

Title:

Neuroscience, in
about 50 minutes

Ethan Gahtan

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Professor of
Psychology,
Humboldt State
University




Hello, Arcata
High School

Go Tigers!

Outline:

1. Who I am and what I'm doing here.
2. What is Neuroscience?
3. Why we have brains and minds.
4. Careers in neuroscience.
5. Resources to learn more.


1. Who I am...

		HUMBOLDT STATE UNIVERSITY				
PSYCHOLOGY DEPARTMENT						
Psychology Home Page	Undergraduate Studies	Graduate Studies	Faculty & Staff	Research Participation	Psi Chi & Psych Club	Community Clinic

Ethan Gahtan, Ph.D.
Associate Professor of Psychology
[Curriculum Vitae](#)
[Teaching and Research Interests](#)

Select Projects and Recent Publications are on the CV.

Research interests: Behavioral neuroscience, structure and function of neural circuits, sensorimotor transformations, hindbrain motor systems.



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[Office Hours](#)



Courses I teach:

Behavioral neuroscience, Evolutionary Psychology, Research Methods, Psychopharmacology

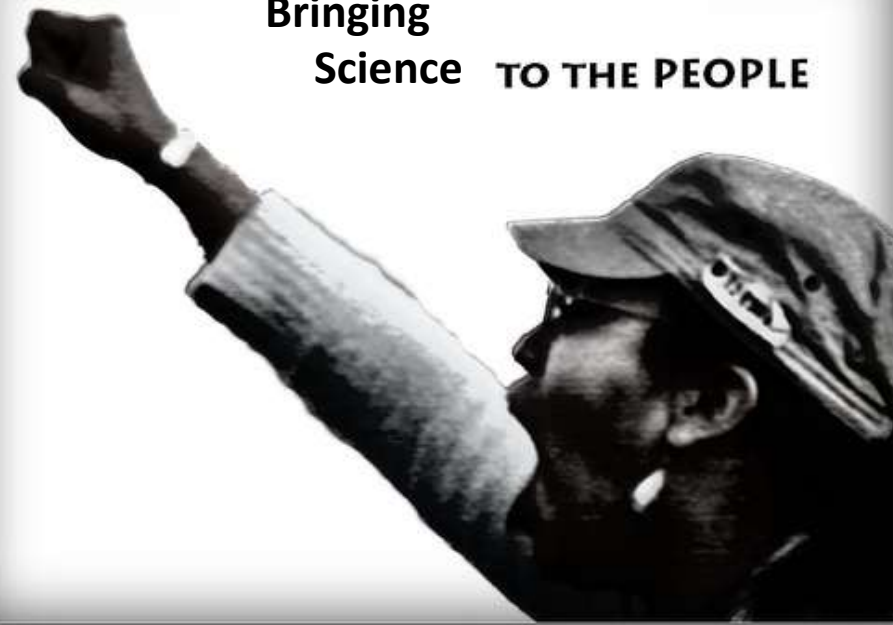
...and what I'm doing here?

SCIENCE OUTREACH

SOCIETY FOR NEUROSCIENCE



Bringing
Science TO THE PEOPLE

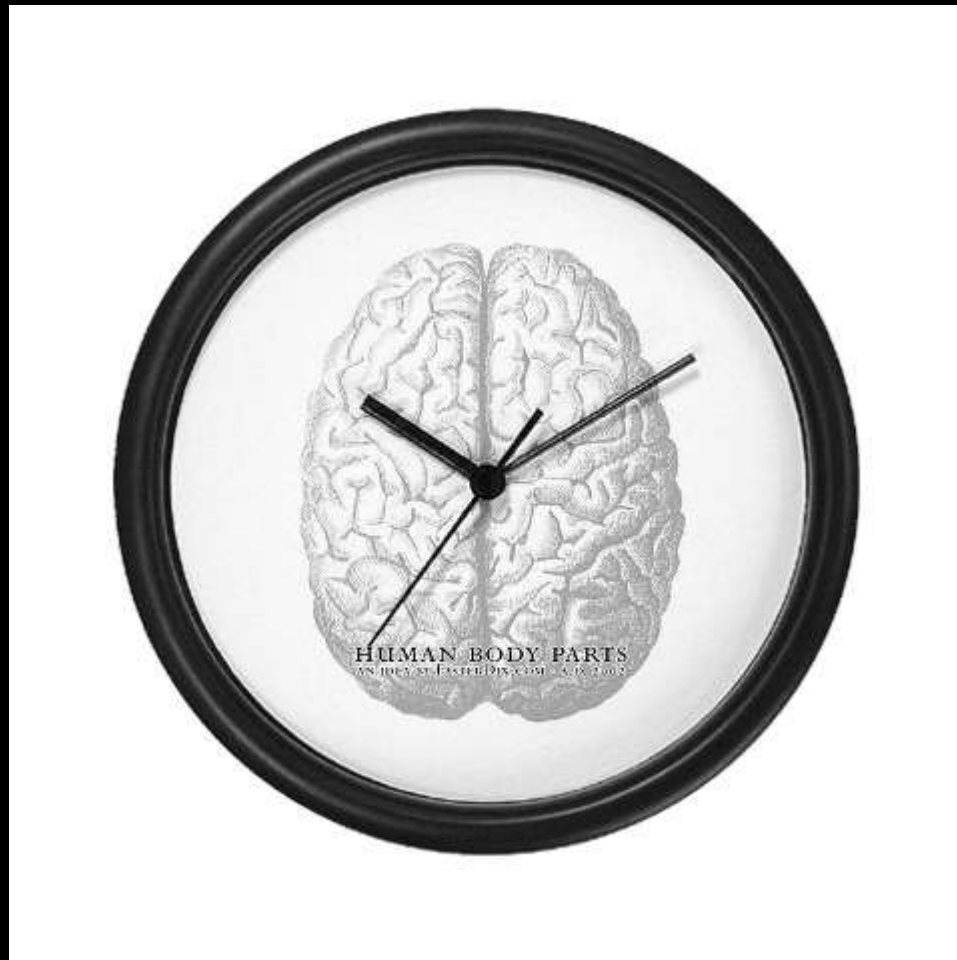


March 14-20, 2011



Neuroscience is an incredibly broad topic!

So what can I tell you about in 50min?



Picture of a brain. This one happens to be my brain



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2. What is Neuroscience?

Narrow Definition – Studying how the nervous system works

SOCIETY FOR NEUROSCIENCE

*Advancing the Understanding
of the Brain and Nervous System*

What is Neuroscience?

Neuroscience, the study of the nervous system, advances the understanding of human thought, emotion, and behavior. Neuroscientists use tools ranging from computers to special dyes to examine molecules, nerve cells, networks, brain systems, and behavior. From these studies, they learn **how** the nervous system develops and functions normally and what goes wrong in neurological disorders.

Biological Variables
(observe or manipulate)



Behavioral Variables
(observe or manipulate)



Neuroscience in the News: February 26 - March 4

Brain Waves Foretell Whether We'll Sleep Soundly *

Science Magazine - March 3

Why does the rustle of sheets wake us up on some nights, but we sleep through the sound of our alarm clocks going off on others?

Study: Scientists Revive Old, Fading Memories

Time - March 3

What would it be like if you never forgot — if your brain were able to access your haziest long-term memories as though they had just been freshly made?

Cerebral palsy cases have dropped

Los Angeles Times - March 3

A study published Thursday suggests that general improvements in the care of infants just before, during and after delivery are making a difference.

Finely tuned minds: The secret of perfect pitch

New Scientist - March 2

Musicians, psychologists and neuroscientists have struggled for decades to work out what causes absolute pitch and whether it really does contribute to exceptional musicianship.

How Brains Guesstimate

Science News - February 28

When the brain can't nail an answer, it falls back on reasonable guesses. Now scientists have evidence that this strategy may happen very early in the processing of sensory inputs.

Thoughtcrime? The ethics of neuroscience and criminality

Ars Technica - February 28

This is not an area that lends itself to easy answers—these are questions that society will have to grapple with as the technology and science gets better.

If your mother has Alzheimer's disease, your brain is at greater risk, researchers say *

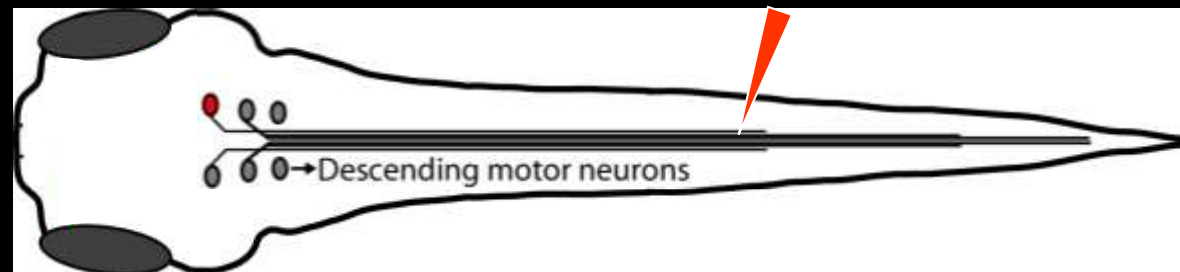
Los Angeles Times - February 28

A new study adds to growing evidence that inheriting the condition from your mother is much worse than inheriting it from your father.

2. What is Neuroscience? – Example of my own research

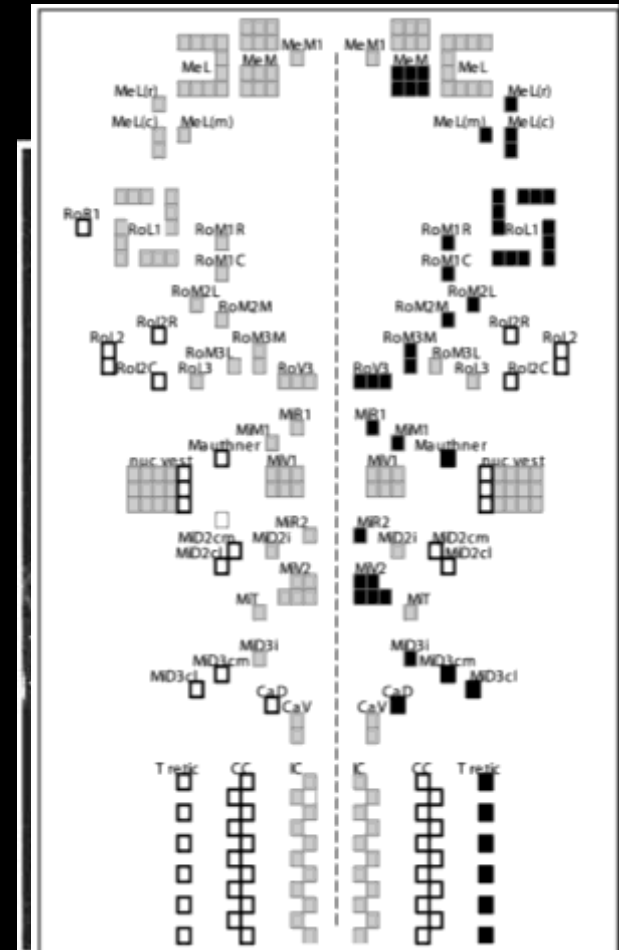
Research question: How do neurons that descend from the brain to the spinal cord control movement?

6 day old larval zebrafish



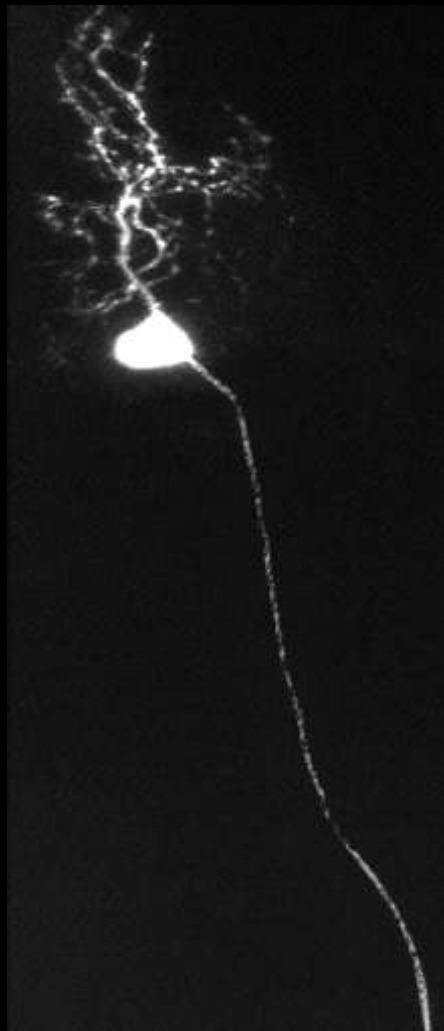
Methods: relate activity of individual descending neurons to sensory-motor behavior

RS neuron schematic



2. What is Neuroscience? – Example of my own research

This neuron is required for visually guided prey capture behavior



9294 • The Journal of Neuroscience, October 5, 2005 • 25(40):9294–9303

Development/Plasticity/Repair

Visual Prey Capture in Larval Zebrafish Is Controlled by Identified Reticulospinal Neurons Downstream of the Tectum

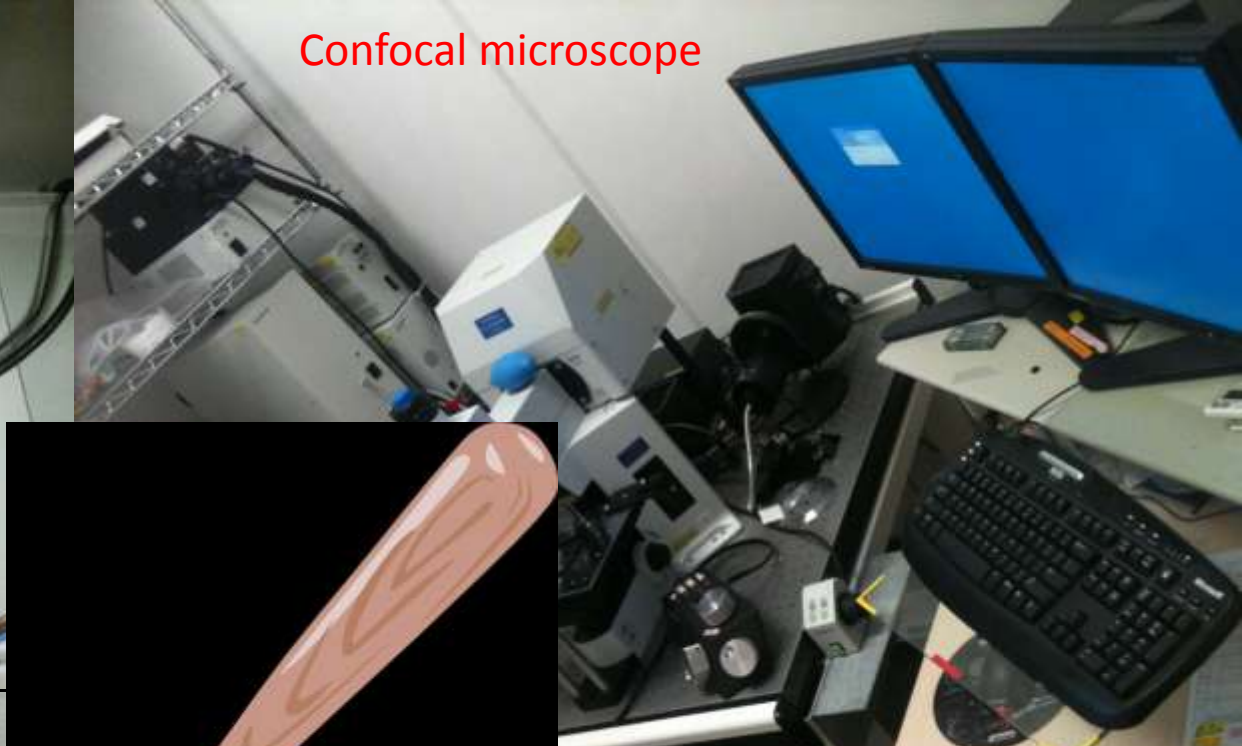
Ethan Gahtan,^{1,2,3} Paul Tanger,¹ and Herwig Baier³

¹Department of Psychology, University of Massachusetts, Amherst, Amherst, Massachusetts 01003, ²Department of Psychology, Humboldt State University, Arcata, California 95521, and ³Department of Physiology, Program in Neuroscience, University of California, San Francisco, San Francisco, California 94158-2722





High speed camera



Confocal microscope



Electrophysiology rig



e

Recap:

Narrow Definition of Neuroscience:

How the nervous system controls behavior and the mind.

There are many 'how questions' still to answer, e.g., in social neuroscience

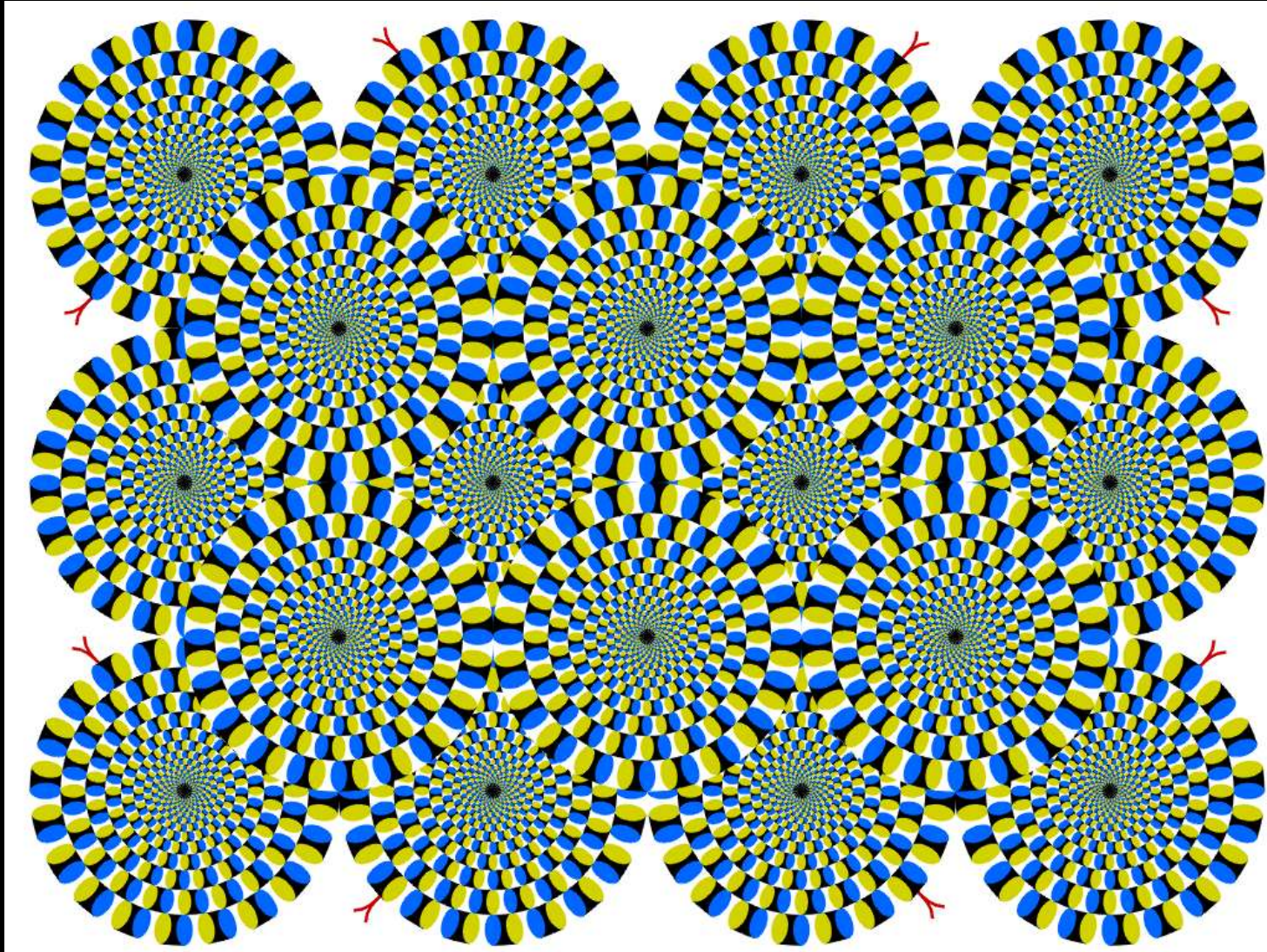
2. What is Neuroscience?

Broad Definition – Studying what makes us who we are

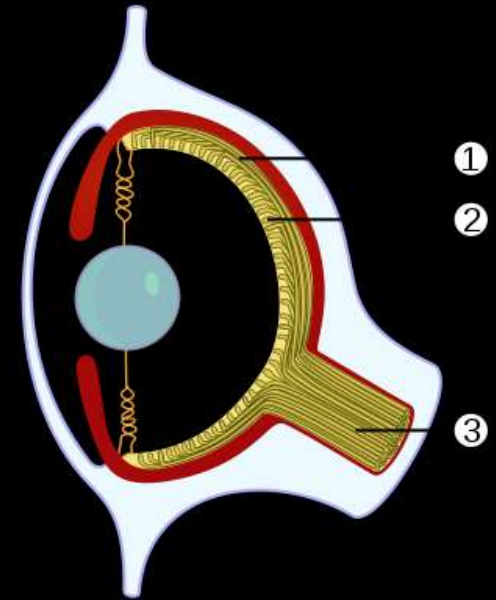
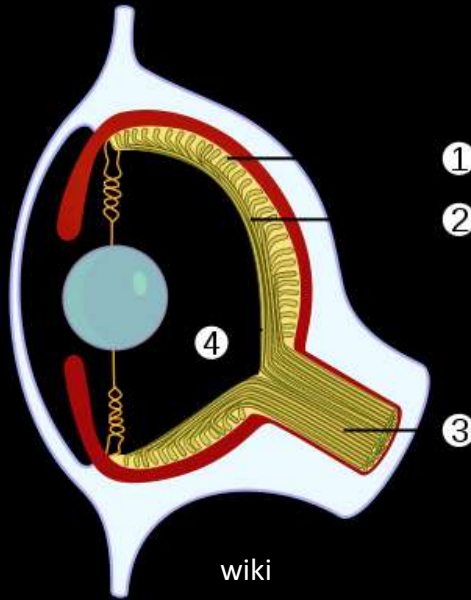
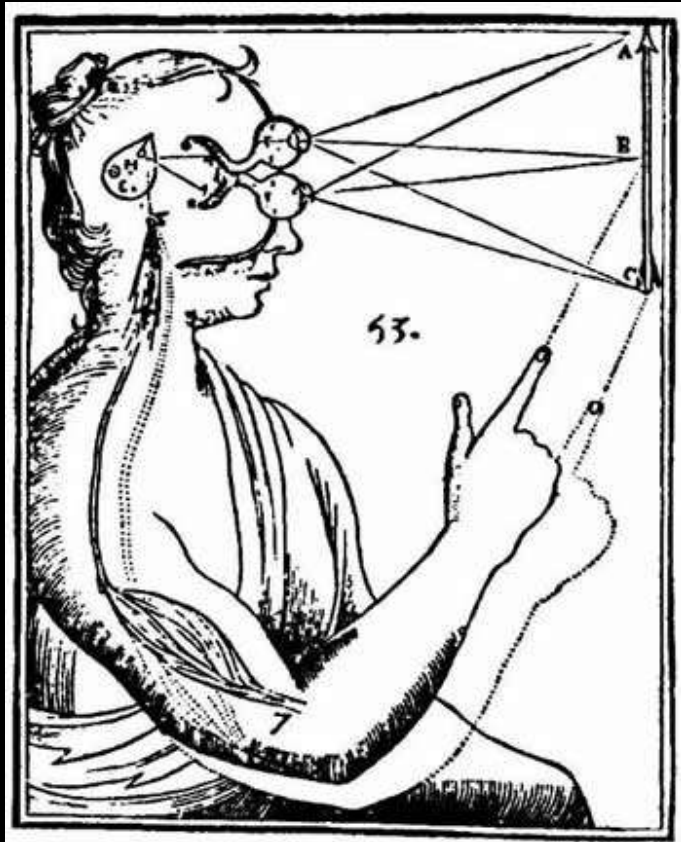


Contrast induced motion

You experience motion but no motion is occurring.
The point: your brain creates the 'reality' you experience.



Blind spot - a gap in photoreceptors where your optic nerve exits the retina. **The point: your mind fills in the gap!**

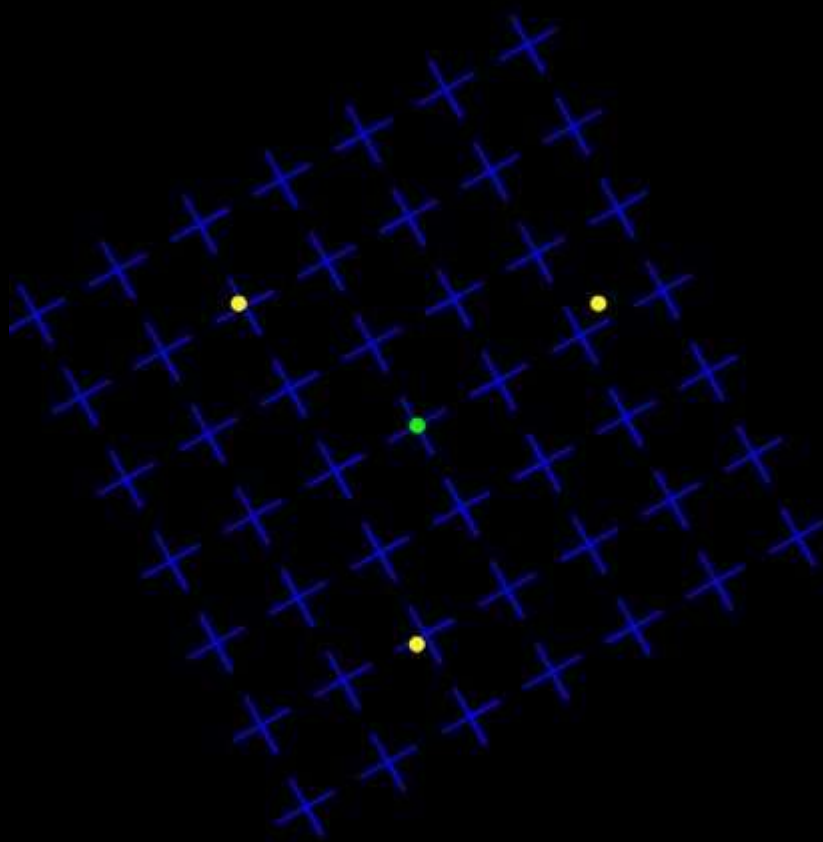


Cephalopods don't have a blind spot – are you jealous?

Another mind-blowing visual illusion

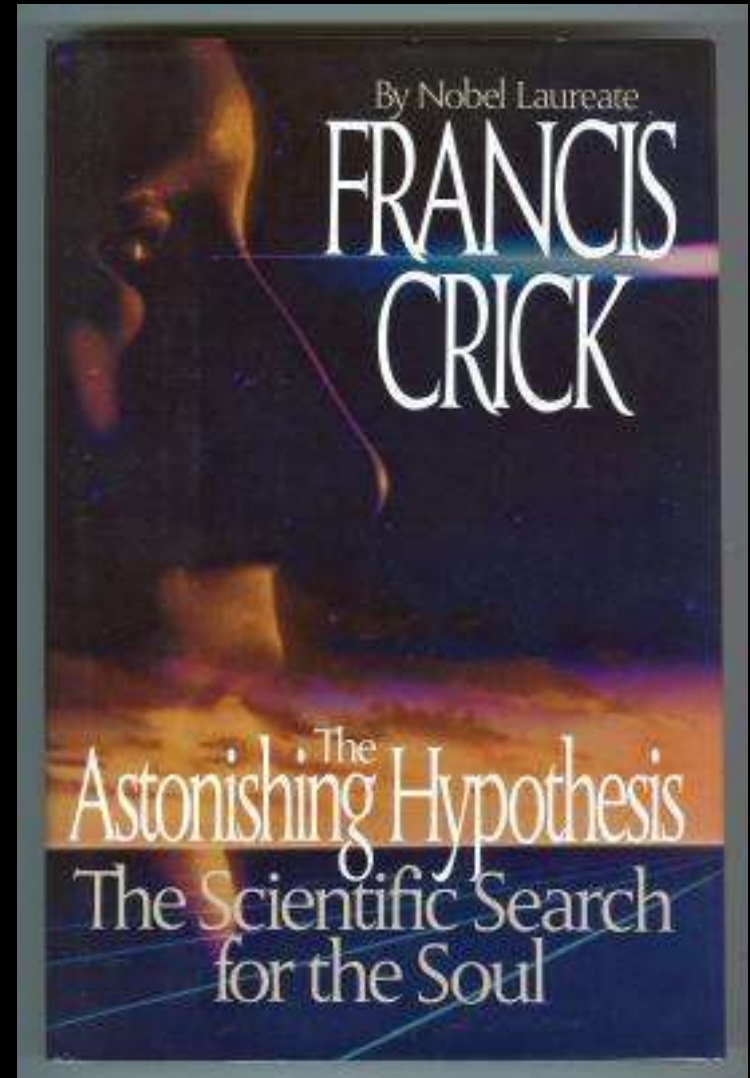
Motion induced blindness:

<http://www.youtube.com/watch?v=vw101eBziHI>



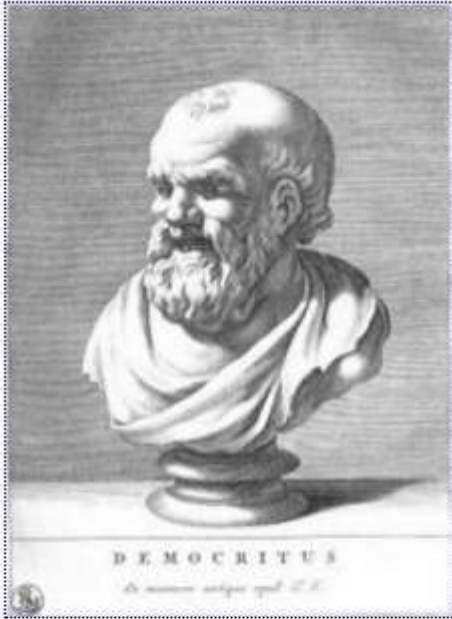
Neuroscience: studying what makes us who we are

"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"



Neuroscience: studying what makes us who we are

Democritus



Democritus

Full name	Democritus
Born	ca. 460 BC Abdera, Thrace
Died	ca. 370 BC (Aged 90)

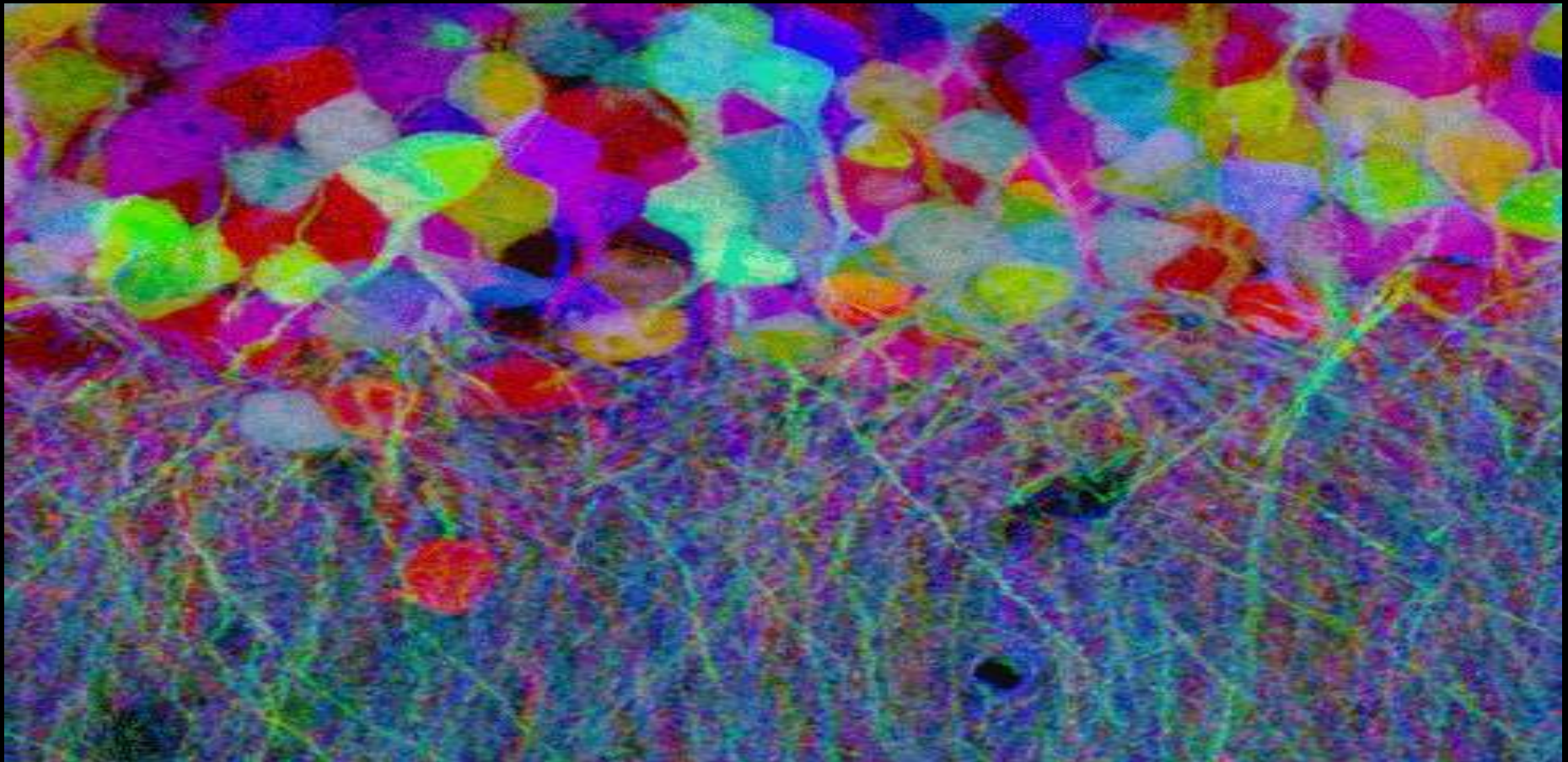
The idea that the brain creates our reality is not a new one.

"By convention sweet and by convention bitter, by convention hot, by convention cold, by convention color: in reality atoms and void."

“The brain is wider than the sky.

For put them side by side the one the other will
contain with ease, and you, beside”

-Emily Dickinson, 19th century American poet



Pyramidal neurons in the hippocampus

Outline:

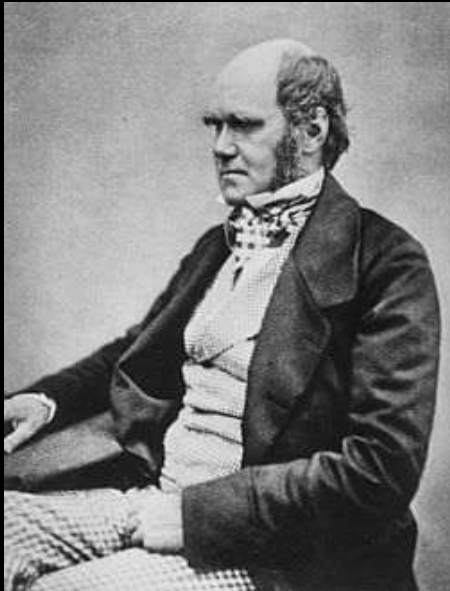
1. Who I am and what I'm doing here.
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3. Why do we even have brains and mental states?

Neuroscience is not a theory. Evolution provides the meta-theory for neuroscience and psychology.

Darwin's key insight:

Natural selection* shapes behavior and psychology just as it does physical body parts.



"Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation."

-Darwin, 1859

"Is it not reasonable to anticipate that our understanding of the human mind would be aided greatly by knowing the purpose for which it was designed?"

George C. Williams

***Definition of evolution by natural selection:**

Differential reproductive success of inherited variants.

4. Careers in neuroscience

- Research
- Education
- Health care
- Biotechnology

Recent Job Postings

ONLINE NEUROSCIENCE CAREER CENTER
NeuroJobs
Only from SfN

[Postdoctoral Associate in Neurology](#)
University of Louisville
Louisville, KY

[Director, Center for Excellence in Learning and Teaching](#)
University of Baltimore
Baltimore, MD

[Postdoctoral Fellow](#)
University of Florida
Gainesville, FL

[Neurosciences Postdoc](#)
UC San Diego
La Jolla, CA

[Project Scientist \(Any Level\)](#)
University of California, San Diego
La Jolla, CA

[View All Jobs](#)

Typical research career path

College

Major: Biology, Psychology, Chemistry, Engineering.
Do research internships.

Graduate School

PhD, MD

Post-doctoral fellowship

2-5 years is typical

Investigator / professor

Being a neuroscientist is fun...

Random Observations from SfN 2010



<http://neurocritic.blogspot.com/2010/11/random-observations-from-sfn-2010.html>

SfN Posterface - UCSD graduate student dance party at the San Diego convention center, Hall Gaga.

But whatever you do, just learning a bit about neuroscience will be illuminating

5. Resources

Lots of information about neuroscience and careers

- Society for Neuroscience: www.sfn.org

Look up neuroscience (and any biology) articles using keyword searches at

www.ncbi.nlm.nih.gov/pubmed

Recommended books about neuroscience

- Steven Pinker (How the Mind Works, others)
- VS Ramachandran (Phantoms in the Brain, others)
- Oliver Sacks (Man who Mistook his Wife for a Hat, others)
- Carl Sagan (Broca's Brain)
- Richard Dawkins (Ancestor's Tale, others)
- many others

Recommended videos about neuroscience

www.pbs.org/wnet/brain/

nobelprize.org/nobel_prizes/medicine/laureates/2000/kandel-lecture.html

www.ted.com/speakers/jim_fallon.html

www.youtube.com/watch?v=M7lE2cl2zFo

THANK YOU!!

Contact:

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Eric Kandel

2000 NOBEL PRIZE
IN PHYSIOLOGY OR MEDICINE

Learning is the means whereby we acquire new working knowledge about the world. Memory is the means whereby we retain that knowledge over time. Our abilities to learn and remember are essential to our sense of self and our ability to function effectively in daily life. Memory is the glue that holds our mental life together. As a result, we are who we are in large part because of what we have learned and what we remember from past experience.

HHMI INVESTIGATOR



Eric R. Kandel

“we are who we are in large part because of what we have learned and what we remember”

NATURAL SELECTION APPLIES TO THE MIND

"Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation." Darwin, 1859

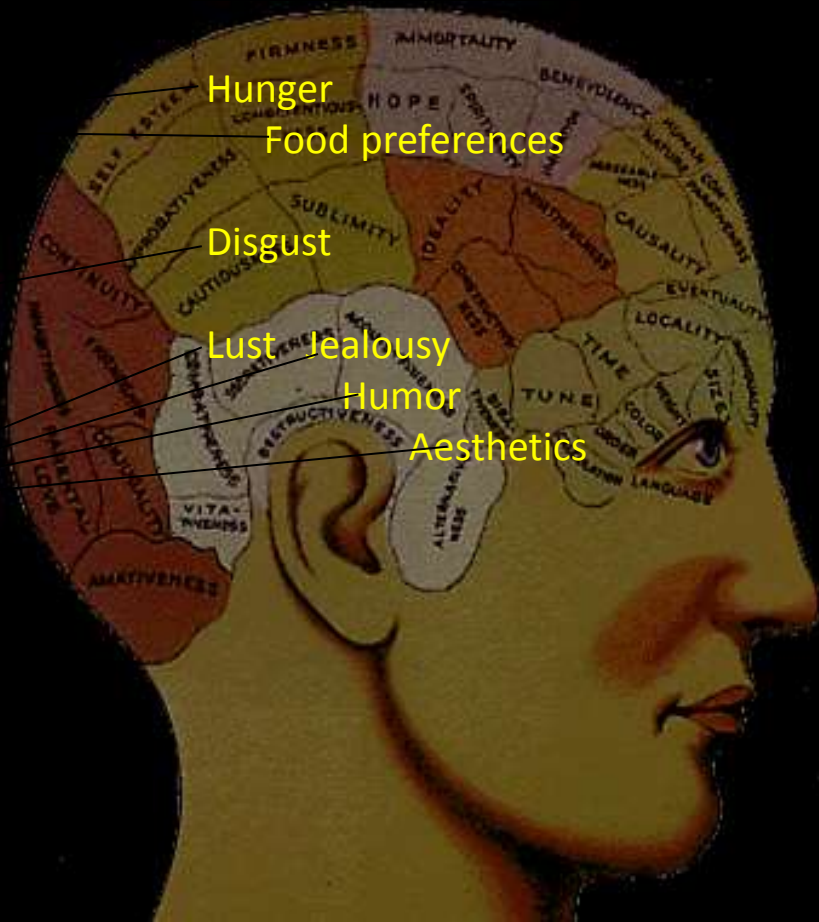
Evolutionary Challenges

Acquire nutrients

Avoid toxins

Reproduce

Psychological adaptations



[Display Settings:](#) ☒ Abstract

Curr Psychiatry Rep. 2006 Apr;8(2):151-7.

The genetics of alcohol dependence.

Dick DM, Bierut LJ.

Department of Psychiatry, Box 8134, 660 South Euclid Avenue, St. Louis, MO 63130, USA.

Abstract

Alcohol dependence is a common, complex disorder, which affects millions of people worldwide and causes considerable burden in terms of interpersonal and societal costs. Family, twin, and adoption studies have convincingly demonstrated that **genes play an important role in the development of alcohol dependence, with heritability estimates in the range of 50% to 60% for both men and women.** A number of studies are under way to identify specific genes involved in the predisposition toward alcohol dependence, and there is reason to be enthusiastic about recent progress. Several associated susceptibility genes are reviewed here, including genes involved in alcohol metabolism, as well as genes involved in GABAergic, endogenous opioid, dopaminergic, cholinergic, and serotonergic transmission. The next challenge will be to further characterize the risk associated with these susceptibility genes, examining how they may be related to comorbid disorders, developmental trajectories of risk, and potential moderation by environmental factors.



Genes, Evolution, and Personality

Thomas J. Bouchard, Jr.,^{1,2} and John C. Loehlin³

How to read the chart:

People differ on these personality traits. ie, there is 'variability' in the population

The numbers are the percentage of variability that can be explained by your genetics alone

Genes, Evolution, and Personality

Table III. Broad Heritabilities of Self-Report Measures of the Big Five Factors^a

	Loehlin review	Jang <i>et al.</i> (Canada)	Waller (U.S.)	Loehlin <i>et al.</i> (U.S.)	Riemann <i>et al.</i> (Germany)
Extraversion	0.49	0.53	0.49	0.57	0.56
Agreeableness	0.35	0.41	0.33	0.51	0.42
Conscientiousness	0.38	0.44	0.48	0.52	0.53
Neuroticism	0.41	0.41	0.42	0.58	0.52
Openness	0.45	0.61	0.58	0.56	0.53
MZ pairs		123	313	490	660
DZ pairs		127	91	317	304

Also large genetic influences on:

Alcoholism and drug use, religiousness, occupational interests, leisure activities, artistic interests, likelihood to marry, intelligence, memory ability, etc etc

