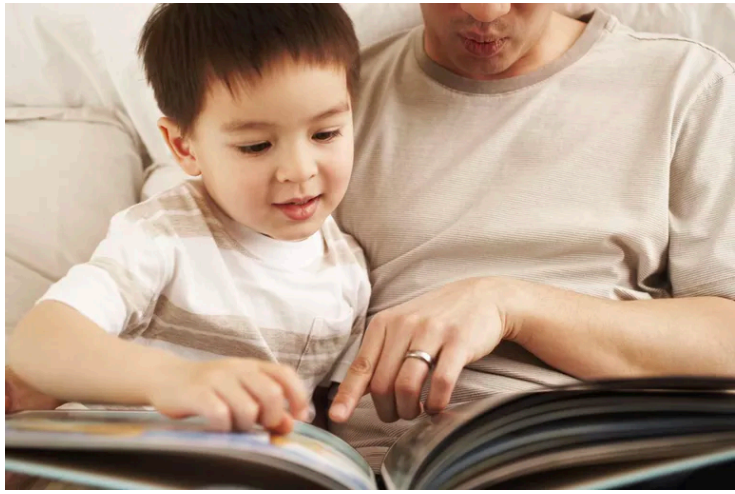
Modern Research Methods: Introduction

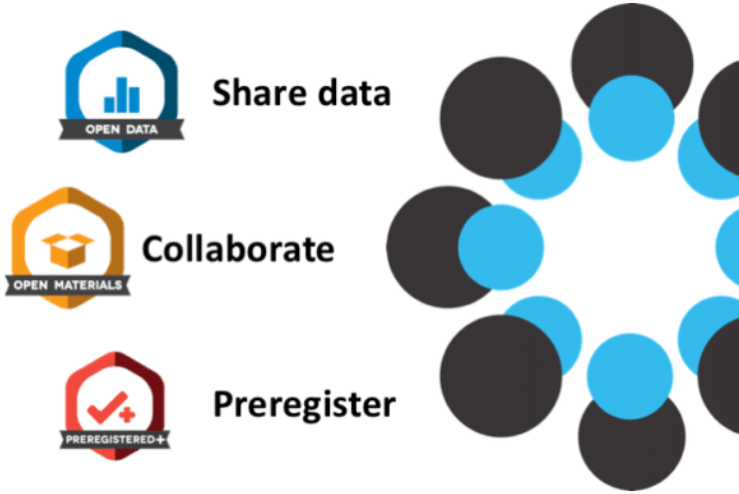
30 August 2021

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: Roderick Seow

- 4th year Ph.D. student in the Psychology department.
- Studying how people learn about regular relationships between natural phenomena from observation and how that knowledge is translated into predictions.
- Also studying the influence of expertise and past experiences on decision-making under time pressure.
- Originally from Singapore, came over to the US in 2015

The Scientific Process

1. Observation
2.
3.
⋮
n. Scientific theory

THEORY

Case Study of the Scientific Process

….in Developmental Psychology

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

Why?

“Theory of mind” (ToM)

- Maybe someone was drowning?
- Maybe he saw a $20 bill at the bottom?
- Maybe he was drunk and thought it would be fun?

- Having a “theory of mind” allows you to reason about the guy’s behavior when he jumped in the swimming pool
- He had something in his head (a belief) that caused him to do what he did

What are 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.

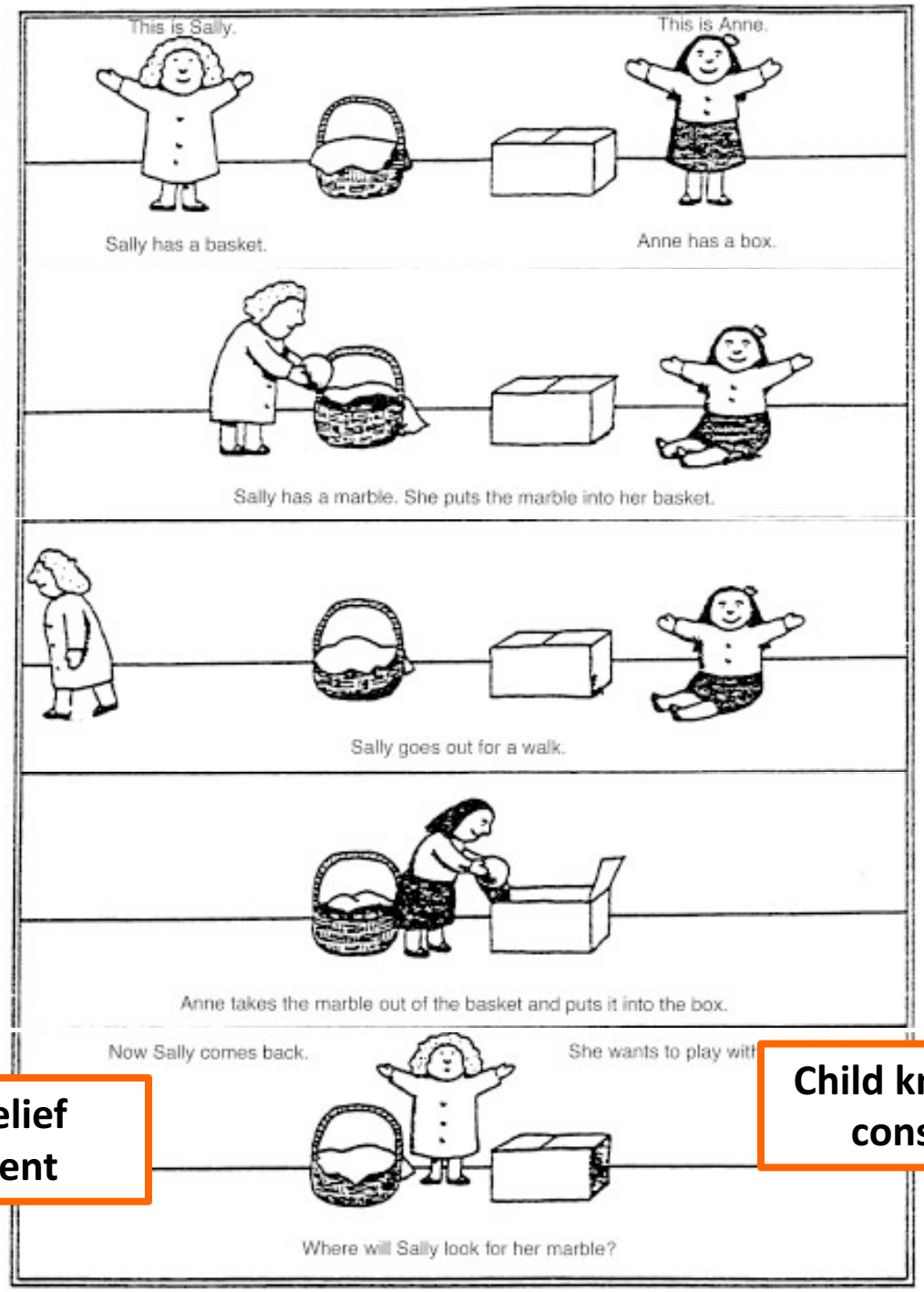
Premack & Woodruff (1978): "Does the chimpanzee have a "theory of mind"?

Building a scientific theory of ToM

THEORY


KAPWING
This is Ann and this is Sally

False belief: a key test



False belief consistent

Child knowledge consistent

The Sally-Anne Task

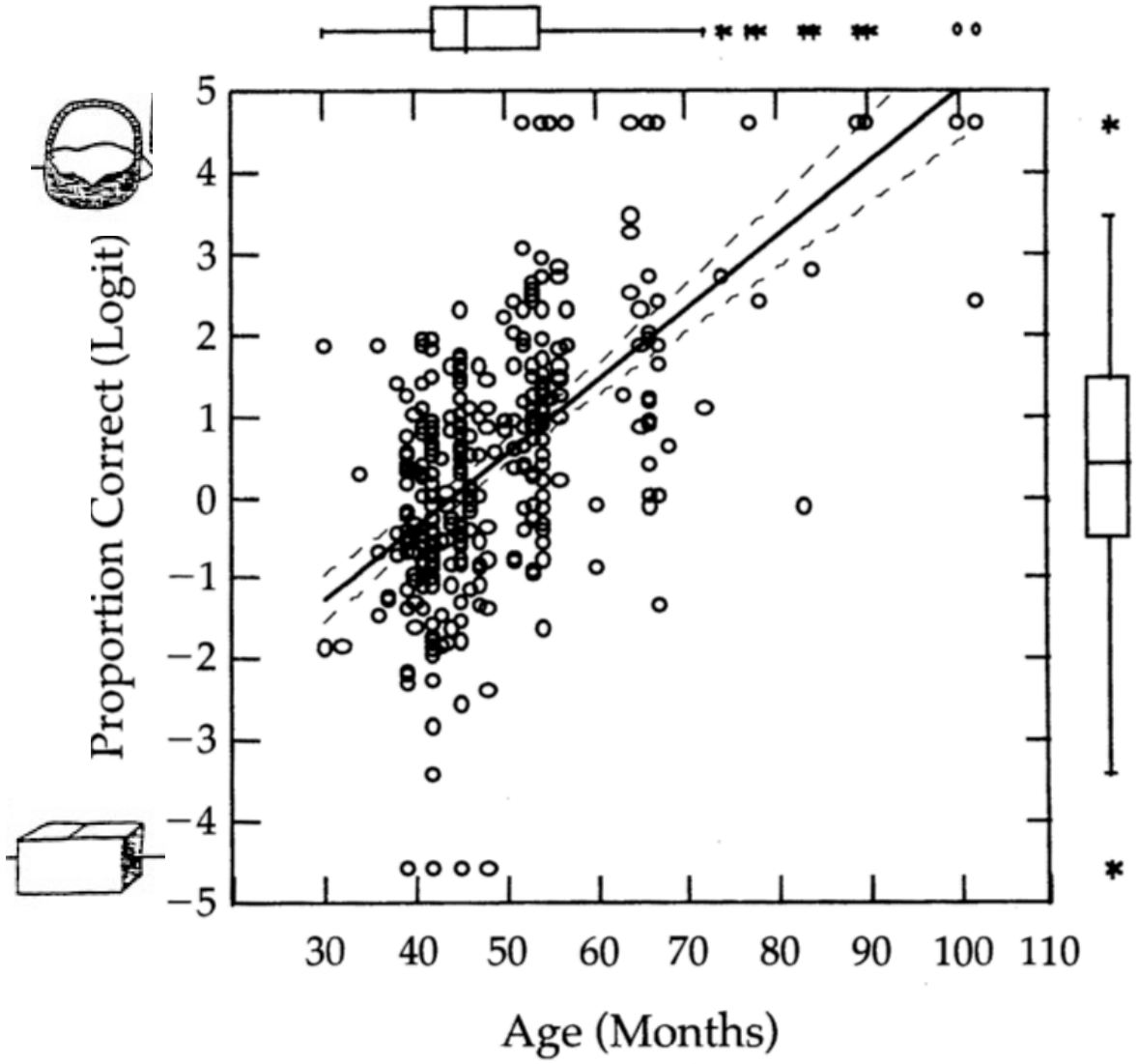
- Failure at 3 years, success at 4
  - Developmental pattern is very robust
- **Why do children fail?**
- Demands of the task:
  - Represent the true state of the world
  - Represent false belief
  - Attribute false belief to another person
  - Select between them on the basis of a linguistic prompt

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)

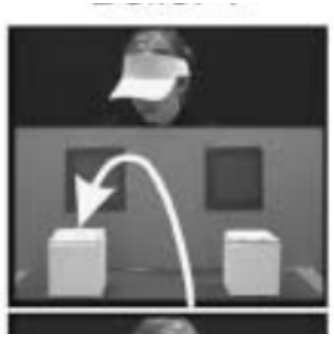
A beautiful story

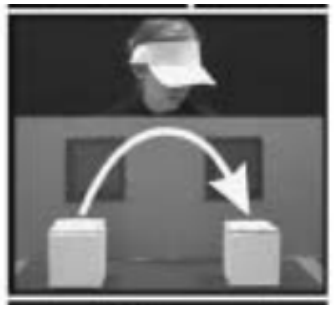
- Children gradually develop a representational theory of mind around 3 years of age
- Theory of mind is only seen in humans

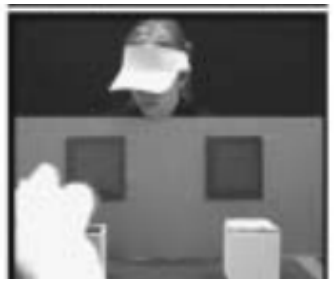
…

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

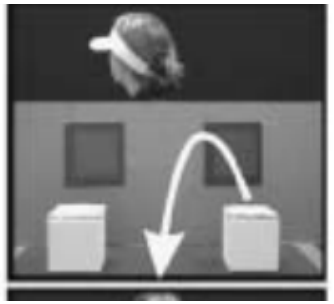
Evidence for early theory of mind?







(Closes lid)



(Secretly removes ball)

(Where will the lady look?)

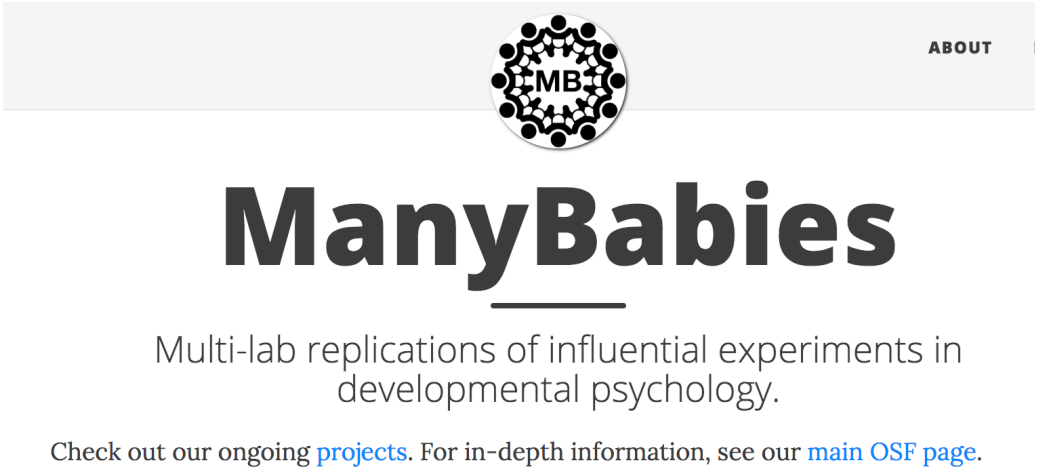
25+ papers from 10+ different labs
(e.g. Buttelman et al, 2009; Clements & Perner, 1994; Knudsen & Liszkowski, 2012; Onishi & Baillargeon, 2005; Southgate et al., 2007; Southgate et al., 2010)

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

Southgate et al. (2007)

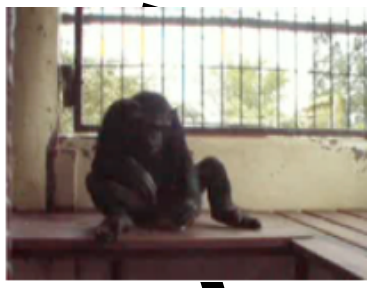
How do we resolve this discrepancy?

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

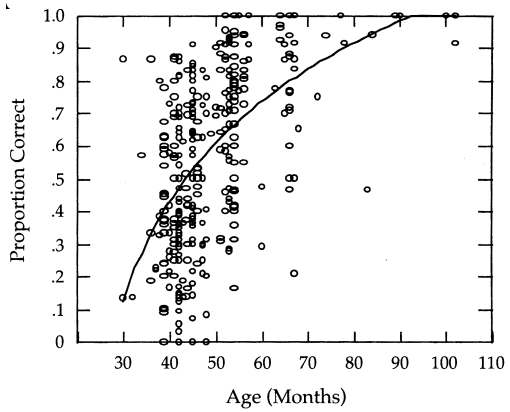


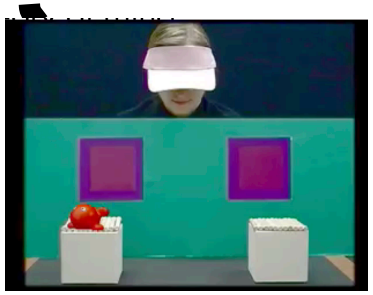
- Revise the theory
  - Complete continuity
    - Preschool results are artifacts
    - Standard tasks too difficult
  - TOM_1 and TOM_2
    - Implicit system and explicit system
    - One early/innate, a second one learned slowly
  - Other possibilities?

The Scientific Process



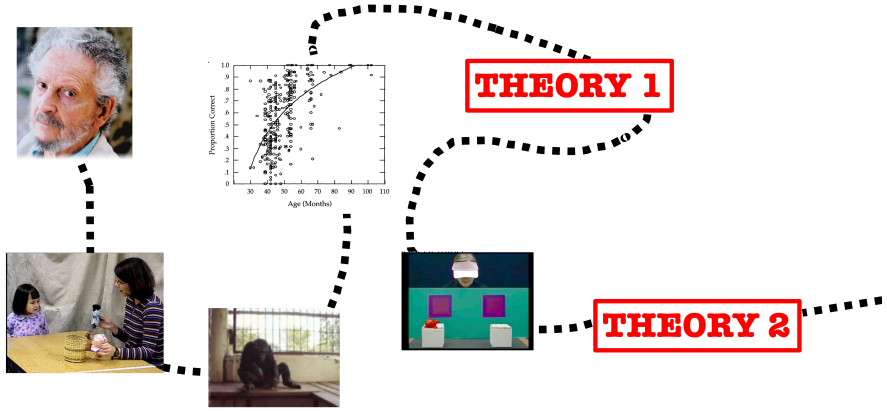
THEORY 1

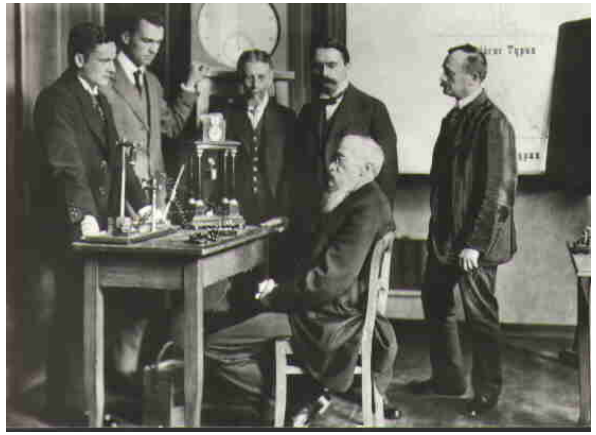




THEORY 2

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 Fa

John P. A. Ioannid

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 skills** for doing so.

Overview of course

1) **Process 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)
  - Lecture: Some lecturing, some interactive
  - Lab: Tutorials and introduction to assignment
- Assignments
  - Focus on R
  - Typically handed out in lab, and due Thursday at noon
  - Must be completed individually, but can work with others
- Monday quizzes
  - Completed on laptop in class
- Take home midterm
- Final project: Meta-analysis (completed in teams)

Class expectations

- **Say things!** Ask questions during lecture, answer my questions, 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.

Some Covid caveats

- **Wear a mask** when there is a requirement on campus
- In-class participation is critical for the course, but I understand that issues may arise due to sickness and quarantine
- Please reach out to me and let me know when these problems come up so that we can figure out how to accommodate you
- Don’t come to class if you’re not feeling well!

How to contact us

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

Note the office hour password!

Instructor

Dr. Molly Lewis

mollylewis@cmu.edu

Porter Hall 208H

[Zoom office]

Office Hours:

W 2:45-4:45pm

TA

Roderick Seow

yseow@andrew.cmu.edu

TBD (email)

[Zoom office]

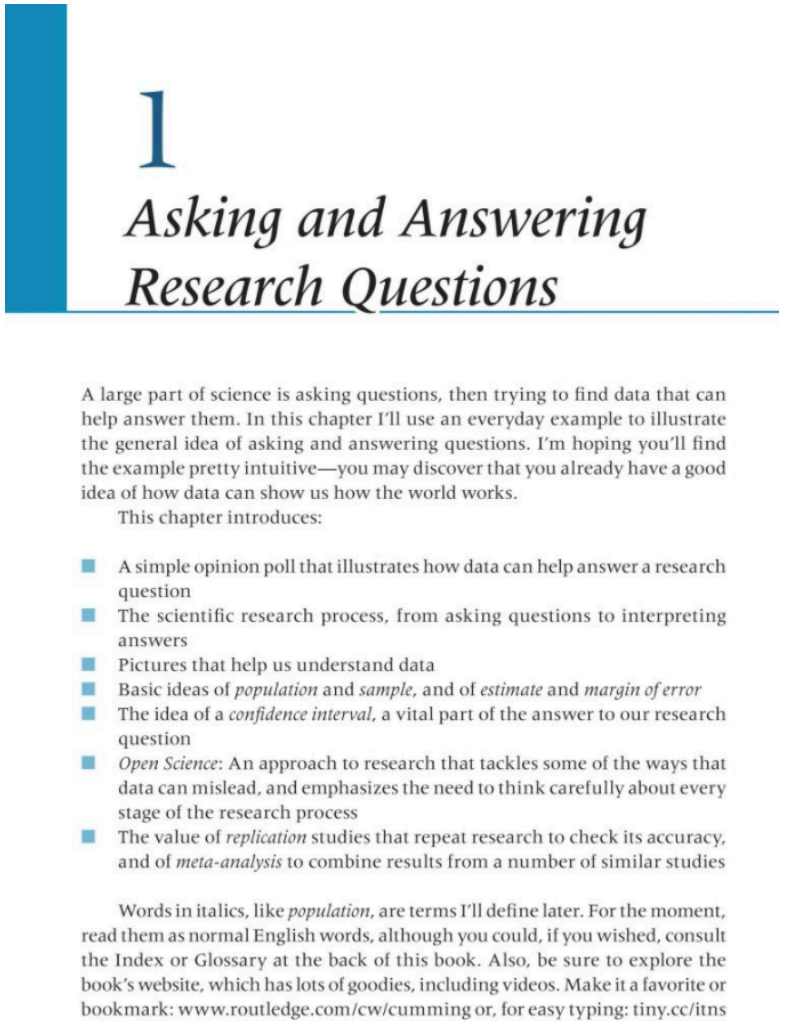
Office Hours:

M 3:30-5:30pm

https://cumulativescience.netlify.com/

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

- Reading: "Asking and Answering Research Questions?"
- Several optional readings which we'll talk about in class
- Complete short survey: https://tinyurl.com/MRMbriefsurvey



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Asking and Answering Research Questions

A large part of science is asking questions, then trying to find data that can help answer them. In this chapter I'll use an everyday example to illustrate the general idea of asking and answering questions. I'm hoping you'll find the example pretty intuitive—you may discover that you already have a good idea of how data can show us how the world works.

This chapter introduces:

- A simple opinion poll that illustrates how data can help answer a research question
- The scientific research process, from asking questions to interpreting answers
- Pictures that help us understand data
- Basic ideas of *population* and *sample*, and of *estimate* and *margin of error*
- The idea of a *confidence interval*, a vital part of the answer to our research question
- *Open Science*: An approach to research that tackles some of the ways that data can mislead, and emphasizes the need to think carefully about every stage of the research process
- The value of *replication* studies that repeat research to check its accuracy, and of *meta-analysis* to combine results from a number of similar studies

Words in italics, like *population*, are terms I'll define later. For the moment, read them as normal English words, although you could, if you wished, consult the Index or Glossary at the back of this book. Also, be sure to explore the book's website, which has lots of goodies, including videos. Make it a favorite or bookmark: www.routledge.com/cw/cumming or, for easy typing: tiny.cc/itns

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

Brief class survey:
https://tinyurl.com/MRMbriefsurvey

Acknowledgements

Slides 6 – 16 adopted from Mike Frank.