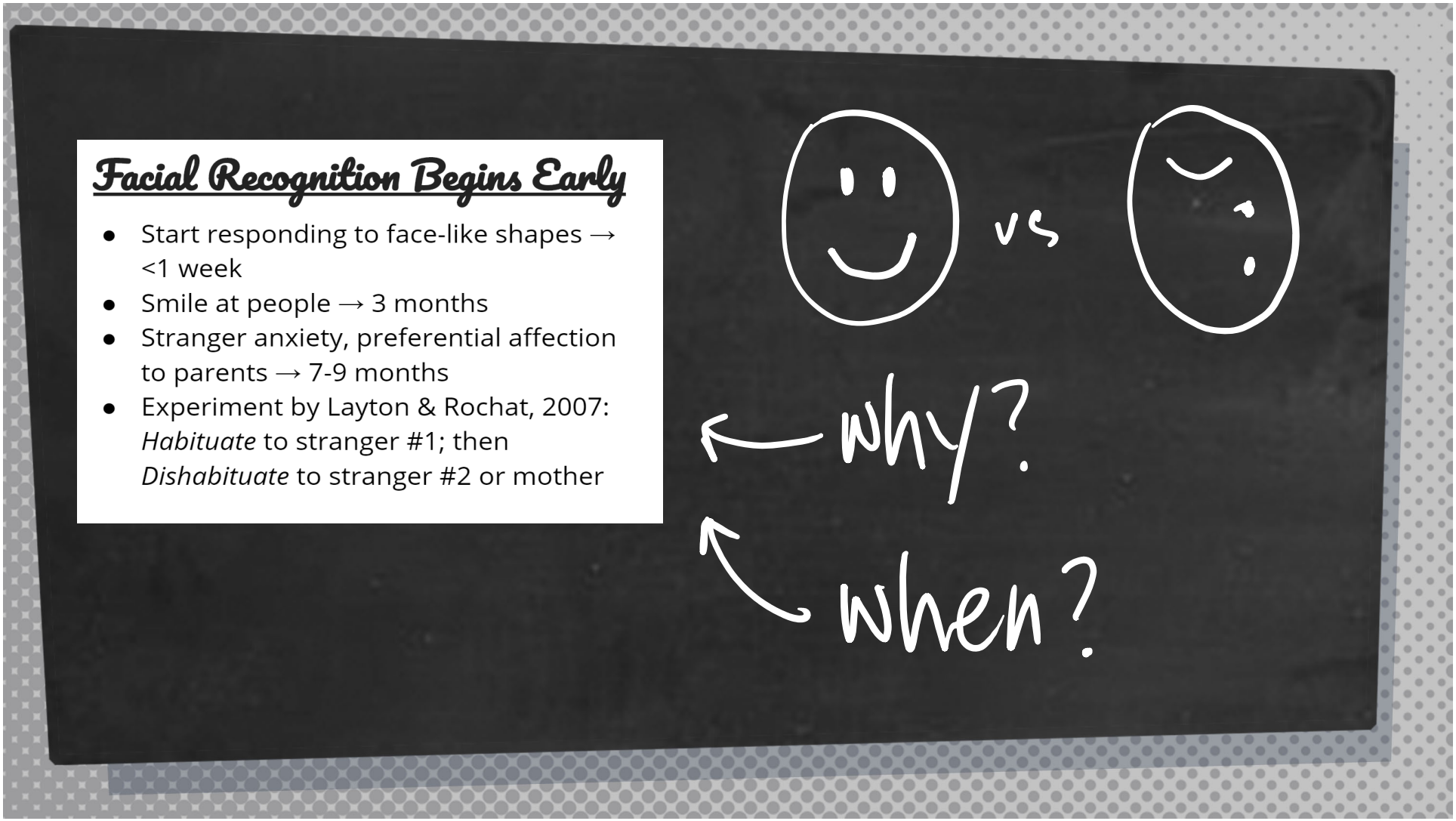
understand this experiment

* habituation

when? how?

Facial Recognition Begins Early

- Start responding to face-like shapes → <1 week
- Smile at people → 3 months
- Stranger anxiety, preferential affection to parents → 7-9 months
- Experiment by Layton & Rochat, 2007: *Habituate* to stranger #1; then *Dishabituate* to stranger #2 or mother

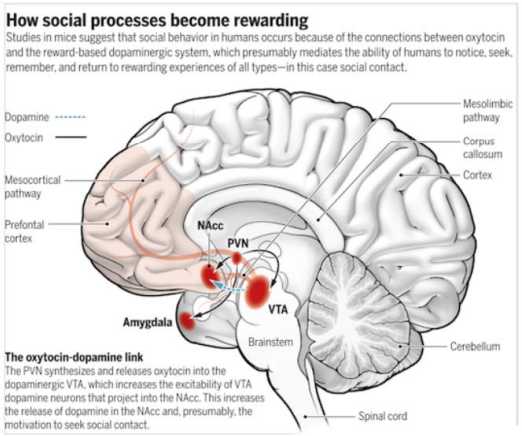


Neural Correlates of Parent-Infant Interaction

Interaction of oxytocin & dopaminergic system ⇒ motivation to seek social contact

Dopamine (DA):
Involved in motivation / reward

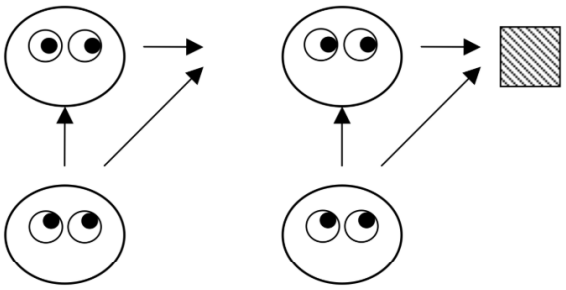
Oxytocin:
Facilitates childbirth-related processes, promotes social behavior



Learning! ↘

Social Gaze in Non-Human Primates

- Evidence for gaze following
  - Found in primates e.g. macaques, chimpanzees, etc.
- Joint attention can also be observed these species.



1. Gaze Following vs. 2. Joint Attention



Statistical pattern ⇒ in developmental context: **identifying regularities vs. discrepancies in the environment**

- Draw conclusions about the world

Example from your reading:

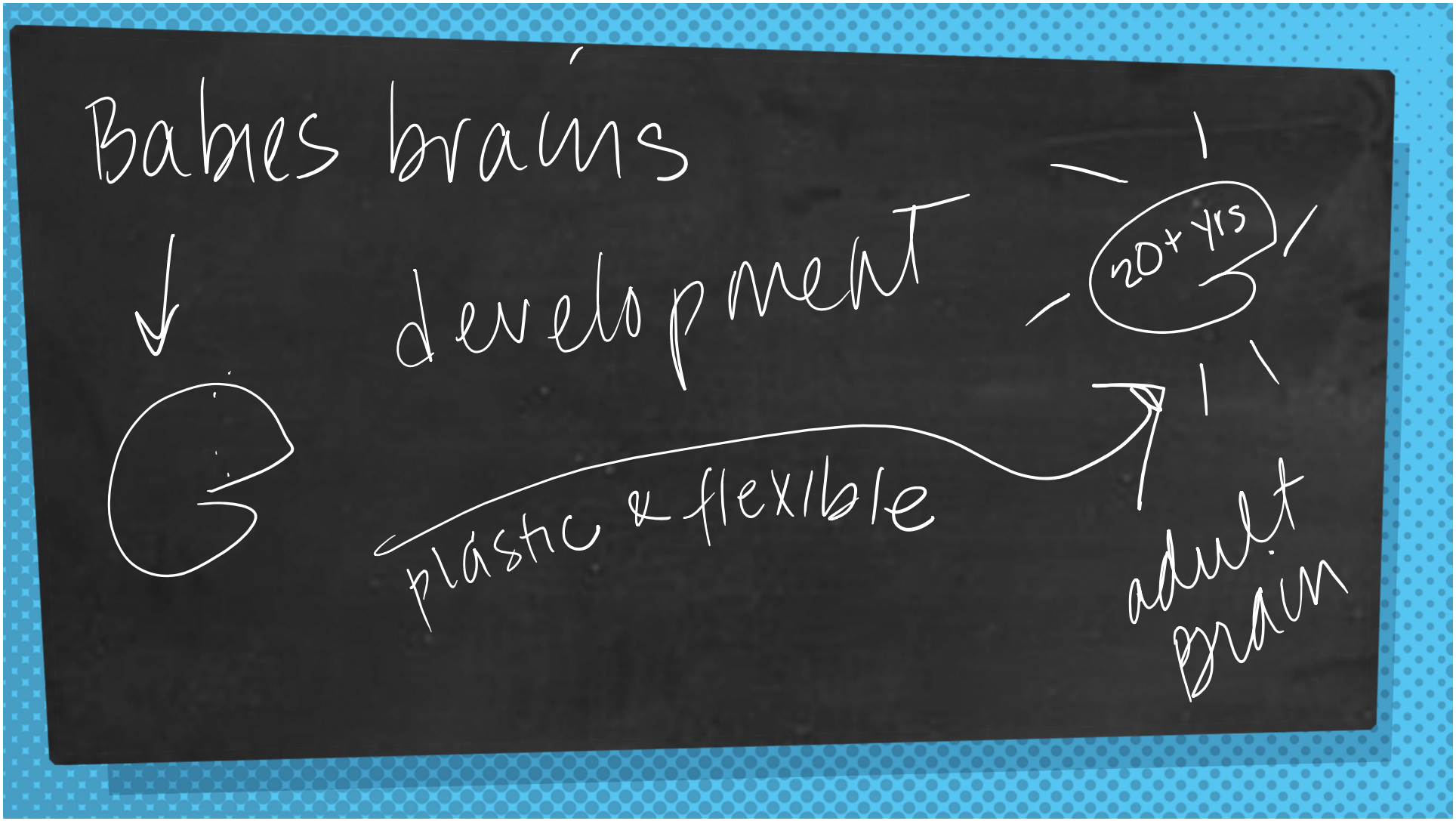
- **Grammatical patterns**
  - Study by Saffran, Aslin & Newport (1996)
  - Play syllable sequence, some are more likely to follow than others (e.g. "ro" follows "bi" ⅓ of time, while "da" always follows "bi")

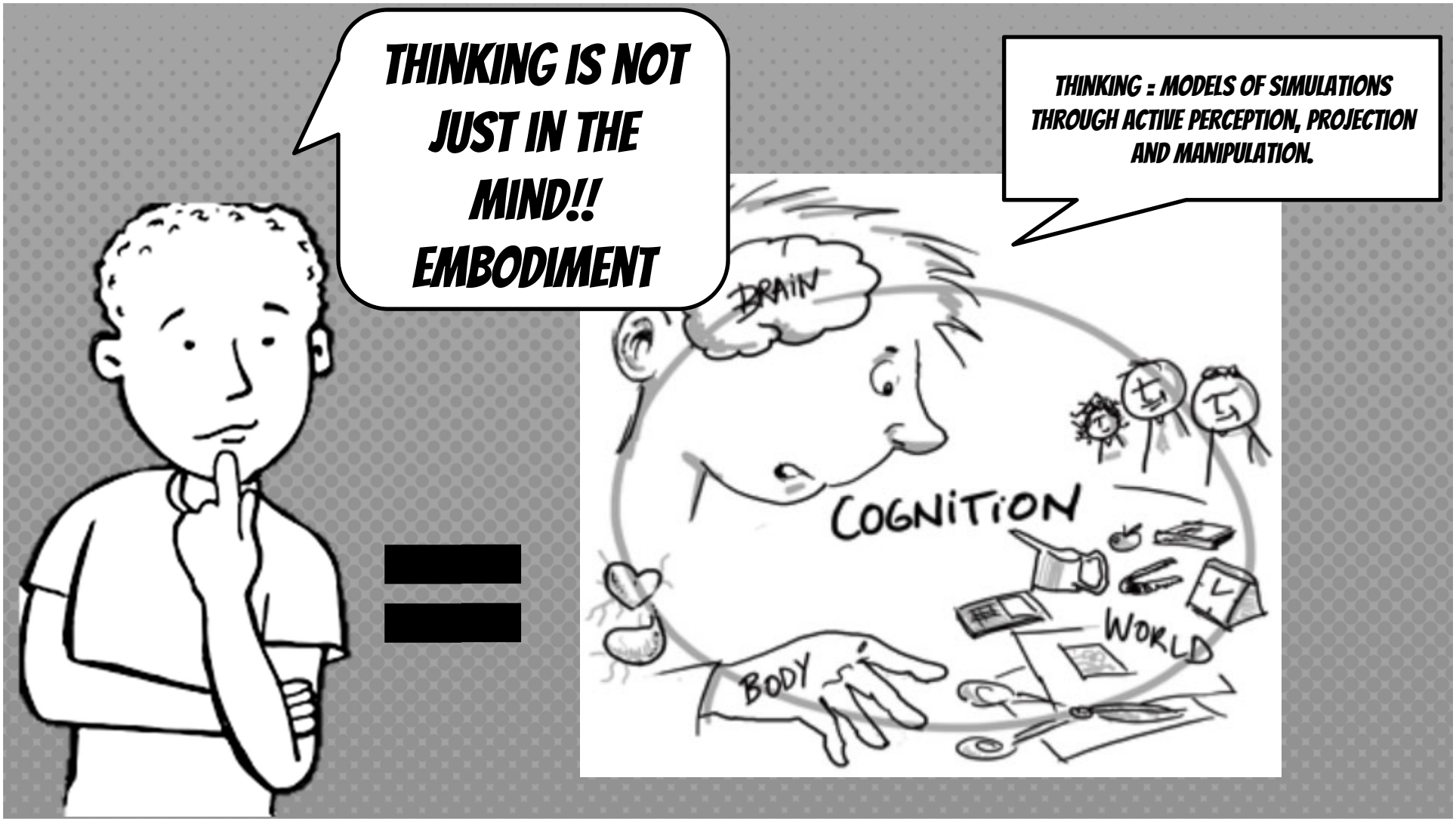
Babies listened longer to the statistically improbable syllable strings!

Baby Scientists

↙ cause & effect

↳ novelty is interesting


Babies brains
development
20+ yrs
plastic & flexible
adult brain

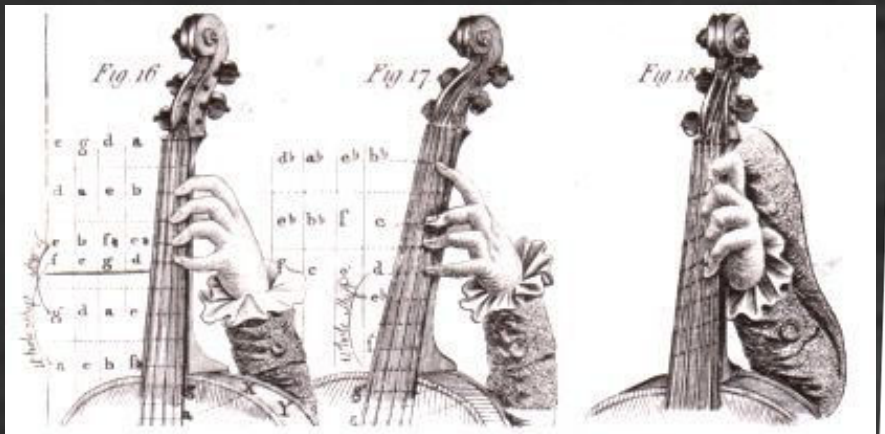

THINKING IS NOT JUST IN THE MIND!! EMBODIMENT
THINKING = MODELS OF SIMULATIONS THROUGH ACTIVE PERCEPTION, PROJECTION AND MANIPULATION.
BRAIN
COGNITION
WORLD
BODY

Marking

- Abstracts from full
- Focus on specifics
- Less energy compared with full out

Examples

- Tennis swing - by aspect
- Cello - on the arm



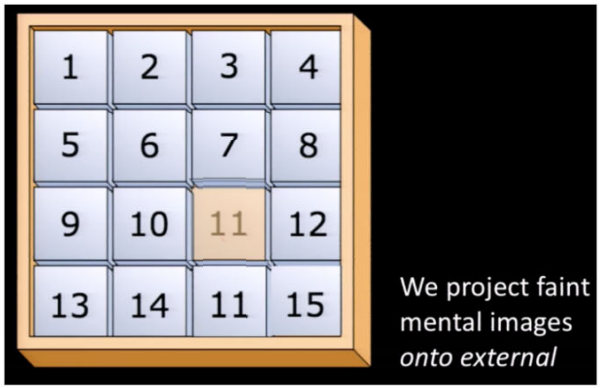
33. Violoncello hand positions from John Gunn's 'The Theory and Practice of Fingering the Violoncello' (1789): 1st position (left), extended position (centre), and the position described by Gunn as 'formerly much in use, and originating probably from the position of the hand on the violin' (right)

Surroundings Enable Externalization

- Interactive mental imagery can be generated through:
  - Gestures
  - Body movement
  - Object manipulation
  - Writing
  - Drawing

Attaching Mental Images To Physical Structures

- Projection ⇒ more powerful than mental imagery alone as we can project beyond what we can readily imagine.
- External structures can be utilized to project with eyes closed or open.



HMM,
WHY STUDY
PROFANITY??

IT CAN TELL US ABOUT --- US!

BRAIN ORGANIZATION
LANGUAGE
CULTURE
RELATIONSHIP WITH OTHER
ANIMALS

Categories of Profanity

- **Contemporary American English**:
  - Religion, copulation, body, slurs
- **Other languages** ⇒ diff categories
  - E.g. animals, diseases

Characteristics

- Word length
  - 4， also 3 and 5, → one syllable
- Consonants ending
  - 95 % of profane English monosyllabic (closed)
- C onset ↔ sC onset

Taboo Words = Dependent on Culture

- Cultural belief / cultural structures for reinforcement
- Eg 1: Japanese ⇒ NO profanity equivalent
- Eg 2: bilinguals ⇒ stronger response to taboo words in native language

Words Can Transform in Meaning Over Time

- Profanity ⇒ constant flux
- E.g. “Dick”
  - 1920’s: Dick = “average guy”
  - Originally a common nickname for Richard
  - Also referred to handle of riding crop (military) ⇒ take on new meaning

Tourette's Syndrome

- Repetitive, stereotyped, involuntary movements and vocalizations
- Eg: coprolalia
- Patients with Tourette's syndrome have different Basal ganglia
  - Fail to inhibit

Basal Ganglia

- Shared with other animals
- Produce sounds to express emotional states

Coprolalia

- Associated with Tourette's Syndrome
  - Involuntary and repetitive use of taboo language

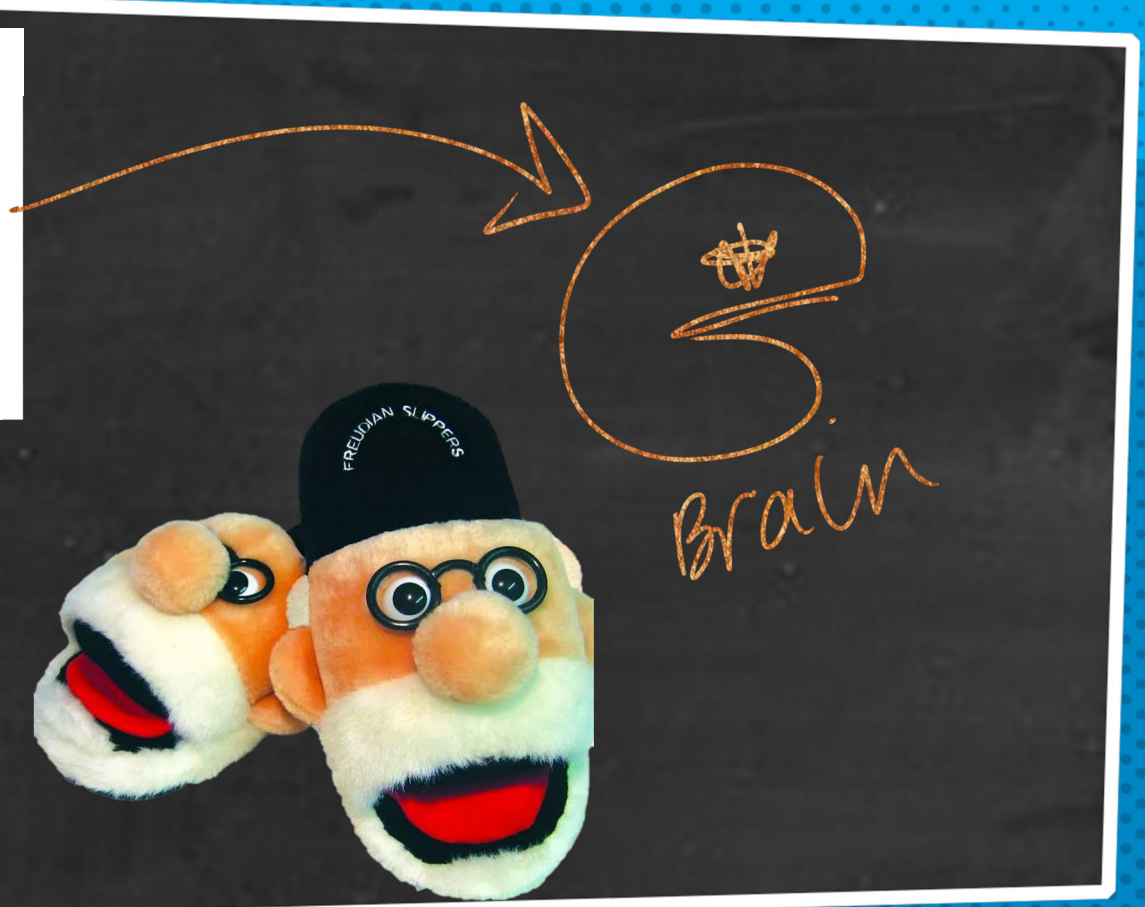
Automatic Aphasia

"could not provide the correct expletive for situations described to him nor could he complete a curse"

Speedie et al., 1993

Right Inferior Frontal Gyrus

- Inhibitory control
  - Stop unwanted things
- Evidence
  - Picture- word interference
    - Censorship from the brain will slow you down



Speech Errors

- Errors → unstated and repressed thought (Freud)
- Through experiment
  - More errors for neutral words

... Brain areas to know

- Entorhinal cortex
- Parietal lobe
- Basal ganglia
- Hippocampus
- CA1 region
- Hypothalamus
- Primary Motor cortex
- Cerebellum
- Hypothalamus
- Right/Left Hemisphere
- Right inferior frontal gyrus
- Prefrontal/frontal cortex
- Broca's & Wernicke's areas

... CONCEPTS TO KNOW RELATING TO SPACE...

- Allocentric
- Egocentric
- Grid cells
- Place cells
- Axis-tuned cells
- Head direction cells
- Goal direction cells
- Graph theory
- Bats, Bees, Rodents, Worms and Humans
- Motion parallax
- Texture Gradient
- Occlusion
- Path integration
- Retinal Disparity
- Routes and paths
- Odor gradients
- Cognitive Maps

... CONCEPTS & TERMS FROM PROFANITY ...

- Syllable structure
  - Open vs. closed
- Coprolalia
- Automatic aphasia
- Tourette's
- Skin conductance
- Speech Errors
- Pain & emotion
- Bilingual/monolingual
- Religion
- Slurs
- Bodily functions
- Cultural relativity

PEOPLE TO KNOW ...

- Lordat
- Broca
- Wernicke
- Patient EC
- O'Keefe
- Moser & Moser
- Sarel, Finkelstein, Las, and Ulanovsky

... CONCEPTS AND TERMS TO KNOW

- Precocial
- Altricial
- Intelligence flexibility
- Probabilistic models and statistical patterns
- Shared attention
- Babies, chimps, bats
- Blicket detector
- Habituation
- Dishabituate
- Point light display
- Kin recognition
  - Face recognition

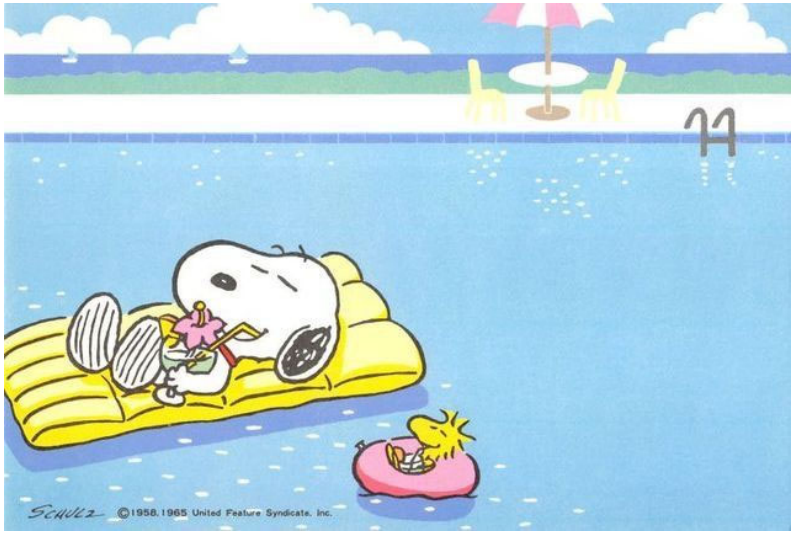
... CONCEPTS AND TERMS TO KNOW

- Embodiment
- Externalization
- Projection
  - modalities
- Marking
- Abstraction
- Tic Tac Toe
- Marking experiment

... Neurotransmitters and Neuromodulators

- Oxytocin
- Dopamine
- Acetylcholine
- Neuromodulators
- Serotonin
- Norepinephrine

STAY WORKING HARD ... SUMMER IS ALMOST HERE!



MIDTERM2 - TUESDAY MAY 21, 2019

- 11:00am – 12:20pm
- Sleep well and study hard.
- You got this!