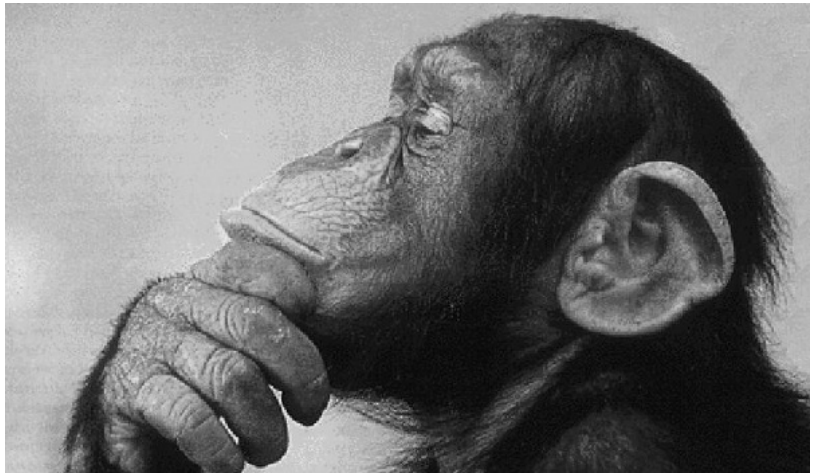
Welcome to Animal Behavior!

- Instructor: Alexandra (Lexi) Ding
- Location and Time: 56-154, **2:30-3:30pm [NOTE CHANGE]**
- *Syllabus will be sent out via email*

Course Details

- **Goal:** have an engaging and enjoyable learning experience
- **Expectations:** Arrive on time (before 5 after), don't use electronics for distractions, ask questions, interact respectfully with each other
- **Course Materials:** I will send out slides after class, via the class email list. Supplementary materials will be sent out via the list as well.
- **Prerequisites:** Curiosity



Course-Specific Goals:

- Interdisciplinary study of animal behavior
- Basic knowledge of genetics and genetic methods
- Read and critically evaluate scientific papers
- Gain basic skills in experimental design

Aplysia (sea slug)

Syllabus (tentative)- 6 weeks

Subject to change

1. Introduction – The Study of Behavior
2. Sensory Systems and Innate Behavior
3. Learning and Conditioning
4. Sibling Rivalry and Parent-Offspring Conflict + Game Theory
5. Eusociality, Sexual Selection and Mating Conflict
6. Genetics of Neurological Disease + Modern Genetic Methods

Introduction to Animal Behavior

9 July 2017

Lecture 1: Executive Summary

1. The **study of animal behavior** aims to determine the cause, development, evolutionary history, and function of behaviors

2. **Genetics, Environment and their Interaction** (relationship) affect how animals behave.

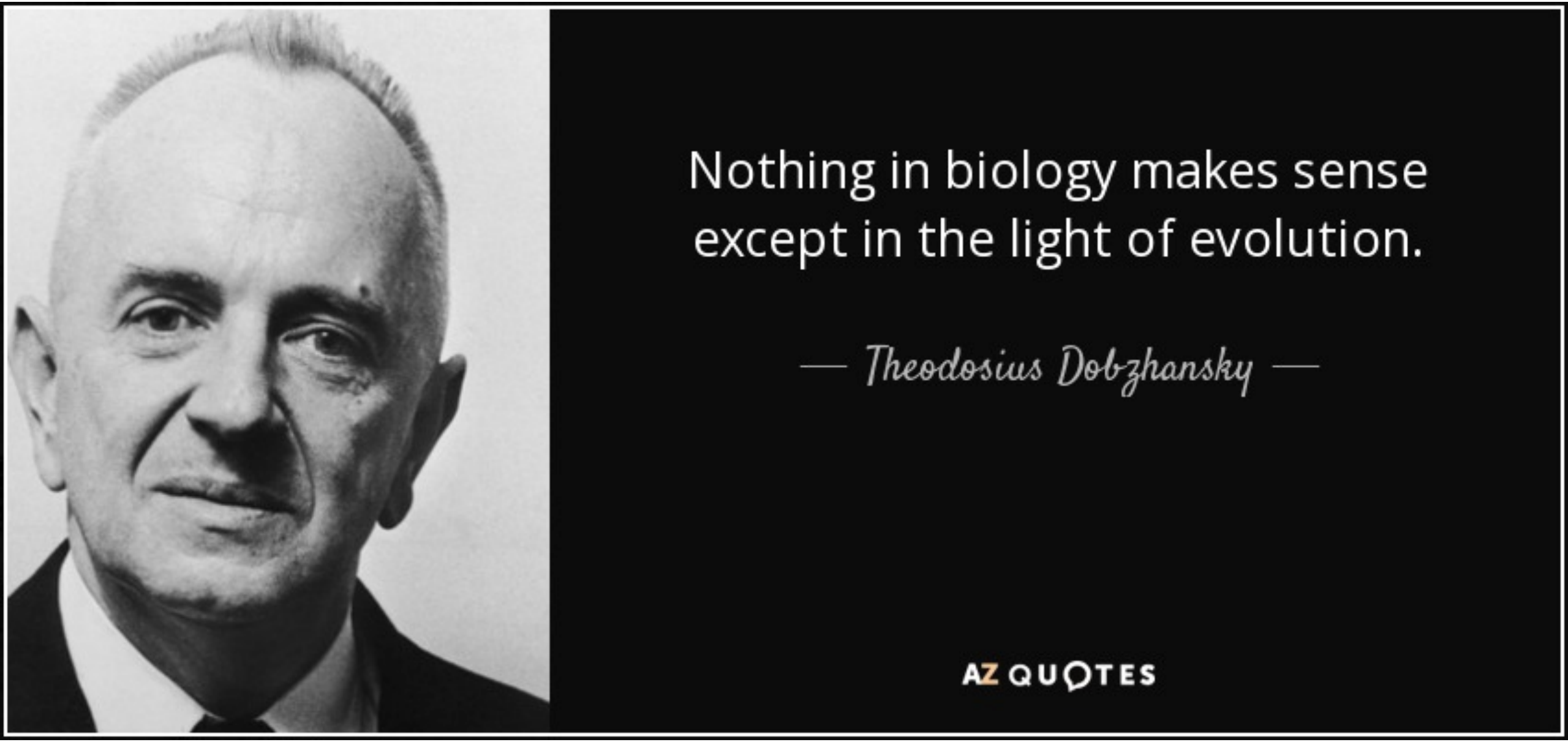
3. **Experimental Design** influences what conclusions one can make from a given dataset

Tinbergen's 4 Questions: CDEF*

1. **Causation**- What is the behavior? (Morphology, molecules, underlying factors, external stimuli)
2. **Development**- What changes over the course of an individual's lifetime? How do behaviors change through learning or environmental exposures?
3. **Evolutionary History**- What past environments shaped behavior?
4. **Function-** Adaptive Value, how does the behavior increase an organism's lifetime reproductive success?

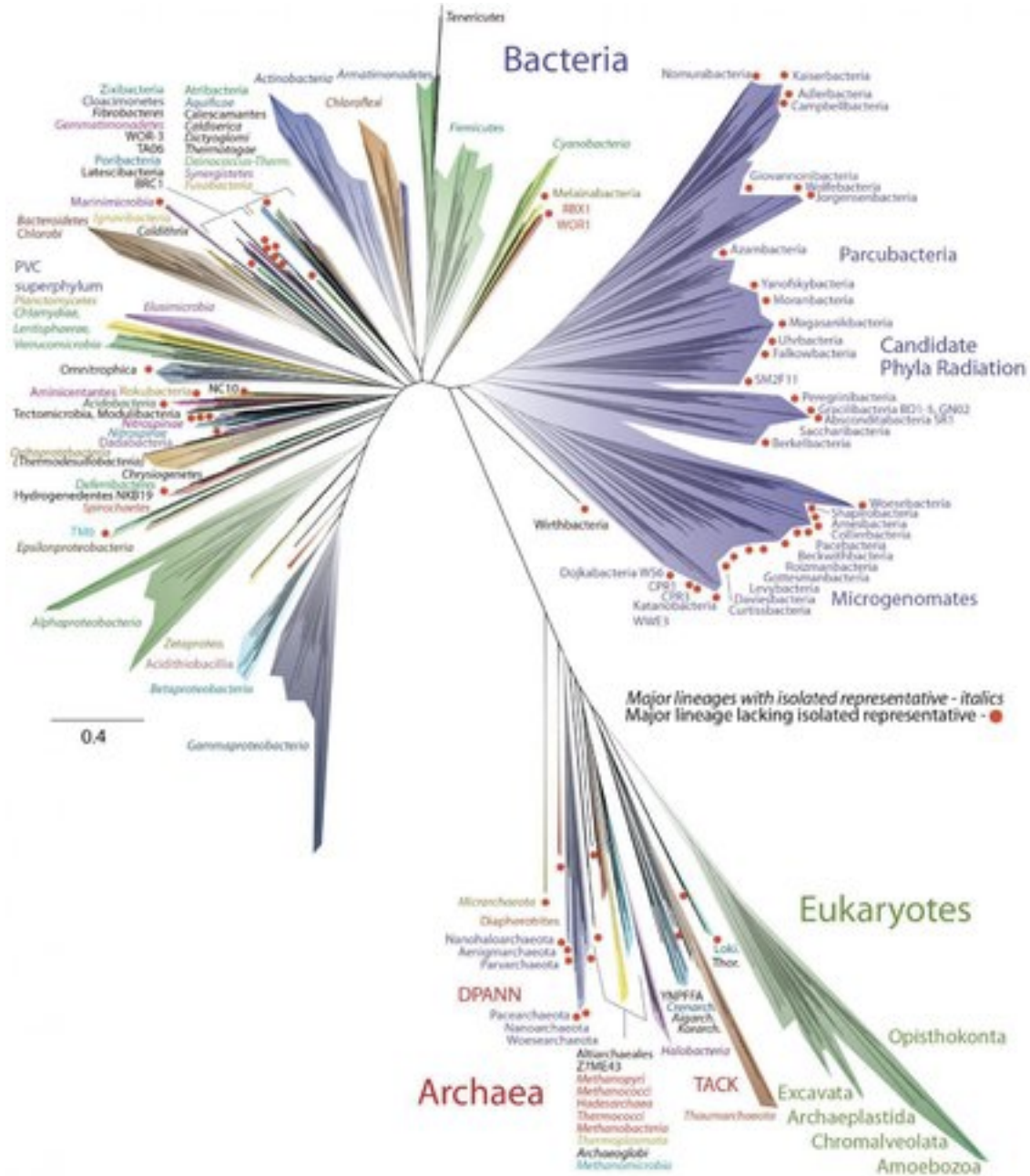
*Related to Aristotle's Four Causes

Wording comes from Reed College website

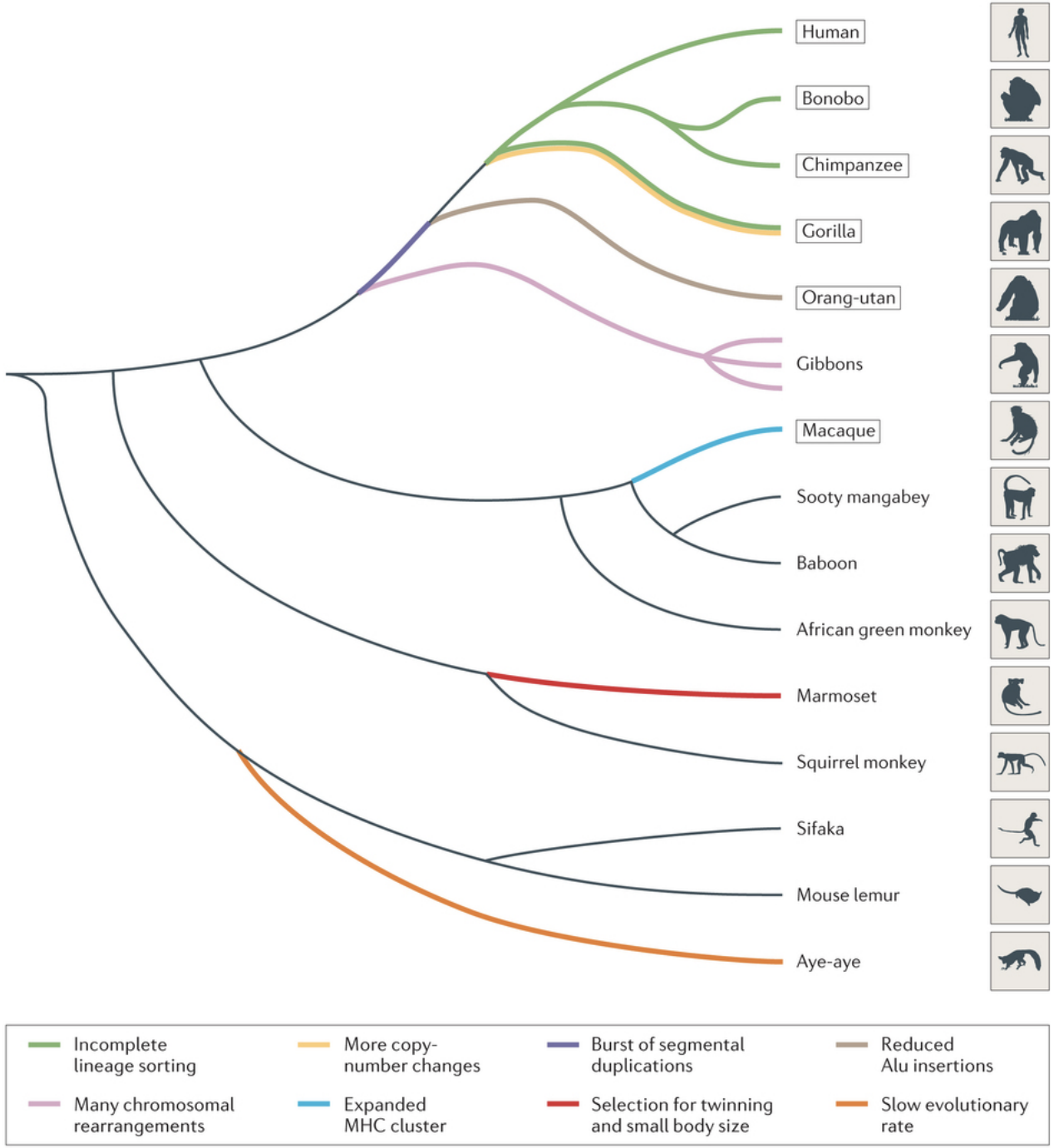

Nothing in biology makes sense except in the light of evolution.
— Theodosius Dobzhansky —
AZ QUOTES

Evolution works on the Genome

- “Descent with modification”
- **The Central Dogma:**



Jill Banfield/UC Berkeley, Laura Hug/University of Waterloo



Nature Reviews | Genetics

A numbers game!

- **In the human genome:**
- How many pairs of chromosomes?
- How many protein-coding genes (estimated)?
  - What proportion of the genome consists of protein-coding sequences?
- What percentage of the genome doesn’t code for protein?
- How many base pairs in genome?

How do genes and environment come together to shape animal behavior?

- Nature or Nurture?
- Gene
- Environment
- Gene x Environment Interaction
- NOT ”one gene one function”
- In fact, genes can interact with each other IN ADDITION TO the environment

Disease Concordance

- **Concordance:** Degree to which a trait is inherited
- Monozygotic ("identical") vs Dizygotic ("fraternal") same-sex twins

	Probandwise concordance* (%)		Refs
	MZ twins	DZ twins	
Type 1 diabetes	42.9	7.4	129
Type 2 diabetes	34	16	130
Multiple sclerosis	25.3	5.4	149
Crohn's disease	38	2	150
Ulcerative colitis	15	8	150
Alzheimer's disease	32.2	8.7	134
Parkinson's disease	15.5	11.1	151
Schizophrenia	40.8	5.3	152
Major depression	31.1‡ or 47.6§	25.1‡ or 42.6§	153
Attention-deficit hyperactivity disorder	82.4	37.9	154
Autism spectrum disorders	93.7	46.7	155
Colorectal cancer	11	5	114
Breast cancer	13§	9§	114
Prostate cancer	18	3	114

*Defined as $2C / (2C + D)$, where C is the number of concordant affected twin pairs, and D is the number of discordant twin pairs. ‡Concordance in male twin pairs. §Concordance in female twin pairs. DZ, dizygotic; MZ, monozygotic.

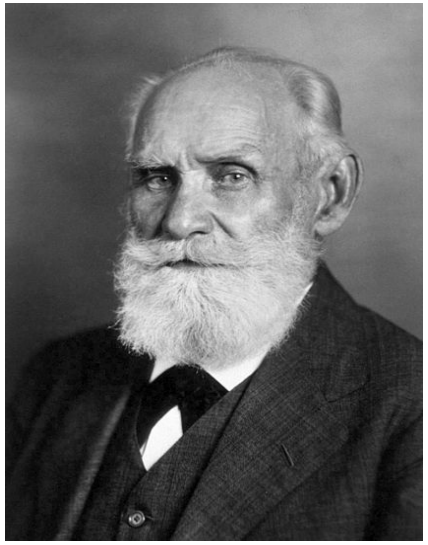
Gejman et al. 2011 R, Doningen et al. 2012 R

Cross-fostering: Australian Galah and Cockatoo

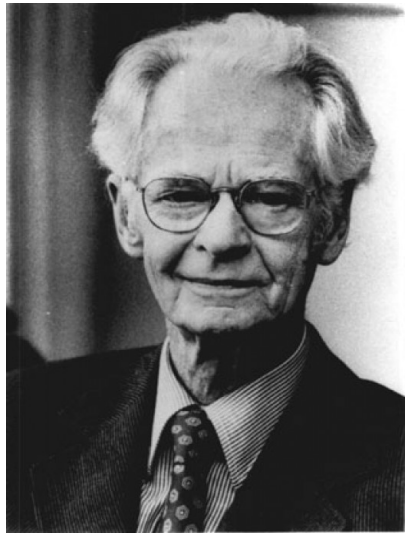
- Fundamental behaviors (begging, alarm calls) innate, but social calls and food preference are learned from adoptive parents

Famous (and Nobel worthy!) Names in Animal Behavior

- **Behaviorists:** study animal behavior in the lab, usually individuals
- **Ethologists:** study animal behavior in natural contexts, usually populations

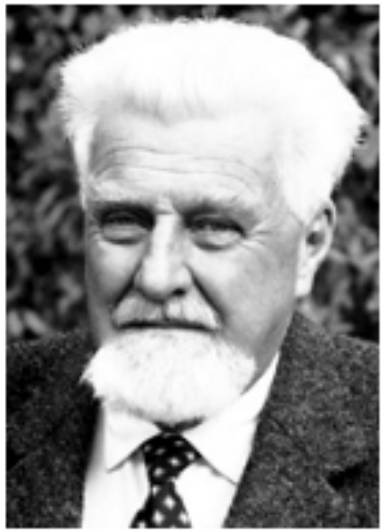


Ivan Pavlov



B.F. Skinner

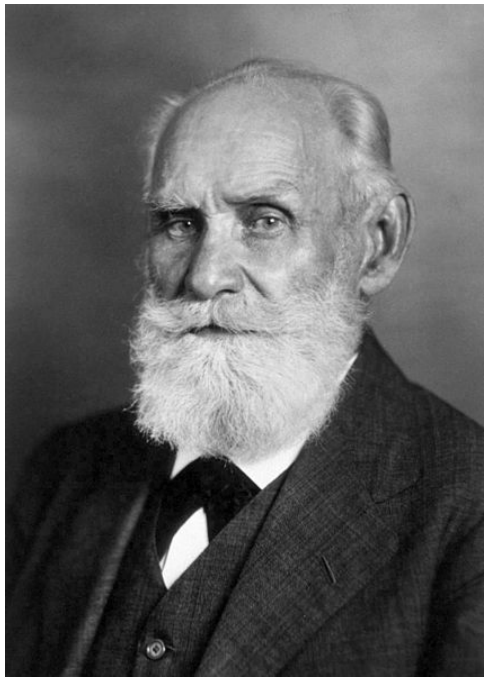
Karl von Frisch



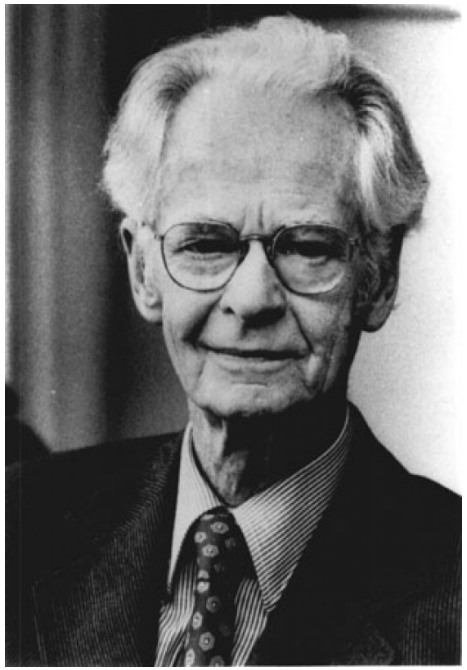
Konrad Lorenz

Nikolaas Tinbergen

Behaviorists

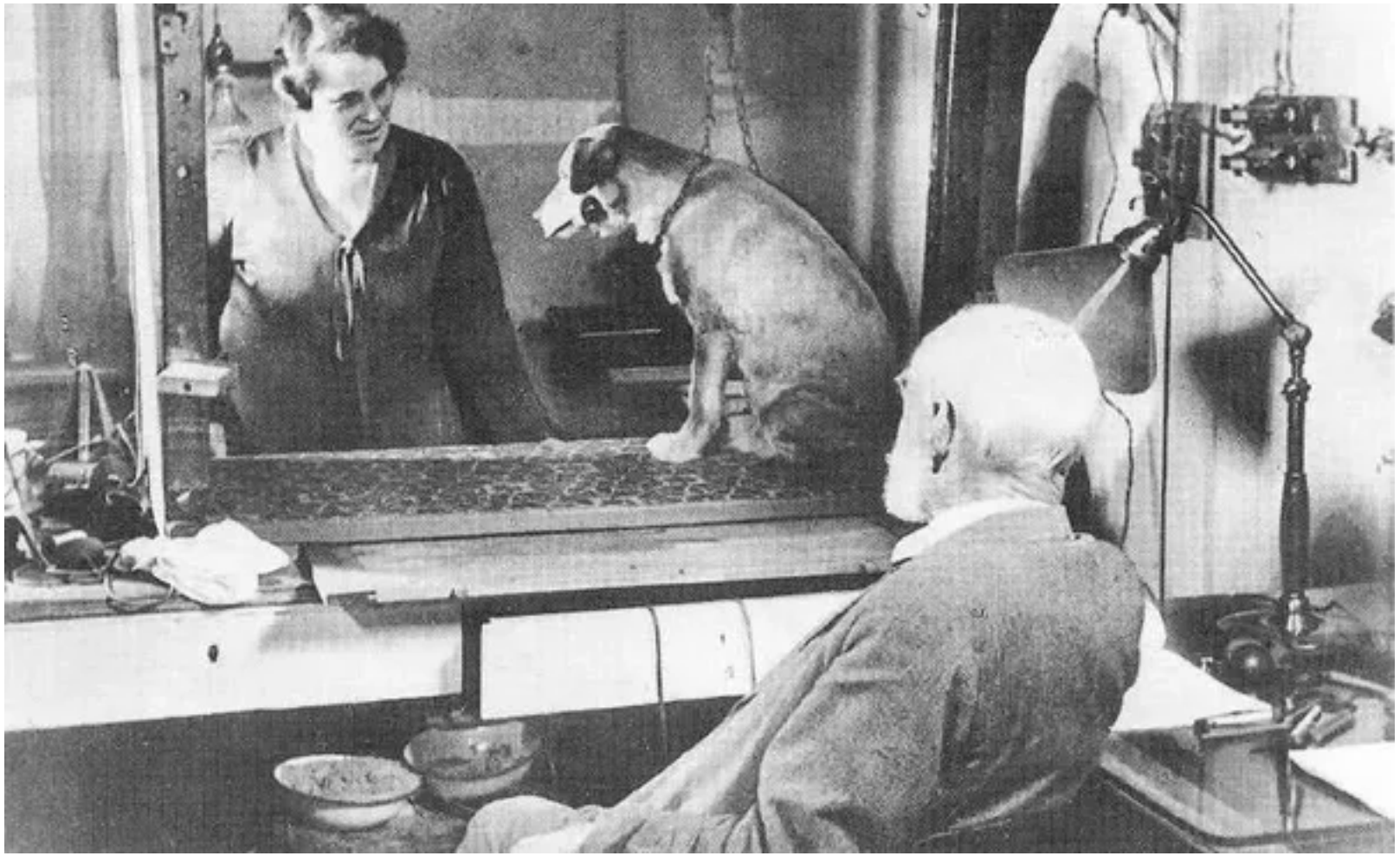


Ivan Pavlov,
Nobel Prize 1904

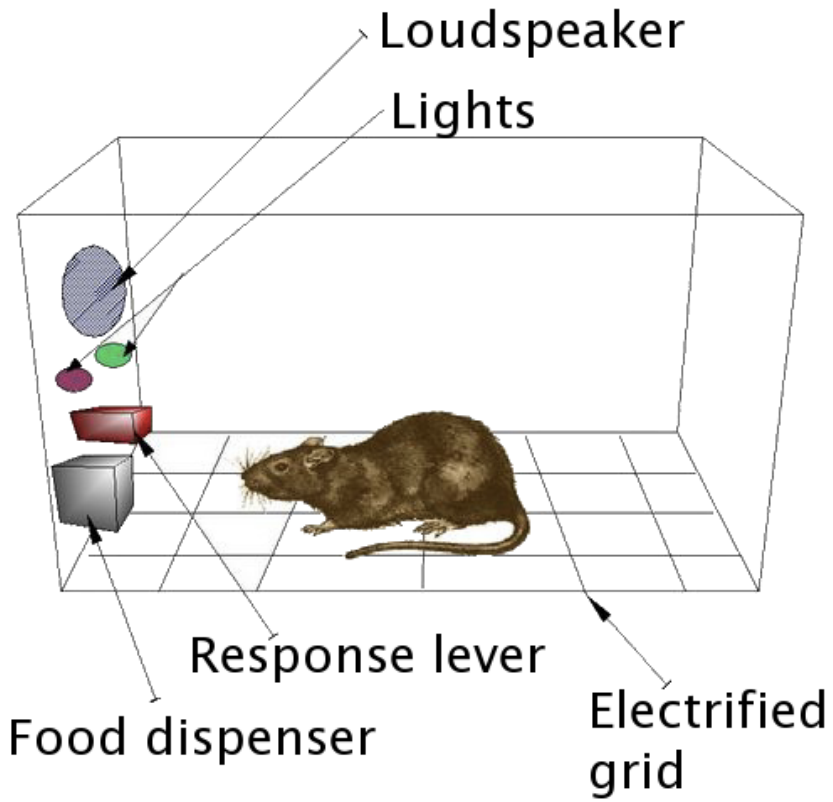


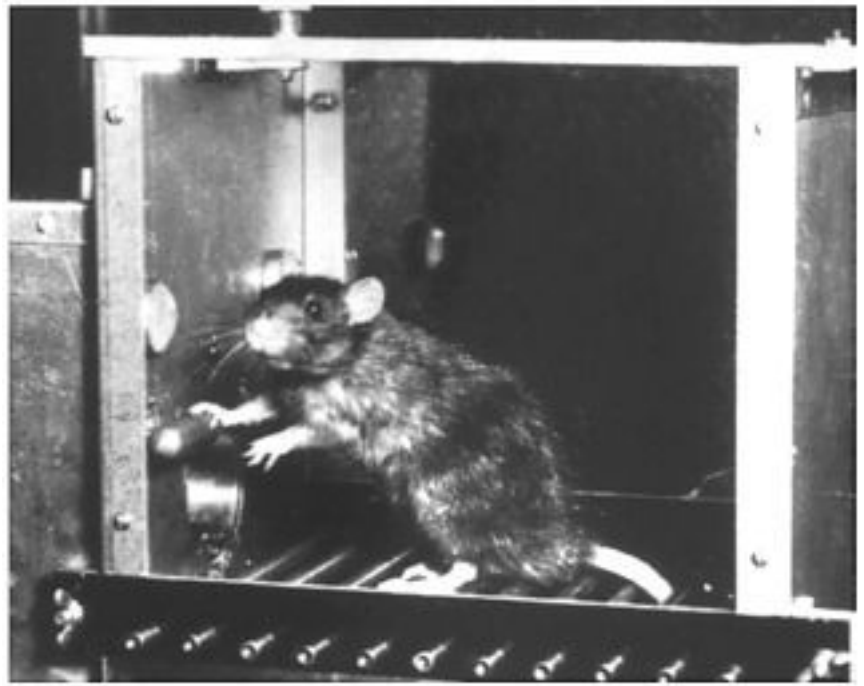
B.F. Skinner
1930s

Pavlov’s Dog



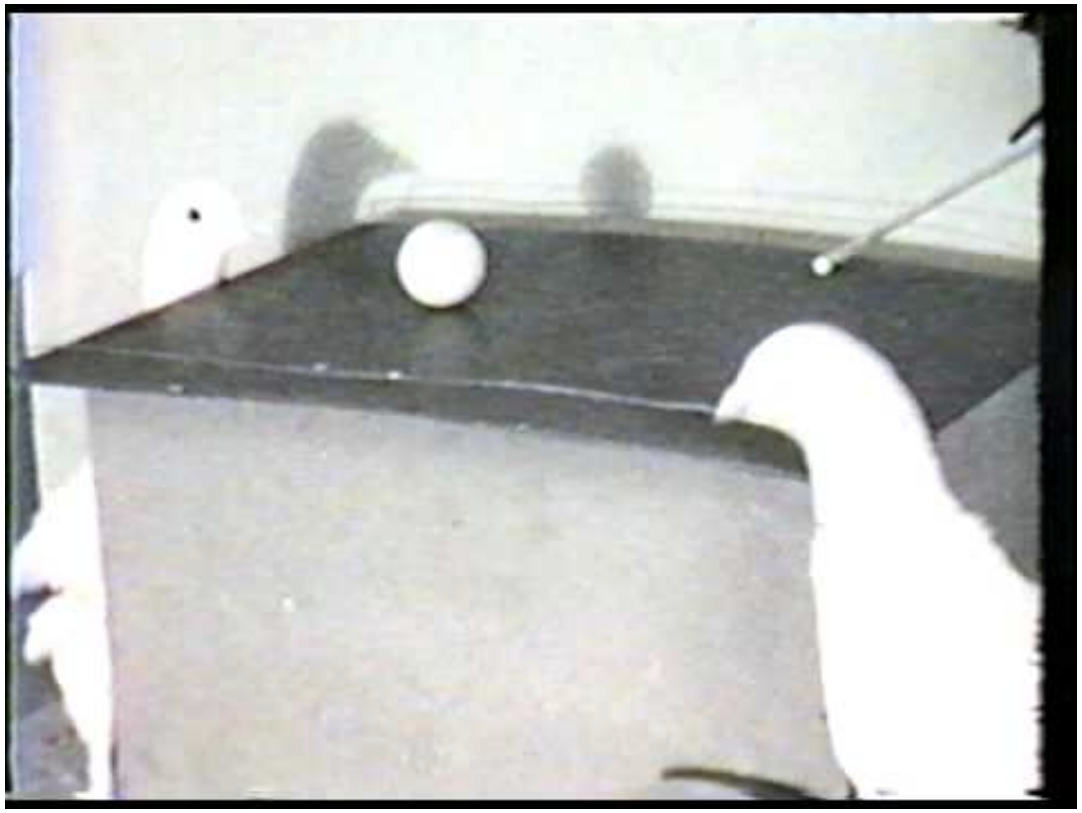
Skinner’s Box(es)





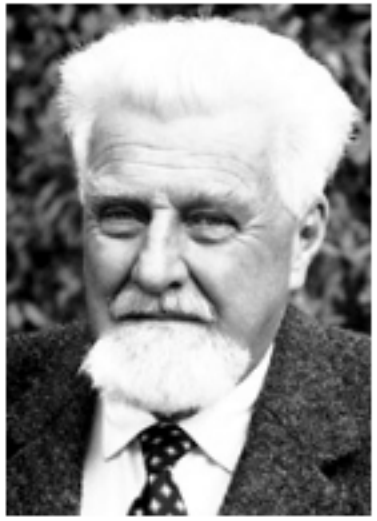
Skinner Pigeon Ping Pong

- https://www.youtube.com/watch?v=vGazyH6fQQ4



Founders of Ethology

Karl von Frisch
Prize share: 1/3



Konrad Lorenz
Prize share: 1/3

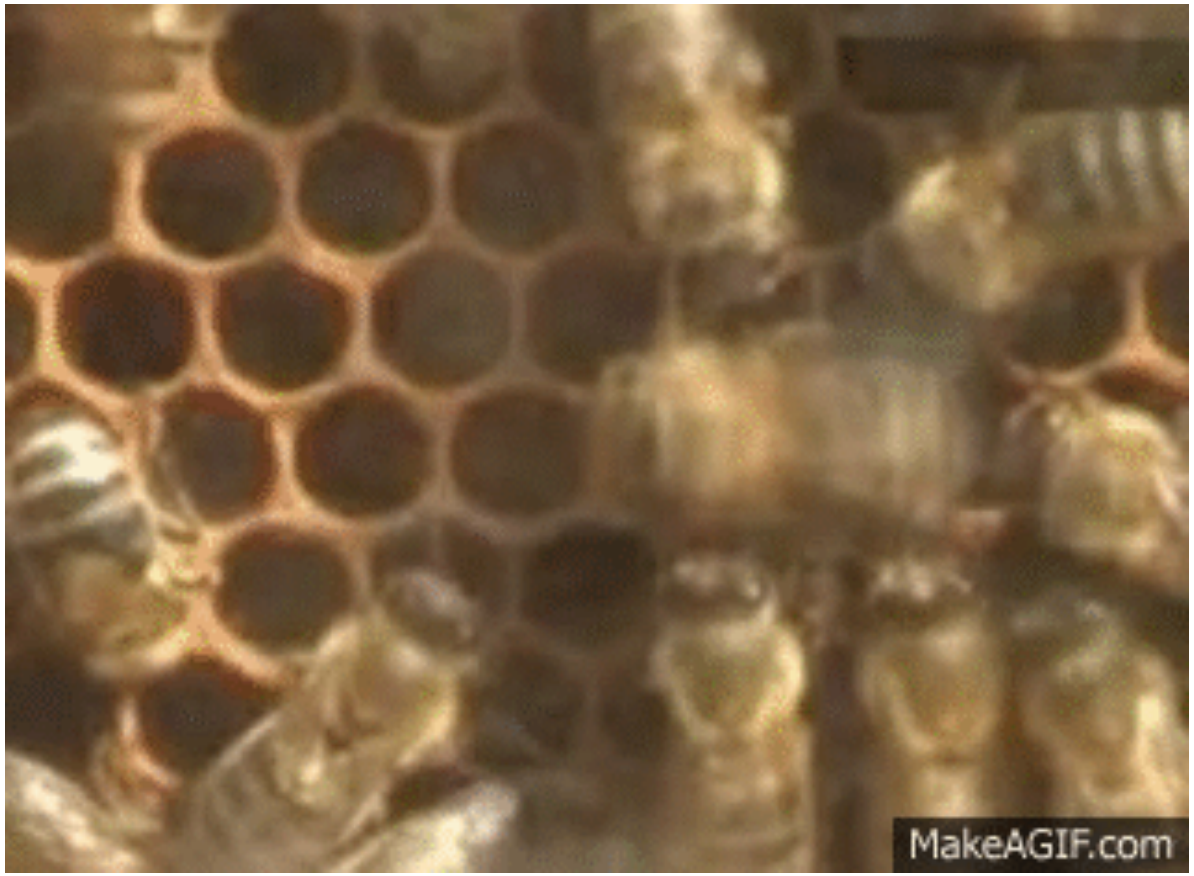
Nikolaas Tinbergen
Prize share: 1/3

Nobel Prize winners, 1973

Lorenz

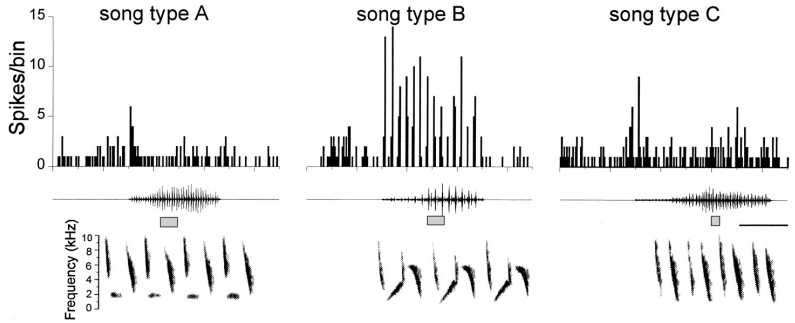
Tinbergen’s stickleback fish

Frisch’s Bee Waggle Dance

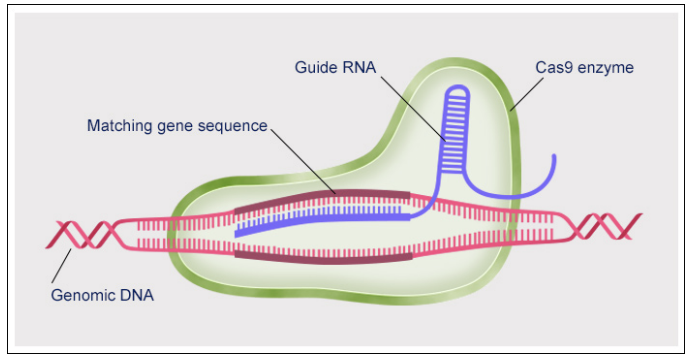


Modern study of behavior

- Methods (somewhat) change, but the goals remain the same

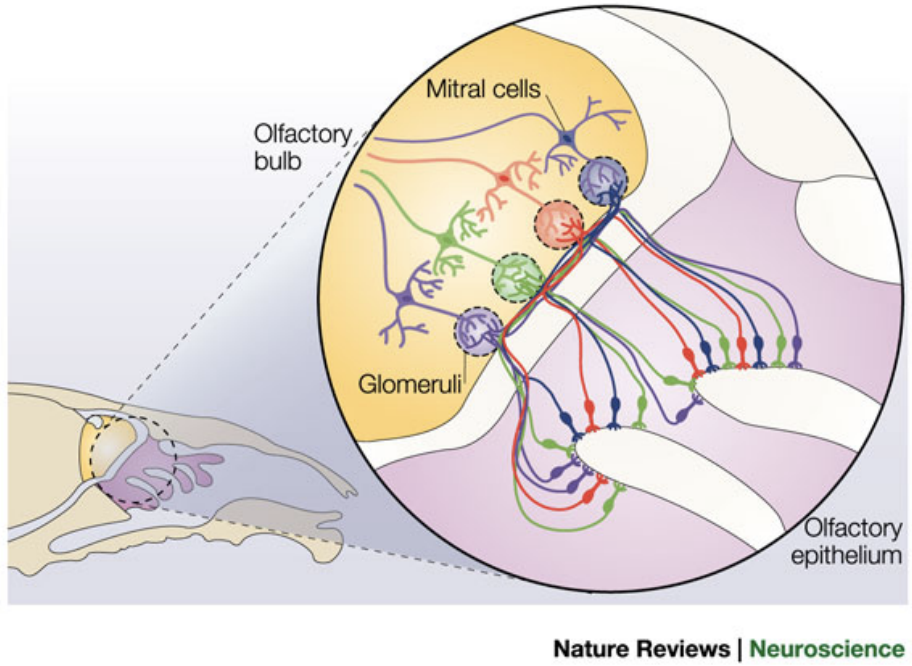


PNAS

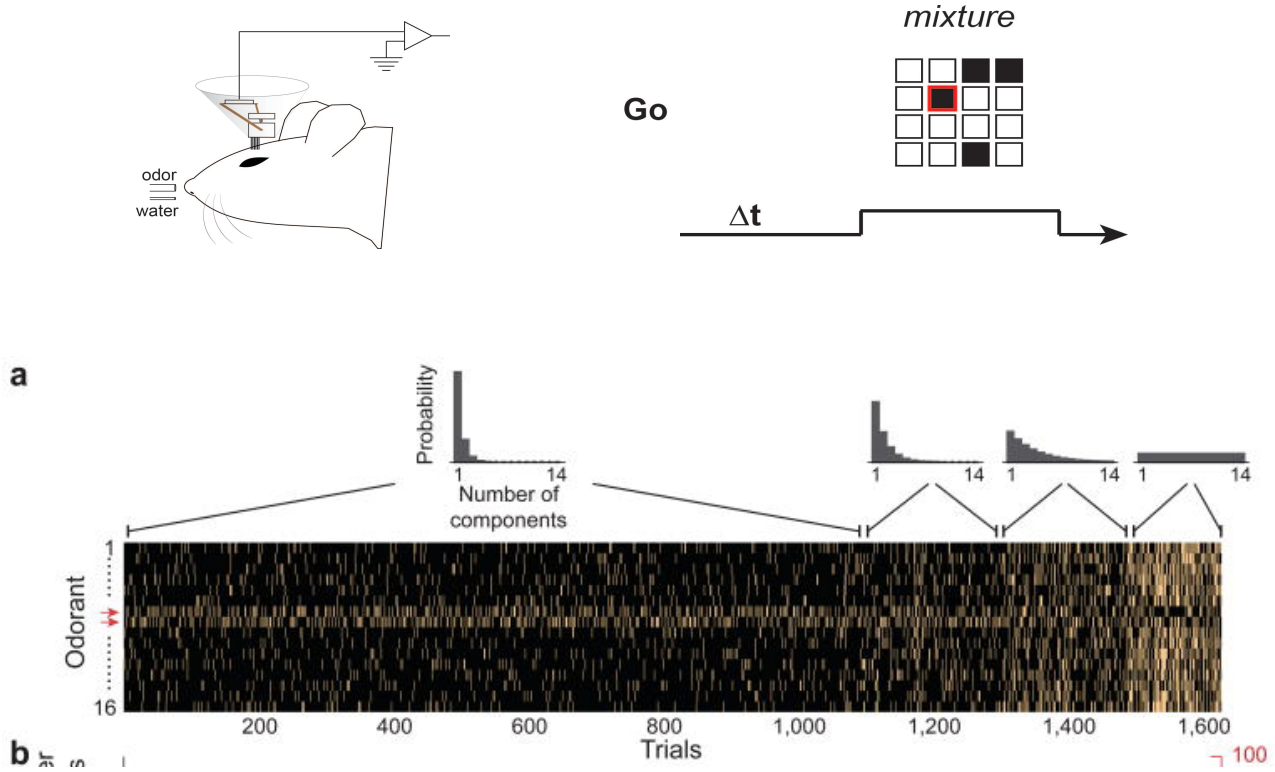


My research: Olfactory figure-ground segregation task

Olfactory System



Task



(Rokni et al. 2013, Mathis et al. 2016)

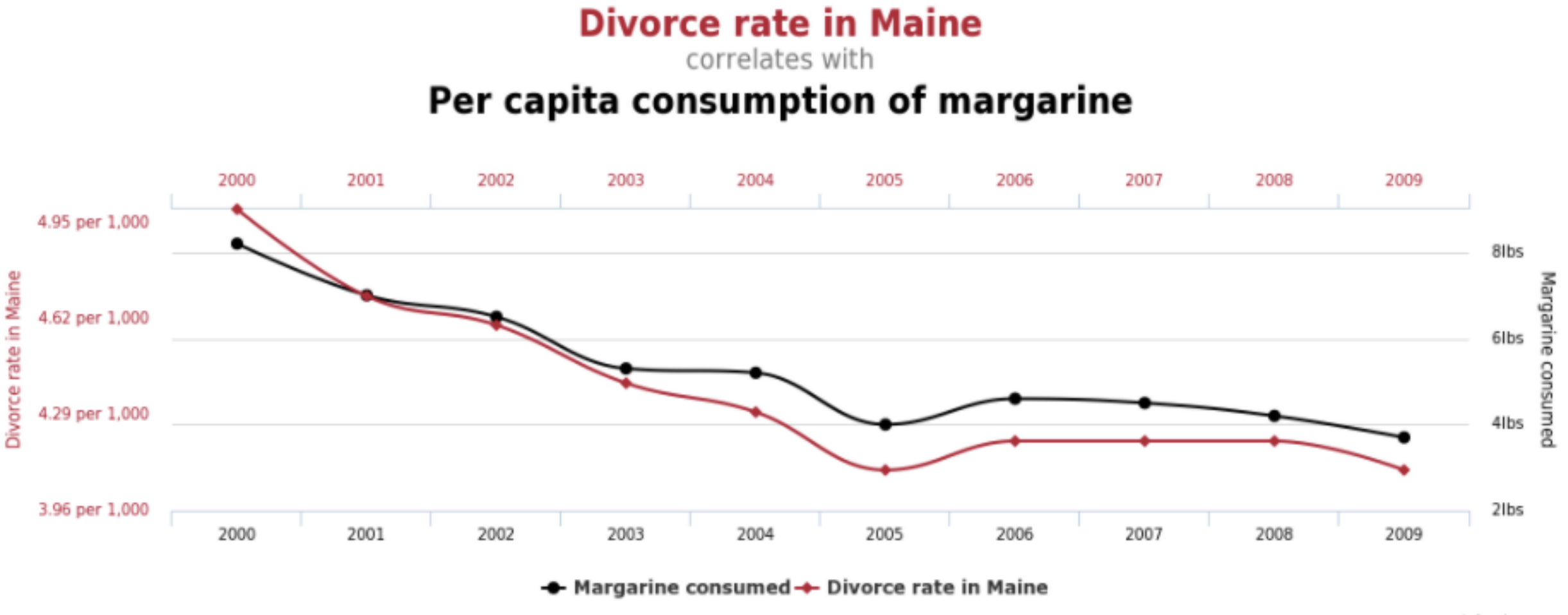
Design of Behavioral Experiments

- Statistics!
- Familiarity with Research Papers

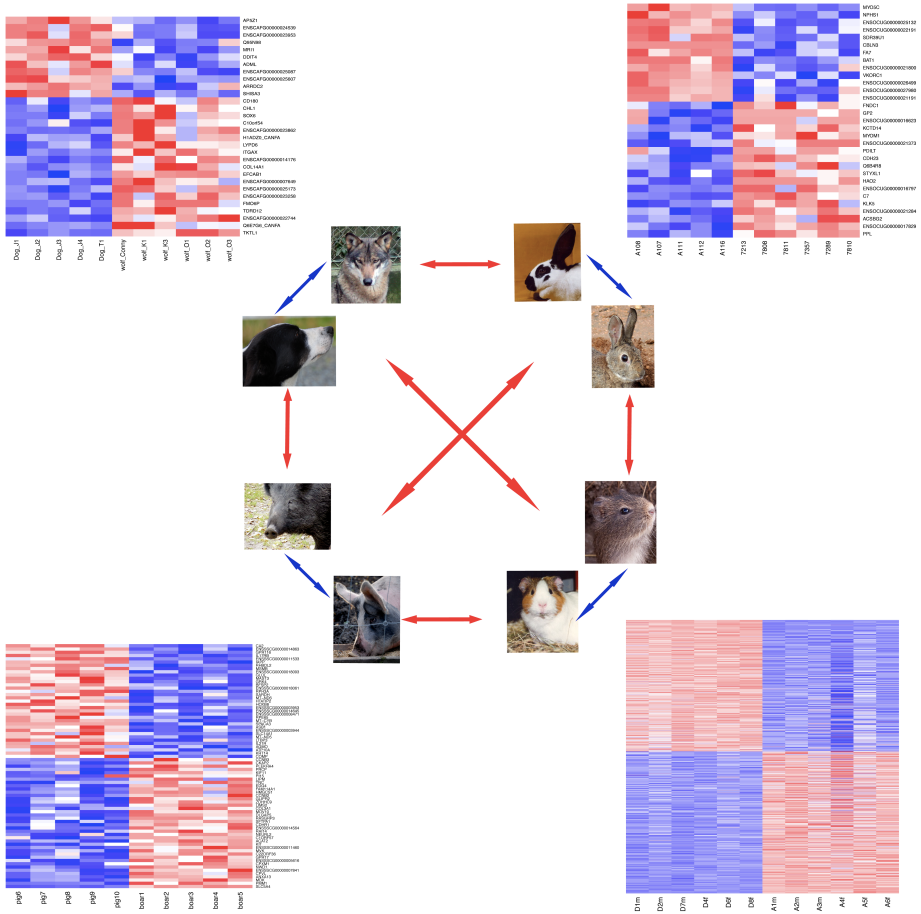
Millinski's Seven Deadly Sins

1. Unjustified conclusions are made from observational (i.e., correlational) data
2. Data are not independent ("**pseudoreplication**")
3. Treatments are confounded by **time and sequence effects**
4. No effort is made to avoid **observer bias.**
5. Potential artifacts arise when animals are not accustomed to experimental procedures
6. **Unsuitable controls** are used
7. An attempt is made to "prove" the hypothesis with **small samples.**

Correlation vs. Causation



Correlation vs. Causation: Gene expression patterns in domesticated and wild animals



Reynier et al. 2011

Pseudoreplication

- “Testing for treatment effects with data where treatments are not replicated, or duplicates are not statistically independent”
- Confounds

Control

Treatment

Other factors in bad experimental design

4. No effort is made to avoid **observer bias.**
5. Potential artifacts arise when animals are not accustomed to experimental procedures
6. **Unsuitable controls** are used
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Why study animal behavior?

- Recall Tinbergen's 4 questions
- Executive Summary

Executive Summary

1. The **study of animal behavior** aims to determine the cause, development, evolutionary history, and function of behaviors

2. **Genetics, Environment and their Interaction** (relationship) affect how animals behave.

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