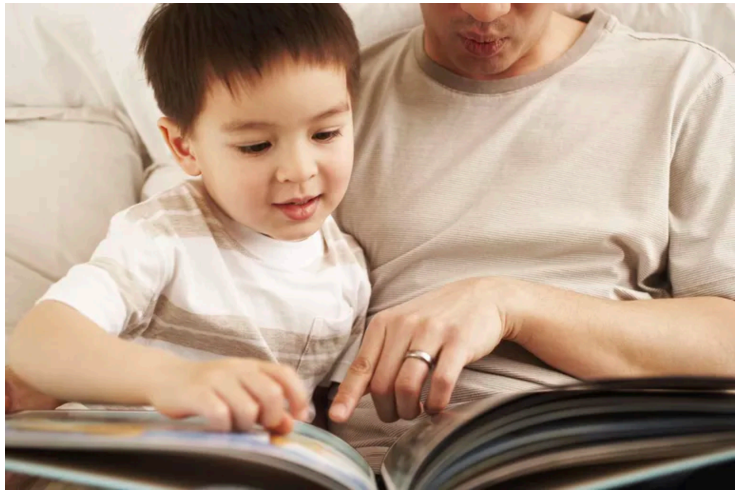
Modern Research Methods: Introduction

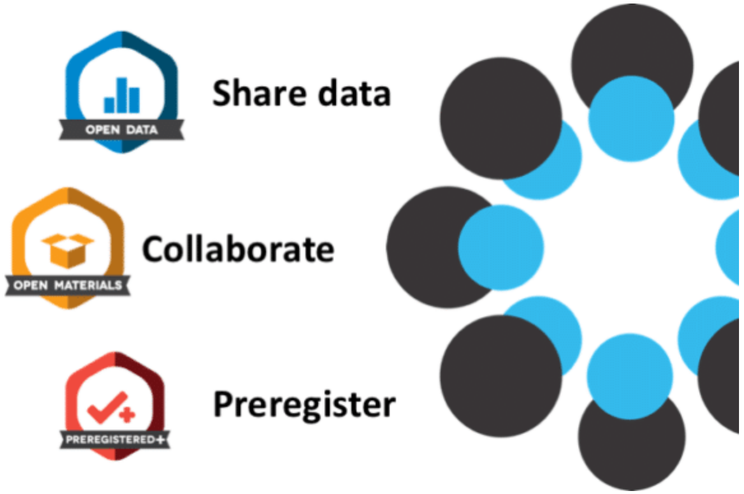
13 January 2020

Molly Lewis

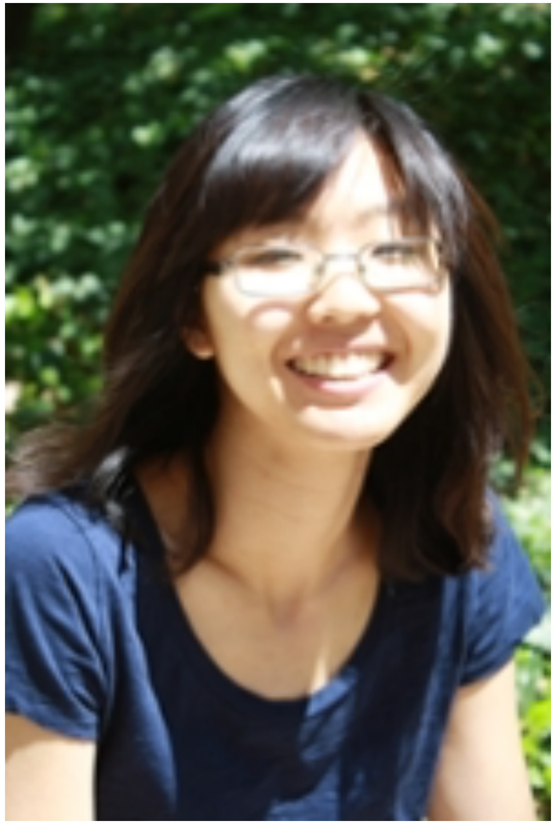
Dr. Molly Lewis

- Psychologist interested in understanding how languages are learned and change over time
- PhD from Stanford University in Developmental Psychology
- In my own research, use combination of classical experimental methods and large scale data
- Care a lot about open science and tools for open science





TA: Jaeah Kim



- 4th year PhD student in the Psychology department.
- Did my undergrad at Carnegie Mellon University as well.
- Currently interested in seeing how we can measure attentional states from eye-tracking data and studying how some attentional abilities might develop over childhood (especially between ages 3 and 5).

The Scientific Process

Case Study of the Scientific Process

A guy jumps in the swimming pool
with all his clothes on.

Why?

“Theory of mind” (ToM)

- Having a “theory of mind” allows you to reason about the guy’s behavior when he jumped in the swimming pool
  - Maybe someone was drowning?
  - Maybe he saw a $20 bill at the bottom?
  - Maybe he was drunk and thought it would be fun?
- Regardless: He had something in his head (a belief) that caused him to do what he did

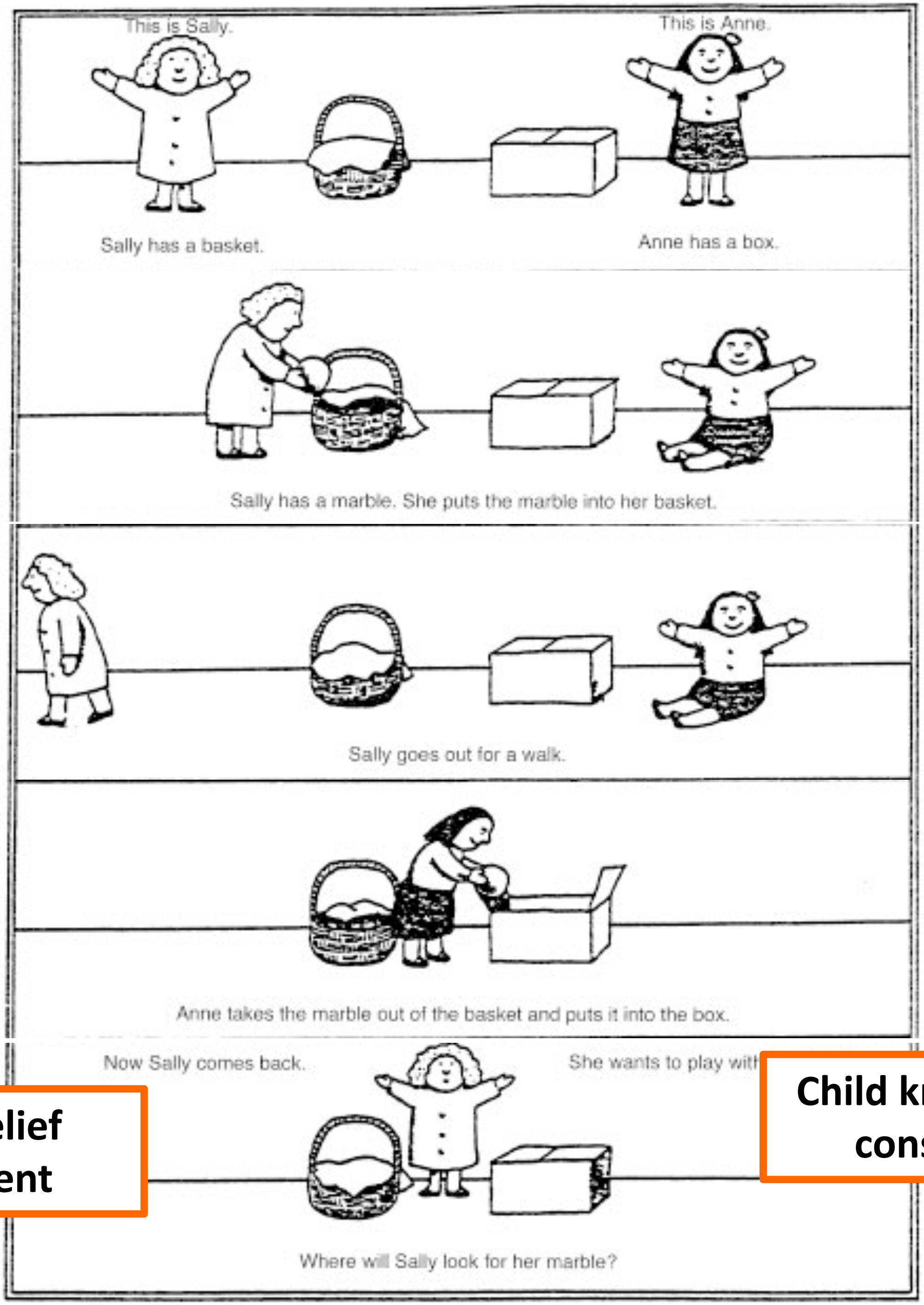
The origins of “theory of mind”

In assuming that other individuals *want, think, believe,* and the like, one infers states that are not directly observable and one uses these states… to predict the behavior of others as well as one’s own. These inferences, which amount to a **theory of mind**, are, to our knowledge, universal in human adults.

Premack & Woodruff (1978): “Does the chimpanzee have a “theory of mind”?


KAPWING
This is Ann and this is Sally

False belief: a key test



False belief consistent

Child knowledge consistent

The Sally-Anne Task

- Failure at 3 years, success at 4
  - Developmental pattern is very robust
- **Why do children fail?**
- Demands of the task:
  - Represent the true state of the world
  - Represent false belief
  - Attribute false belief to another person
  - Select between them on the basis of a linguistic prompt

Wimmer & Perner (1983)

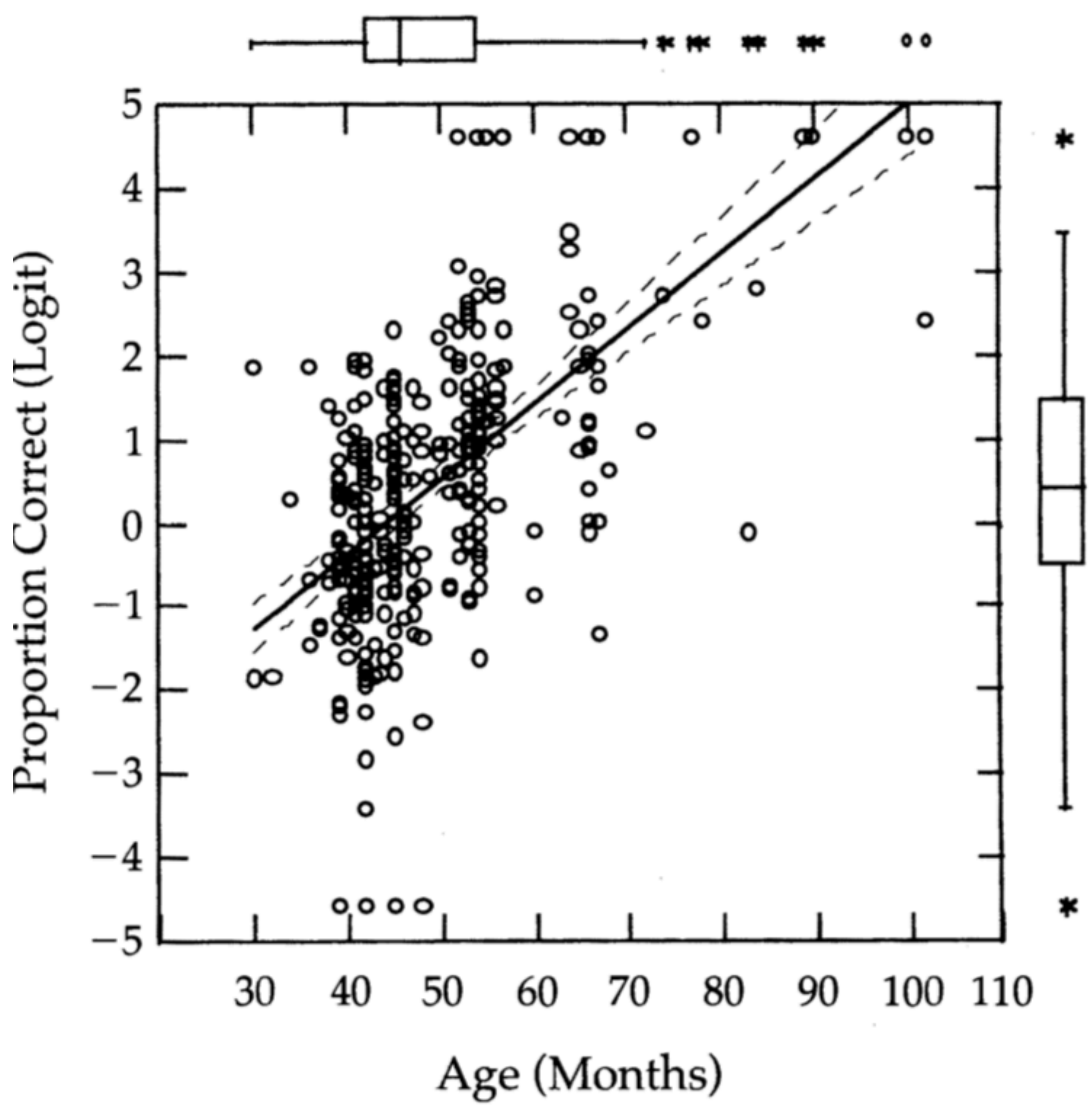
Meta-analysis of ToM tasks

Table 1 Listing of the Studies and Conditions Included in the Meta-Analysis

Authors	Year	Studies Reported	Studies Used in Meta-Analysis
Astington, Gopnik, and O'Neill	1989	2	2
Avis and Harris	1991	1	1
Baron-Cohen	1991	1	1
Baron-Cohen, Leslie, and Frith	1985	1	1
Bartsch	1996	2	2
Bartsch, London, and Knowlton	1997	2	1
Bartsch and Wellman	1989	2	1
…			
Yoon and Yoon	1993	2	1
Zaitchik	1990	5	1
Zaitchik	1991	1	1
Totals		178	143

Things that mattered:

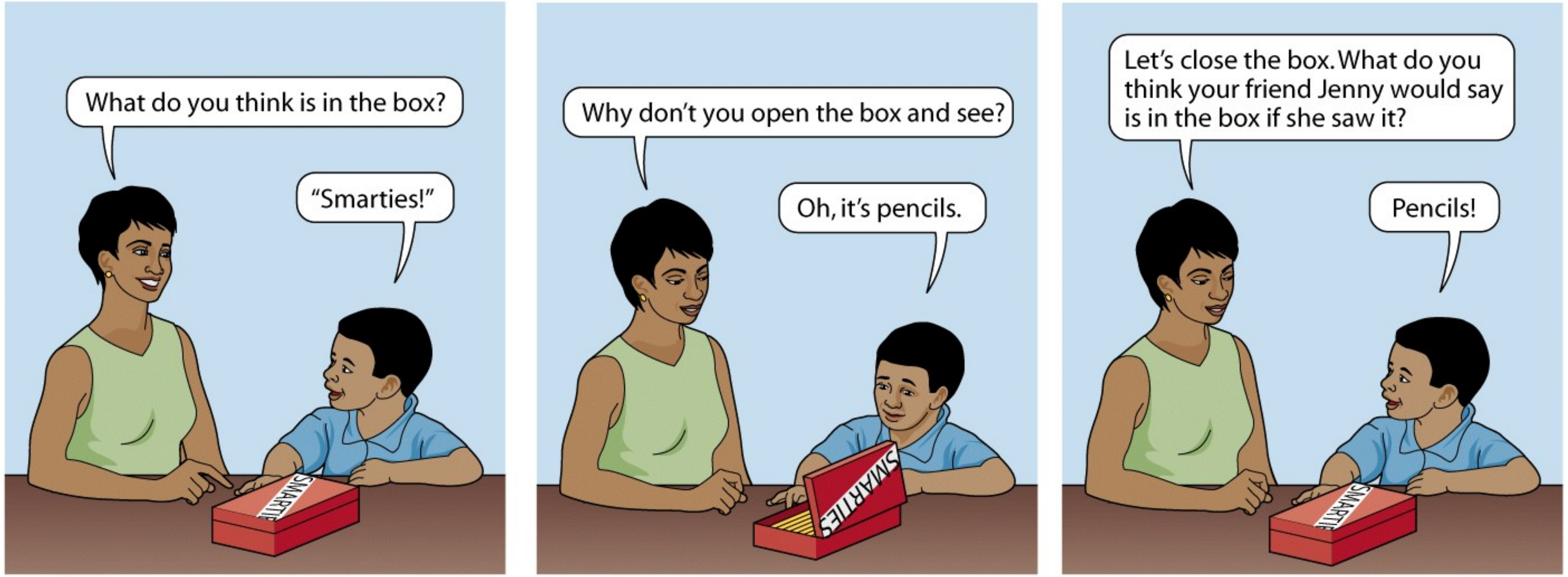
- "Anne" having a motive
- Child's participation
- Physical presence of object
- Salience of mental state



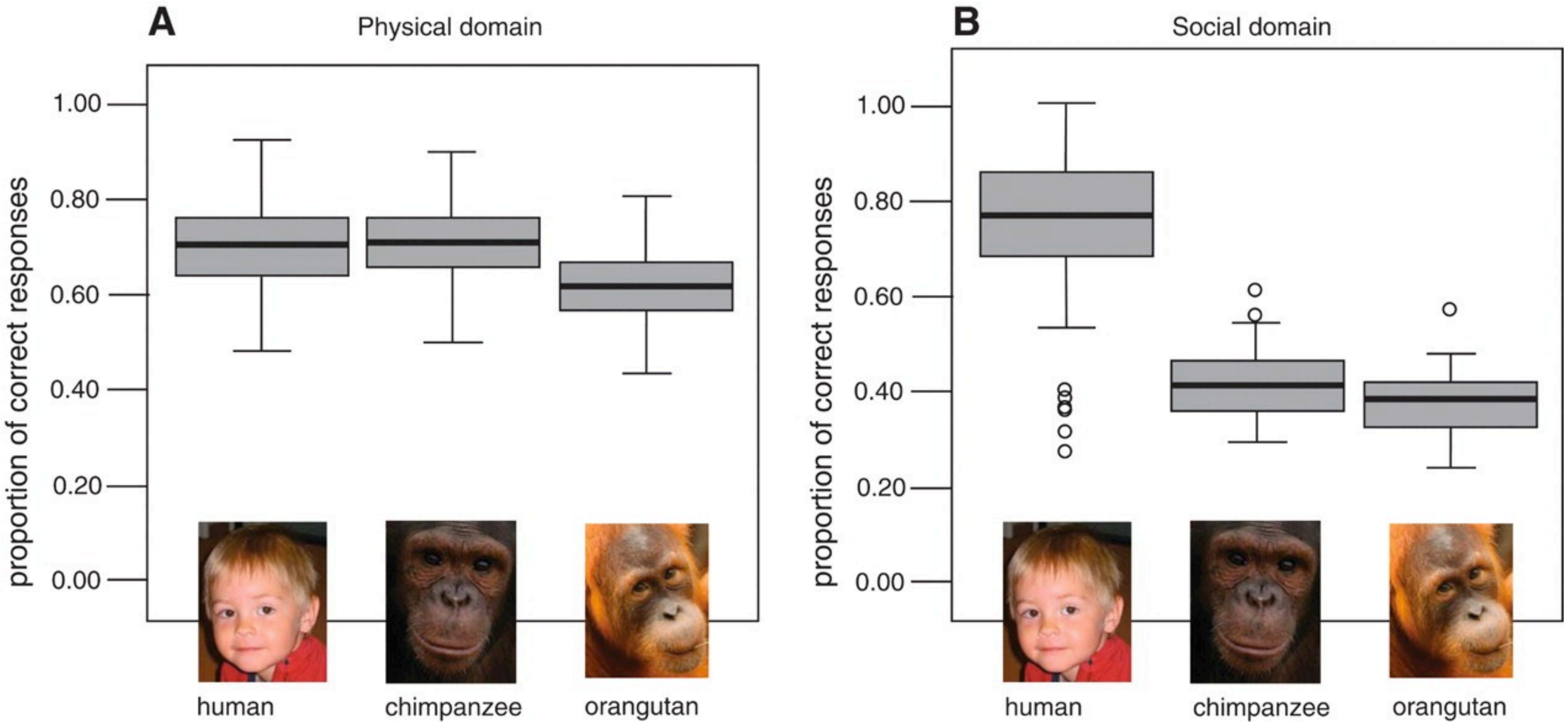
Wellman et al. (2001)

Related achievements

- Ability to imagine alternate realities (pretending)
- Ability to make people believe things that are false (lying)
- Ability to take different perspectives on the same scene (representation change)
- Understanding appearances can be deceiving (appearance-reality distinction)



Social cognition in other primates



Hermann et al. (2007)

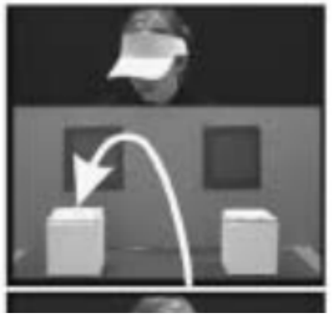
A beautiful story

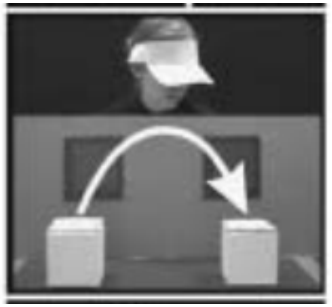
- Children begin reasoning about agents’ desires, goals, and actions
- They then gradually develop a representational theory of mind around 3 years of age
- Theory of mind is only seen in humans

…

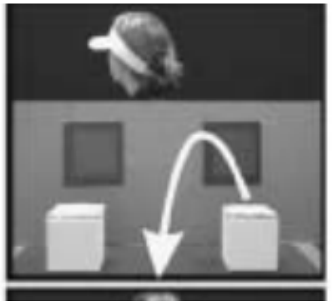
- But what if infants could also represent others’ beliefs?

Evidence for early theory of mind?





(Closes lid)



(Secretly removes ball)

(Where will the lady look?)

25+ papers from 10+ different labs
(e.g. Buttelman et al, 2009; Clements & Perner, 1994; Knudsen & Liszkowski, 2012; Onishi & Baillargeon, 2005; Southgate et al., 2007; Southgate et al., 2010)

17/20 24-month-olds looked at the correct (belief-consistent) window (right)

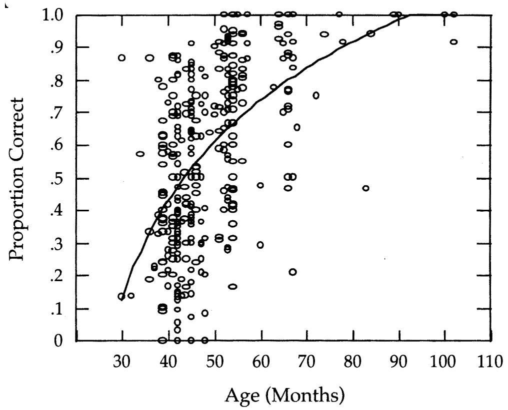
Southgate et al. (2007)

How do we resolve this discrepancy?

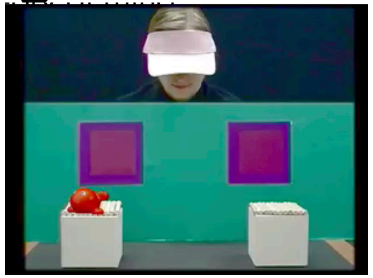
- Collect more data - Are we sure this pattern is correct?
  https://manybabies.github.io/

- Revising the theory
  - Complete continuity
    - Preschool results are artifacts
    - Standard tasks too difficult
  - TOM_1 and TOM_2
    - Implicit system and explicit system
    - One early/innate, a second one learned slowly
  - Other possibilities?

The Scientific Process

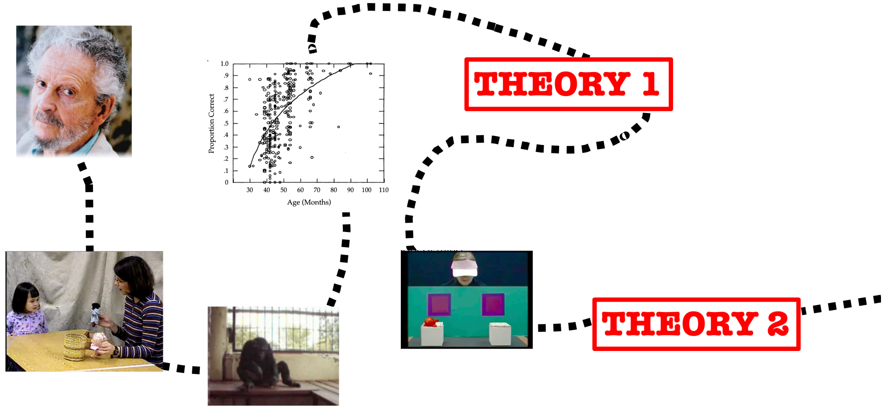


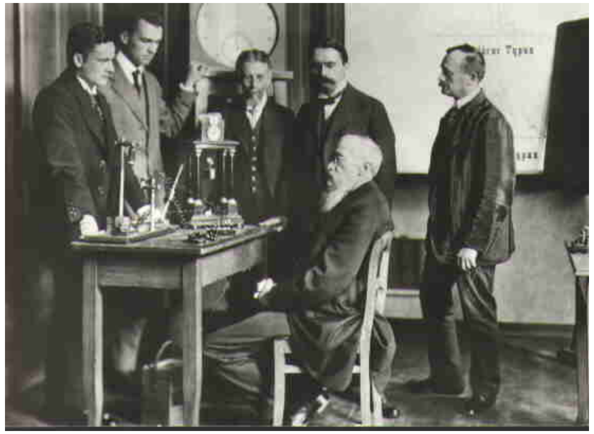
THEORY 1



THEORY 2

The Scientific Process is **cumulative**





Cumulative science is hard

Sometimes doesn't always work the way it should….

Essay

Why Most Published Research Findings Are Fal

John P. A. Ioannidis

The Statistical Crisis in Scien

Data-dependent analysis—a "garden of forking paths"— explains why m statistically significant comparisons don't hold up.

Andrew Gelman and Eric Loken

RESEARCH ARTICLE

Estimating the reproducibility of psychological science

Open Science Collaboration*,†

SCIENCE

Psychology's Replication Crisis Is Running Out of Excuses

Another big project has found that only half of studies can be repeated. And this time, the usual explanations fall flat.

This class is about learning how to think of **psychology as a cumulative science**, and learning **practical methods** for doing so.

Overview of course

1) Philosophy of Cumulative Science
2) The Single Experiment – Experimental design, tools in R for working with data and plotting data, reproducibility
3) Repeating an Experiment – Intro to statistical concepts, replication of experiments
4) Aggregating Many Experiments – Meta-analysis

Course Logistics

Website: https://cumulativescience.netlify.com/

Includes schedule and readings, contact info, grading and other policies

Please read carefully, and let us know if you have questions.

Course Components

- Lecture MW; Lab F (Porter 332P)
  - Some lecturing, some interactive
  - Encouraged to bring your laptop to lab
- 8 assignments
  - Typically handed out in lab, and due Thursday at noon
  - Must be completed individually, but can work with others
  - Focus on R using Rstudio.cloud (more in lab on Friday)
- Take home midterm (completed individually)
- Final project: Meta-analysis (completed in teams)
- Participation

Class expectations

- **Do the readings** – some of them will be hard
- **Say things!** Answer my questions and respond to others' questions/comments in class
- **Come to office hours** when you're having trouble with something related to the course or just want to chat about something you find interesting related to the course
- **Willingness to learn** to program in R (no experience expected!)
- Please **refrain from texting** or using your computer for anything other than coursework during class.

How to contact us

We want to help! Email/office hours are the best way to get in touch.

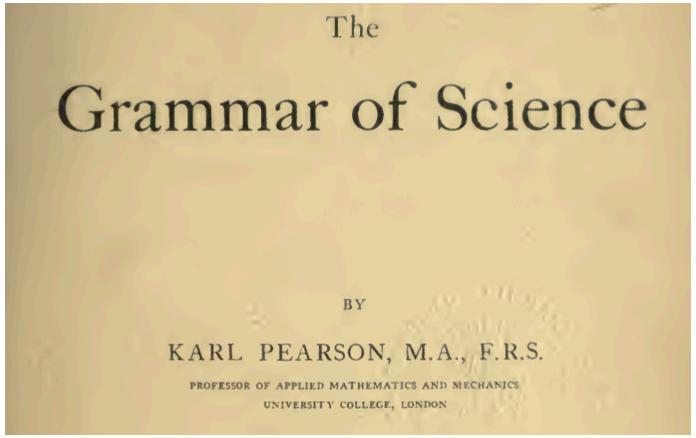
Dr. Molly Lewis
mollylewis@cmu.edu
Porter 223A
Office Hours: W 3:00-5:00pm

Jaeah Kim
jaeahk@andrew.cmu.edu
Baker 455E
Office Hours: M 1:00-3:00pm

https://cumulativescience.netlify.com/

Next Time: What does the process of cumulative science actually look like?

- Reading #1: Philosophy of cumulative science (Pearson)
- Reading # 2 Nuts and bolts of science (Nosek et al)
- Complete short survey: https://tinyurl.com/MRM-survey



The

Grammar of Science

BY

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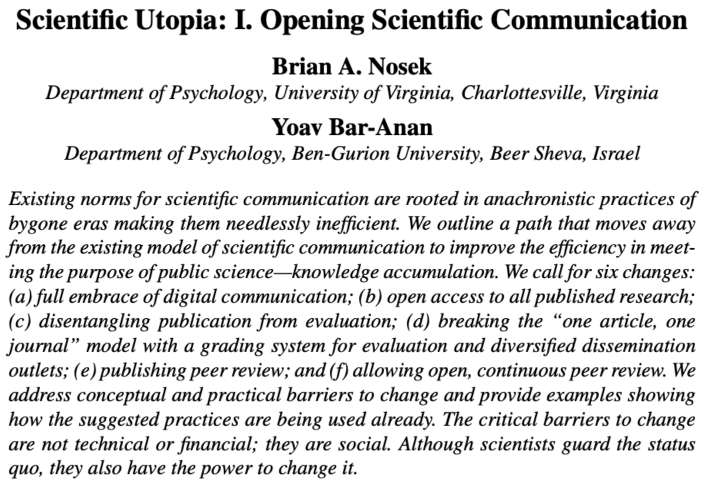

Scientific Utopia: I. Opening Scientific Communication

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Existing norms for scientific communication are rooted in anachronistic practices of bygone eras making them needlessly inefficient. We outline a path that moves away from the existing model of scientific communication to improve the efficiency in meeting the purpose of public science—knowledge accumulation. We call for six changes: (a) full embrace of digital communication; (b) open access to all published research; (c) disentangling publication from evaluation; (d) breaking the "one article, one journal" model with a grading system for evaluation and diversified dissemination outlets; (e) publishing peer review; and (f) allowing open, continuous peer review. We address conceptual and practical barriers to change and provide examples showing how the suggested practices are being used already. The critical barriers to change are not technical or financial; they are social. Although scientists guard the status quo, they also have the power to change it.

Introduction survey:
https://tinyurl.com/MRM-survey

Course website:
https://cumulativescience.netlify.com/

Acknowledgements

Slides 6 – 18 adopted from Mike Frank.