

# Using the Scientific Method

Week 3

# Conducting Research: An example

**Claim:** *People perform best with a good night of sleep*

- ▶ To begin to answer it we've got to FOCUS the idea
  - ▶ Break the general idea down into smaller, more specific ideas
  - ▶ Develop theories as to **how** and **why**
- ▶ EVALUATE the idea (e.g., the ROT test)
- ▶ TEST the idea: use research methods to test parts of the theories (hypotheses)

# Conducting Research: An example

**Claim:** *People perform best with a good night of sleep*

- ▶ Focusing the idea
  - ▶ What do we mean by performance?
    - ▶ Academic performance?
    - ▶ Physical performance?
  - ▶ What do we mean by “good night sleep”?
    - ▶ 8 hours? / Uninterrupted? / 3 hours of REM?
  - ▶ What is the underlying theory?
    - ▶ e.g., consolidation of memories happens during REM sleep, so getting more REM sleep should lead to better recall

# Conducting Research: An example

**Claim**: *People perform best with a good night of sleep*

- ▶ Evaluating the idea (ROT)
  - ▶ Can we replicate the research? Do we get similar results?
    - ▶ Answer may depend on our research methods
  - ▶ How do we observe performance? How do we observe **good sleep**?
    - ▶ Recall tests / recognition tests / “brain waves” from EEG
  - ▶ Are our predictions testable?

# Conducting Research: An example

**Claim:** *People perform best with a good night of sleep*

- ▶ How might we go about trying to test this claim?
  - ▶ What are the things (variables) of interest?
  - ▶ What is the hypothesized relationship between these variables?
  - ▶ How should we test it?

# General approaches to research

**Observational approach:** How do we observe the behaviors of interest?

- ▶ Naturalistic observation
- ▶ Participant observation
- ▶ Survey & interviews
- ▶ Archival data
- ▶ Systematic (contrived) observation

# Observational methods

**Naturalistic observation:** Observation and description of behaviors within a natural setting



- ▶ High external validity
- ▶ Good for behaviors that don't occur in more controlled settings
- ▶ Often a first step in the research project
- ▶ Can be difficult to do well
  - ▶ Hard not to influence things (reactivity effects)
  - ▶ Takes a long time
  - ▶ Need multiple observers to agree

# Observational methods

**Participant observation:** The researcher engages in the same behaviors as those being observed



- ▶ May allow observation of behaviors not normally accessible to outside observation
- ▶ Internal perspective from direct participation (but, could lead to loss of objectivity)
- ▶ Potential for contamination by observer



# Observational methods

**Survey methods:** Questionnaires and interviews that ask people to provide information about themselves



- ▶ Widely used methodology
- ▶ Best way to collect *some* kinds of information (e.g., descriptive and preferential info)
- ▶ Large amounts of data can be collected quickly with relatively little cost (effort, time, etc.)
  - ▶ But, they're often not as "cheap" as you might think
  - ▶ Done correctly, can be a very difficult method

# Observational methods

**Archival data:** Rather than making direct observations, researcher examines existing public or private records



- ▶ If the appropriate existing records can be found, no need for data collection
- ▶ Data set may be more extensive than what you could collect yourself
- ▶ Data may be of observations you cannot (ethically) collect or manipulate
- ▶ Word of caution: be aware of how and where data were collected

# Observation without manipulation

## Advantages

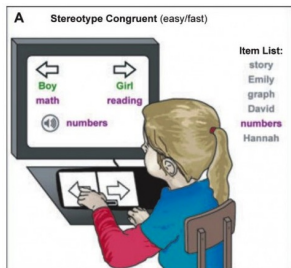
- ▶ Complex patterns of behavior in particular settings
- ▶ Useful when little is known about the subject of study
- ▶ May learn about something that never would have been studied experimentally

## Disadvantages

- ▶ Causality is a problem
- ▶ Threats to internal validity
  - ▶ Every confound is a threat
  - ▶ Lots of alternative explanations
- ▶ Directionality of relationships sometimes isn't known
- ▶ Sometimes results are not reproducible

# Observational methods

**Systematic observation:** The observer sets up the situation that is observed



- ▶ Observations of one or more specific variables made in a precisely defined setting
- ▶ Much less global than naturalistic observations
- ▶ Often takes less time
- ▶ Example: our class memory experiment!

## More general research approaches

- ▶ Case studies
- ▶ Correlational
- ▶ Quasi-experimental
- ▶ Experimental

## More Observational methods

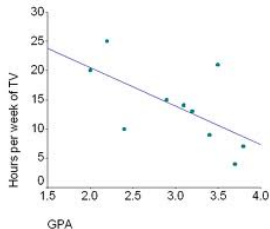
**Case study:** Intensive study of a single person, a very traditional method



- ▶ Typically an interesting (and often rare) case (e.g., Phineas Gage)
- ▶ Often a number of disadvantages
  - ▶ Poor generalizability
  - ▶ A number of possible confounds and alternative explanations
  - ▶ Hard to do correctly

# More Observational methods

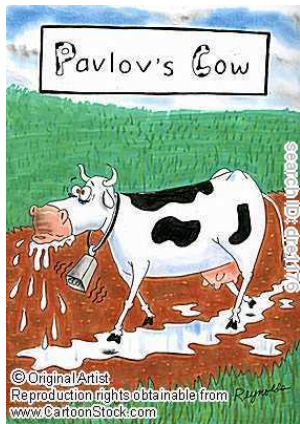
**Correlational methods:** Measure two (or more) variables for each individual and see if the variables co-occur (suggesting they are related)



- ▶ Used for
  - ▶ Predictions
  - ▶ Reliability and validity
  - ▶ Evaluating theories
- ▶ Problem: Can't make causal claims!

# More Observational methods

**Experimental method: Manipulating and controlling** variables in laboratory experiments



- ▶ Must have a comparison
  - ▶ At least two groups that get compared (random assignment to groups)
  - ▶ Quasi-experiment: groups NOT randomly assigned (ex: smokers vs. nonsmokers)
- ▶ Variables
  - ▶ Independent variable – variable that is manipulated
  - ▶ Dependent variable – variable that is measured
  - ▶ Control variables – held constant for all participants in experiment



# The experimental method

## Advantages

- ▶ Precise control possible
- ▶ Precise measurement possible
- ▶ Theory testing possible
- ▶ Can make causal claims

## Disadvantages

- ▶ Artificial situations may restrict generalization to “real world”
- ▶ Complex behaviors may be difficult to measure