

The Brain





Phineas Gage



Horrible Accident.—As Phineas P. Gage, a foreman on the railroad in Cavendish, was yesterday engaged in taming for a blast, the powder exploded, carrying an iron instrument through his head an inch and a fourth in circumference, and three feet and eight inches in length, which he was using at the time. The iron entered on the side of his face, shattering the upper jaw, and passing back of the left eye, and out at the top of the head.

The most singular circumstance connected with this melancholy affair is, that he was alive at two o'clock this afternoon, and in full possession of his reason, and free from pain.—*Ludlow, VI., Union.*

Boston Post, September 21, 1848.

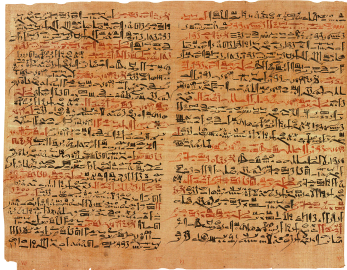
Phineas Gage



You

17th Century BC

Ancient Egyptians report first surgeries, including brain



(Edwin Smith surgical manuscript)

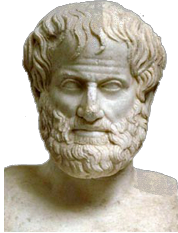


...but didn't seem to think it was very important!

Aristotle (4th Century BC)

Heart: The seat of intelligence

Brain: Cooling mechanism for blood





You

Questions + Themes

What is the relation between **brain** and **mind**?

How does the brain work? How is it **organized**?

How do we **investigate** the brain to answer psychological questions?

Questions + Themes

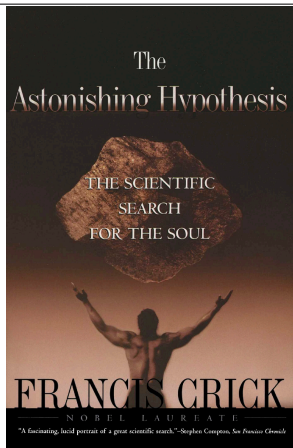
What is the relation between **brain** and **mind**?

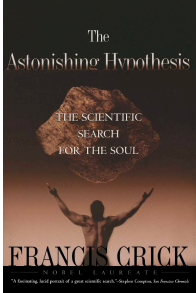
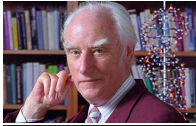
How does the brain work? How is it **organized**?

How do we **investigate** the brain to answer psychological questions?



You





The Astonishing Hypothesis is that **“You”**, your joys and your sorrows, your memories and your ambitions, your sense of personal identity and free will, are in fact no more than the behavior of a vast assembly of nerve cells and their associated molecules...you're nothing but a pack of neurons. This hypothesis is so alien to the ideas of most people alive today that it can be truly called astonishing.

Dualism

The belief that, while bodies are material, minds are **immaterial**



Rene Descartes
(1596-1650)

“I knew that I was a substance the whole essence or nature of which is to think, and that for its existence there is no need of any place, nor does it depend on any material thing ... that is to say, the soul by which I am what I am, is entirely distinct from my body.”

Dualism is a natural, intuitive view...

Dualistic Language

- “my arm” “my hair” “my heart” “my **brain**”

Dualistic Thinking



...but it is wrong about **the mind**

Mind-Altering Drugs



...but it is wrong about **the mind**

Other Animals



...but it is wrong about **the mind**



Brain Damage
=
Mind Damage



Questions + Themes

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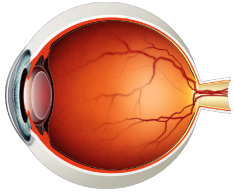
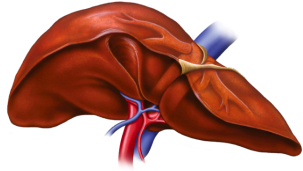
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Recognizes his mother

walked up a long flight of stairs,

saying: "the iron entered there

Pulse at this time 60, soft and regular.



The brain is **organized**

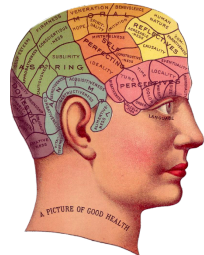


Phrenology



Franz Josef Gall
(1758-1828)

Phrenology



Phrenology

Wrong about
bumps & traits

Right about
localization & specialization

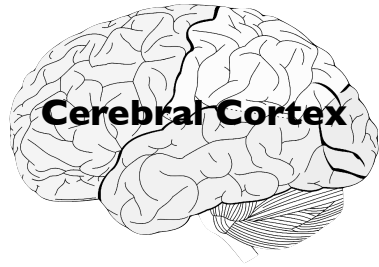


Modularity

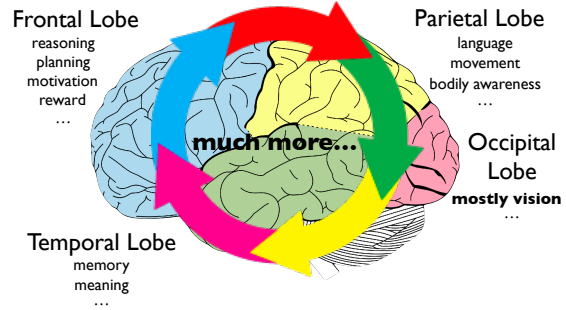
Right about
localization & specialization

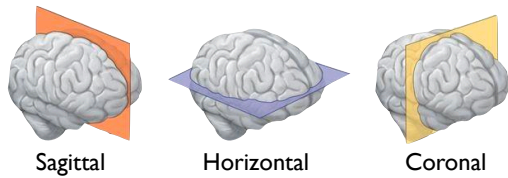


Scales of Organization

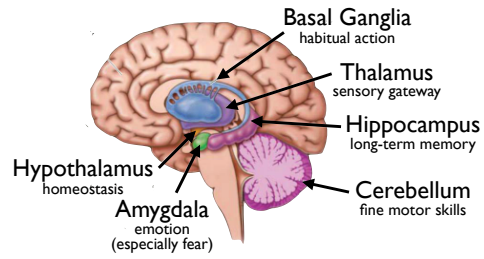


Scales of Organization

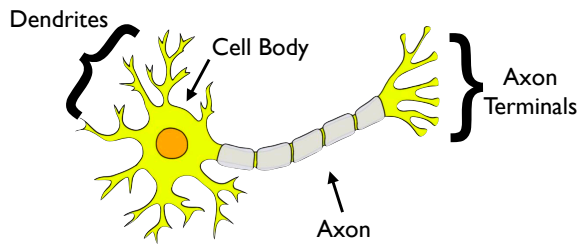




Scales of Organization



Scales of Organization

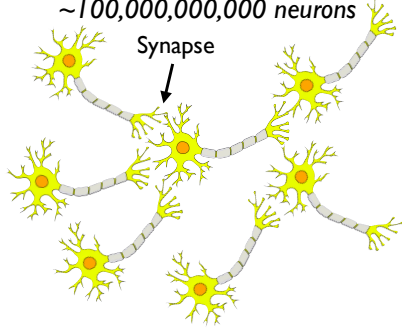


Scales of Organization



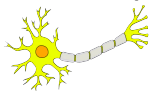
Scales of Organization

~100,000,000,000 neurons





“Brain cells fire in patterns”



1000010111001011000011101001
110110010010011000111100101



Steven Pinker

Questions + Themes

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Questions + Themes

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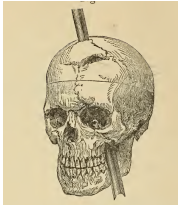
How does the brain work? How is it **organized**?

How do we **investigate** the brain to answer psychological questions?

Studying The Brain

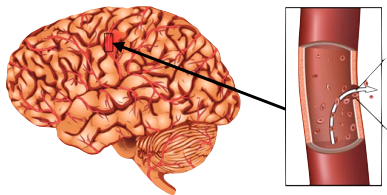
Accidents

“Nature’s Experiments”



Disease & Illness

Stroke



Surgery

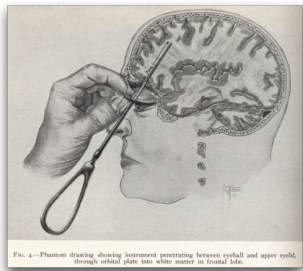


FIG. 4.—Phantom drawing, showing instrument penetrating between eyeball and upper eyelid, through orbital plate into white matter in frontal lobe.

Surgery



Surgery



Treated epilepsy by destroying brain tissue where seizures originated

Under local anesthesia, stimulated brain; asked patients what they felt

Wilder Penfield
(1891-1976)

Surgery



“a mother told me she was suddenly aware, as my electrode touched the cortex, of being in the kitchen listening to the voice of her little boy who was playing outside in the yard”

Wilder Penfield
(1891-1976)

Non-Human Animals



Karl Lashley
(1890-1958)
JHU Class of 1911

**Forever!
A Bluejay!
Goooo, Hop!**

Non-Human Animals



Karl Lashley
(1890-1958)
JHU Class of 1911

Removed pieces of brain from rats

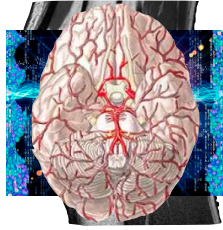
No matter where tissue was taken from, rats could still learn a maze!

Equipotentiality: One part of the brain can carry out functions lost by destruction of other parts

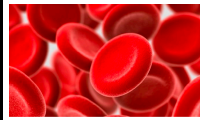
Non-Invasive Techniques?

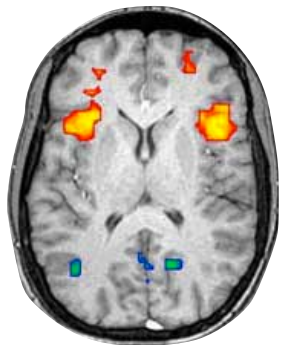
fMRI

functional **M**agnetic **R**esonance **I**maging



fMRI



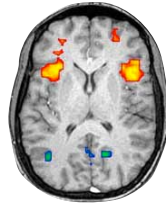


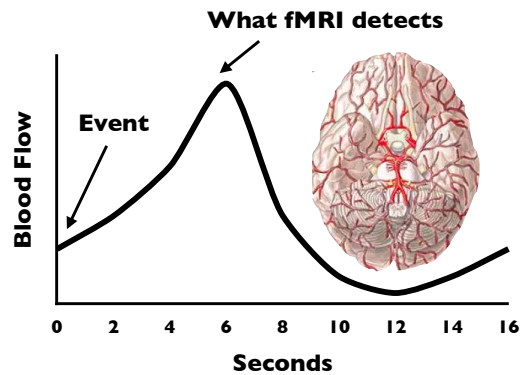
What kind of slice?

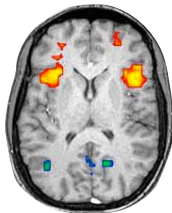
A. Sagittal

B. Horizontal

C. Coronal



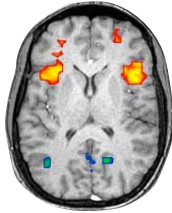




fMRI \neq A direct measure of neural activity

fMRI = A measure of the **consequences**, several seconds **later**, of **many neurons** firing





fMRI \neq **What** your brain is doing

fMRI = **Where** (and **how much**) your brain is doing *something*

Love happens in...your brain!

Brain's regions reveal romance

Researchers using brain scans have found which areas are most associated with feelings of love.

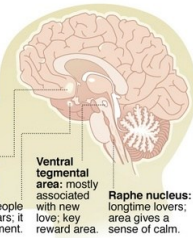
Areas highlighted on scans by type of love:

Nucleus accumbens: those who were madly in love, but recently dumped.

Ventral pallidum: people madly in love after 20 years; it is associated with attachment.

Ventral tegmental area: mostly associated with new love; key reward area.

Raphe nucleus: longtime lovers; area gives a sense of calm.



SCIENCE

Make a Mindless Goof? Blame Your Brain

Observatory
By HENRY FOUNTAIN APRIL 22, 2008



...what else could you blame?



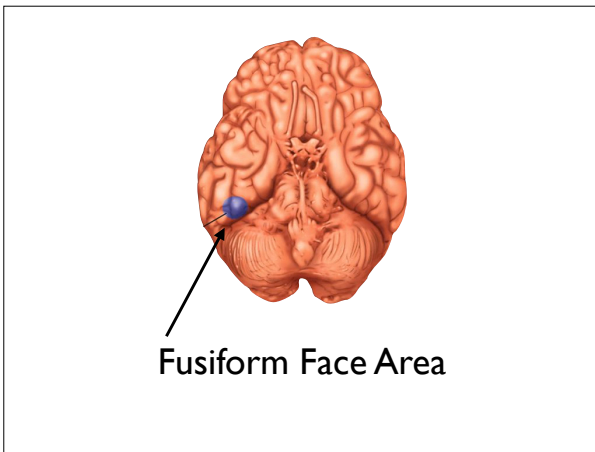
The Fusiform Face Area: A Module in Human Extrastriate Cortex Specialized for Face Perception

Nancy Kanwisher,^{1,2} Josh McDermott,^{1,2} and Marvin M. Chun^{2,3}

¹Department of Psychology, Harvard University, Cambridge, Massachusetts 02138, ²Massachusetts General Hospital NMR Center, Charlestown, Massachusetts 02129, and ³Department of Psychology, Yale University, New Haven, Connecticut 06520-8205

NEW HAVEN, CONNECTICUT 06520-8205
NMR CENTER, CHARLESTOWN, MASSACHUSETTS 02129 AND DEPARTMENT OF PSYCHOLOGY, HARVARD UNIVERSITY,
CAMBRIDGE, MASSACHUSETTS 02138





Faces are processed in your brain

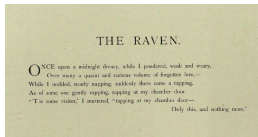
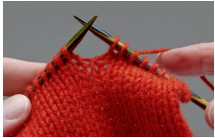
vs.

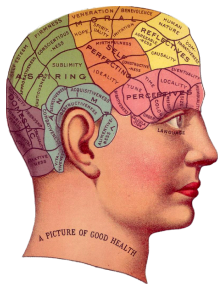
**Your brain has a specialized
“face perception” center**

Areas specialized for...



But not for...





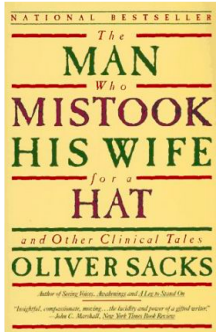
Wrong about
bumps & traits



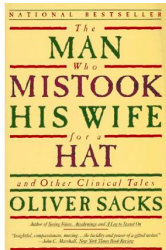
Franz Josef Gall
(1758-1828)

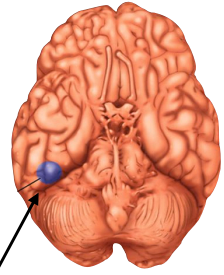
Right about
localization & specialization





Prosopagnosia





Fusiform Face Area

Can fMRI tell us things we **couldn't** know otherwise?

Yes!

1. Plasticity
2. Consciousness

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(1890-1958)
JHU Class of 1911



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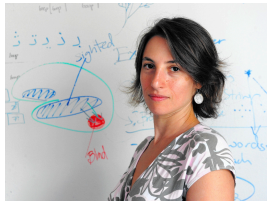
Karl Lashley
(1890-1958)
JHU Class of 1911

Can't do anything like this in humans...

“Visual” Cortex Responds to Spoken Language in Blind Children

©Marina Bedny,^{1,2} Hilary Richardson,² and Rebecca Saxe²

¹Department of Psychological and Brain Sciences, Johns Hopkins University, Baltimore, Maryland 21218, and ²Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139



Marina Bedny
JHU Class of 2001
(Now a Prof. here in PBS!)

Can fMRI tell us things we **couldn't** know otherwise?

Yes!

1. Plasticity
2. Consciousness

Can fMRI tell us things we **couldn't** know otherwise?

Yes!

1. Plasticity
2. Consciousness



Vegetative State

unresponsive wakefulness
"lights are on but nobody's home"

Can recover in weeks, or remain for decades
(**Persistent** Vegetative State)

BREVIA

Detecting Awareness in the Vegetative State


Adrian M. Owen,^{1*} Martin R. Coleman,² Melanie Boly,³ Matthew H. Davis,¹ Steven Laureys,⁴ John D. Pickard²

Знаменитые ученые, люди с высоким уровнем интеллекта, которые работают в области нейробиологии и психологии.

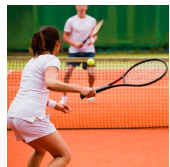
ADRIAN M. OWEN

imagine playing tennis, significant activity was observed in the supplementary motor area (Fig. 1). In contrast, when she was asked to imagine walking through her home, significant activity was observed in the parahippocampal gyrus, the posterior parietal cortex, and the lateral premotor cortex (Fig. 1). Her neural responses were indistinguishable from those observed in healthy volunteers (Fig. S2) performing the same imagery tasks in the scanner (SOM text).

Areas specialized for...



Areas specialized for...



Motor planning



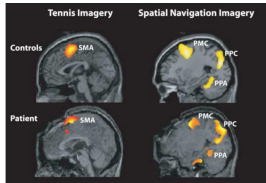
Spatial navigation





“Imagine playing tennis...”

“Imagine walking through your house...”



!!!



“Do you have any sisters?”

YES: Imagine playing tennis

NO: Imagine walking through your house

5/6 questions “correct”!
(6th showed no activity)

Caveats

Just **1** out of **55** patients

5/6 still not that great
(would happen 11% of the time by chance alone)

Could still be a dream-like state
