Research Methods in Cognitive Science

Week 5: Experiment Basics

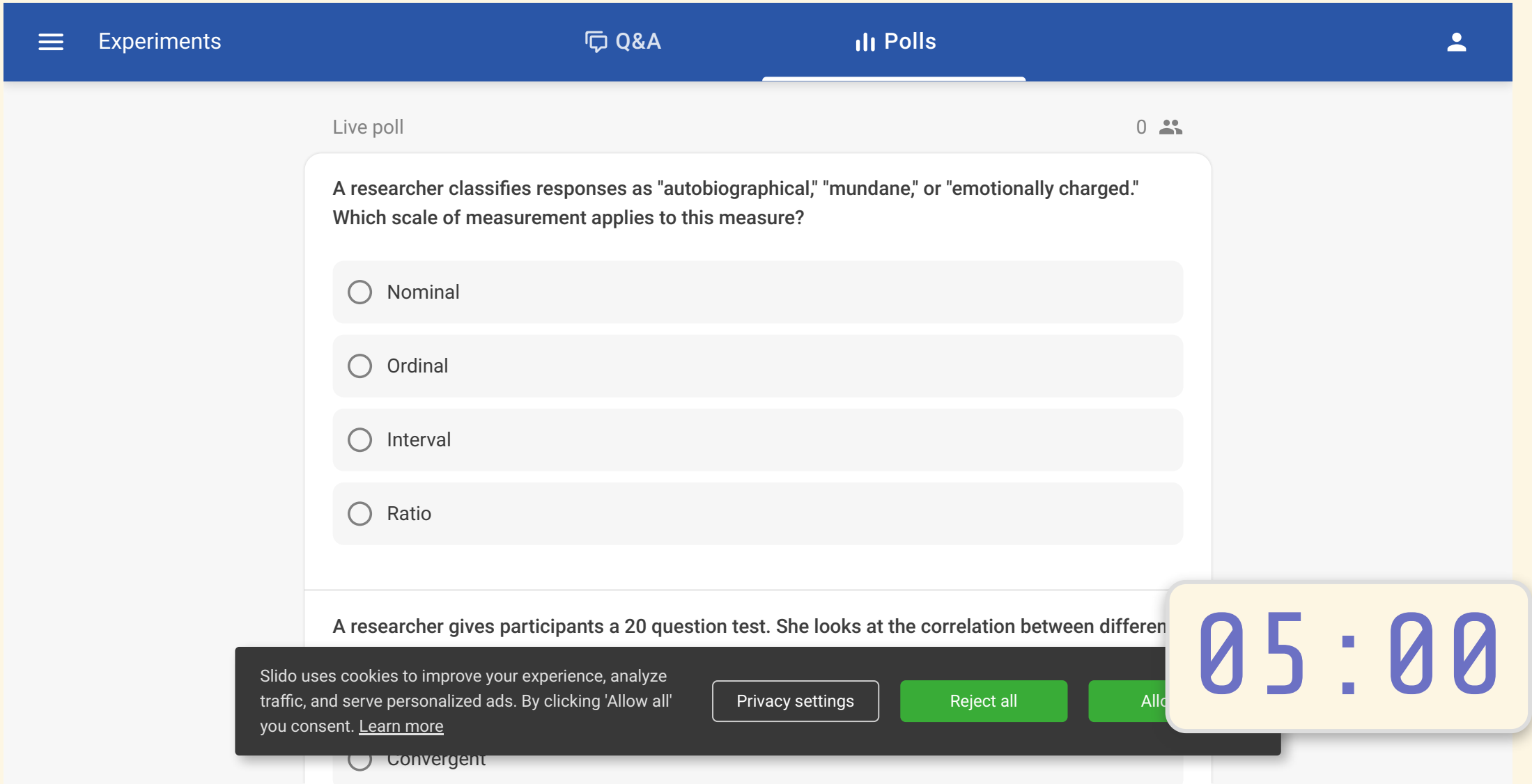
Jason Geller, Ph.D.

2021-09-30

Housekeeping

- Tuesday: Teams 1 and 2 meet me in A120
- Thursday: Sarah Colby Virtual Talk

Last Class


Experiments
Q&A
Polls
Live poll
0
A researcher classifies responses as "autobiographical," "mundane," or "emotionally charged." Which scale of measurement applies to this measure?
Nominal
Ordinal
Interval
Ratio
A researcher gives participants a 20 question test. She looks at the correlation between differen
Slido uses cookies to improve your experience, analyze traffic, and serve personalized ads. By clicking 'Allow all' you consent. Learn more
Privacy settings
Reject all
Allo
Convergent
05:00

Today

- IV and DV
- Experimental Designs: Between vs. Within
- Confounds and Selection Effects
- Critiquing Experiments
- More threats to internal validity

Experiments

> Primary goal of experiments is to identify causal relationships between things in the world

- Two pillars of experimental design:

1. Manipulation
2. Random assignment

Cause and Effect

- Cause
  - Independent variable (IV): Manipulated
- Effect
  - Dependent variable (DV): Measured

IV: Note Taking

DV: Test Performance

Better test scores

Worse test scores

Threat

SELECTION EFFECTS

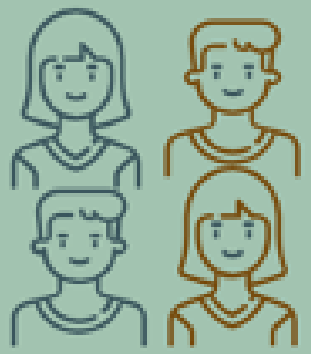
Solution

RANDOM ASSIGNMENT

Random Assignment

IV: Note Taking

DV: Test Performance



Better test scores

Worse test scores

Between vs. Within Designs

- Between-participants design

> Each participant experiences only one condition in the design. Chance determines which condition.

Within-Subjects Design

1. Week 1: Pen and paper
2. Measure Performance
3. Week 2: Typing
4. Measure Performance

Each participant experiences all conditions in the experiment.

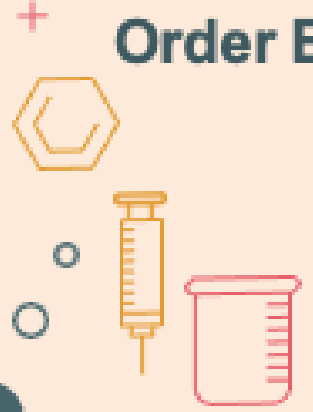
Threat

ORDER EFFECTS

Solution

COUNTERBALANCING

Within-Subjects Design



Order A

Week 1: Pen and Paper → Measure Performance → Week 2: Typing → Measure Performance

1 → 2 → 3 → 4

Order B

Week 1:Typing → Measure Performance → Week 2: Pen and Paper → Measure Performance

Each participant experiences <u>all</u> conditions in the experiment in a randomly assigned order.

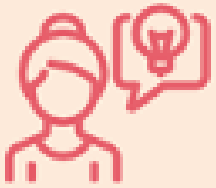
Pros and Cons of Between and Within Designs

- Between-participant designs:
  - Require larger sample sizes (sometimes 100s depending on effect size)
  - But, fewer worries about contamination across conditions
- Within-participant designs:
  - Participants serve as their own controls (increases statistical power)
  - Worries: Order effects, experimental demand

Confounding Variables

An alternative cause of the observed outcome

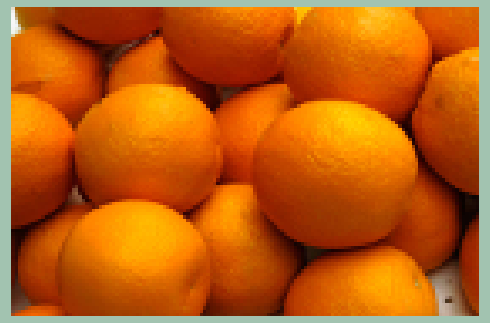
MUST covary with manipulated variable



Consider a study...

IV: Vitamin C

DV: Academic Performance



Better grades

Worse grades

Four Validities

INTERNAL

Are causal conclusions sound?

EXTERNAL

Can results be generalized?

CONSTRUCT

Are measures and manipulations sound?

STATISTICAL

Are quantitative conclusions sound?

Review

- Experiments have a manipulated variable (IV) and a measured variable (DV)
- Ps experience just one condition (between-Ps) or all conditions (within-Ps)
- Watch out for order effects, confounds, and selection effects
- Use the four validities to critique experiments

The bad experiment

- One-group, Pre-test/Post-test design

Maturation

> Participants are changing naturally over time between pre-test and post-test.

- Rule out by using a control/comparison group.

History

> An event intervenes between pre-test and post-test to change participants

- Maybe something big happened in the news that was related to your study.
- Rule out by using a control/comparison group.

Regression to the mean

> Participants are selected for intervention based on their extreme scores. On re-measurement, their scores become more moderate

- A group's average is extremely depressed at pretest, in part because some members volunteered for therapy when they were feeling worse
- Rule out by using a control/comparison group.

Attrition

> Participants drop out of the study at different rates fromtreatment group and control group

- Maybe they got:
  - Illness
  - Died
  - Left the experiment

Testing

> Participants' responses change over repeated testing.

- GRE verbal scores improve only because students take the same version of the test both times
- Solved by using a between-subjects, post-test only design

Instrumentation

> The meaning of a measuring instrument changes over repeated use. Changes are not due to the IV.

- Coders become bored or fatigued over time
- Solve by using masked coders, randomly assigning coders to stimuli,, or training

Review: 3 More Threats

CONFOUNDS

Variables that covary with IV and obscure causal relations.

SELECTION EFFECTS

Participants differ system-atically across conditions.

ORDER EFFECTS

Order of treatments causes a difference instead of IV.

Review

- All told, a dozen different threats conspire to mess up causal claims
- Be attentive to control/comparison group
- Watch out for differences between treatment and control (beyond the one intended change)