

# HCI Methods Overview and Validity

## Lecture 3

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(some slides courtesy of Prof. Adam Aviv and Prof. Michelle L. Mazurek)

# Administrivia

- HW0 is due by midnight
  - Bio + Answer 3 questions
- Reading Assignments
  - Contributions = results of the research
- Cybersecurity and Public Policy Seminars (See Piazza Post)
  - A Conversation with Brittany Saunders, Deputy Commissioner for Strategic Initiatives at the NYC Commission on Human Rights (Wed 12-1pm)
  - Register by emailing [joshua.anderson@tufts.edu](mailto:joshua.anderson@tufts.edu)

# What we did last time!

- Introduction to Security and Privacy
- Introduction to Human Factors in Security and Privacy Concepts
  - Key Challenges
  - Major Topics
- Break – discuss “Users are not the Enemy” or “User-centered Security”

# What are we doing today?

- Research Questions and Hypotheses
- Is my study valid?

# Suppose ...

- You want to measure how users consider privacy and their location information on their mobile devices
  - How would you measure that?
    - What would be some specific research questions?
  - What would be your experimental procedure?
    - What methods would you use in that procedure?
  - Which group of people would you want to recruit?
  - What might be a hypothesis you want to test?
- Read NYT article to help you think of the privacy issues
- **Lets do a quick break out into groups of 3:**
  - Zoom break out room...
- I'll bring everyone back in about 15 minutes

<https://www.nytimes.com/2020/08/19/technology/smartphone-location-tracking-opt-out.html>

## ***How Your Phone Is Used to Track You, and What You Can Do About It***

Smartphone location data, often used by marketers, has been useful for studying the spread of the coronavirus. But the information raises troubling privacy questions.



# Report out about research ideas

- RQ1: How do people react to location services pop-ups
  - Method: In-app survey w/follow-up interviews
  - Target: Broad intersection of population
  - Hyp: People won't remember what they chose or contents of notice
- RQ2: How do people perceive tracking across different devices
  - Method: Semi-structured interviews
  - Target: Broader intersection of US pop, age and political differences
  - Hyp: Older might think more or less tracked
- RQ3: How do people prevent
  - Method: Online survey of concern
  - Target: Broader intersection of US pop, age and political differences
  - Hyp: Older might think more or less tracked
- RQ4: Do users know apps were collecting data?
  - Method: Provide examples of real-world
  - Target: Broader intersection of US pop, age and political differences
  - Hyp: Users dramatically underestimate
- RQ4: Do users change behaviors if they're aware of tracking
  - Method: Provide examples of real-world
  - Target: Broader intersection of US pop, age and political differences
  - Hyp: People will change privacy settings if made aware

# Research Questions / Research Hypothesis

- **Research Questions**

- General desires that should be addressed by conducted research
- *How worried are users that there is implicit location tracking on their mobile devices?*
- *Do users take any actions to combat implicit location tracking on their mobile devices?*

- **Research Hypothesis**

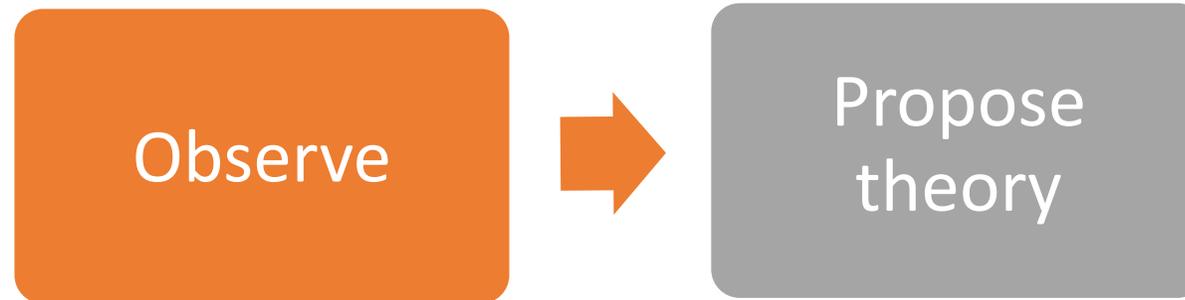
- A statement whose validity can be directly validated (accepted or rejected)
- *Users who are more privacy aware are more likely to be concerned about location tracking.*
- *Users who turn off their phones' wifi do so because they are concerned with implicit tracking.*

*You do not need to have a hypothesis to begin research, but you should at least have a research question!*

# Exploratory vs. Hypothesis Driven Research

- **Exploratory Research**

- Formed around a research questions to be explored
- The goal may be to describe themes, develop hypothesis to test later, or propose new design directions



- Interviews/Focus Groups
- Direct Observation
- Surveys
- Field Studies
- Usability Testing (In Lab)

Warning: Can induce incorrect results from valid data!

# Exploratory vs. Hypothesis Driven Research

- **Hypothesis Driven Research**

- Directly validate a set of hypothesis
  - Typically follows an exploratory research step
- Controlled experiment where it's clear where each hypothesis can be tested

- Surveys
- Field Studies
- Artifact Evaluation
- Controlled Experiments
- Mixed-Methods



AKA: The scientific method

*Many of the research papers we will read are exploratory in nature and not driven by hypothesis, but it's important to be able to develop hypothesis that can be evaluated. Occasionally, you'll find that you have both exploratory research questions as well as direct hypothesis that can be evaluated in the same research.*

# Null/Alternative Hypothesis

- *Users who are more privacy aware are more likely to be concerned about location tracking.*
- $H_0$ : There **is no** difference between more or less privacy aware individuals in their concern about location tracking.
- $H_1$ : There **is** a difference between more or less privacy aware individuals in their concern about location tracking.

# Exercise: Developing some Hypotheses for ...

## *Mobile Device Location Information*

*A good hypothesis is...*

- *Presented in precise, lucid language*
- *Focuses on a problem that is testable in one experiment*
- *Clearly states the control group or conditions of the experiment*

# Dependent vs. Independent Variables

- Independent Variables

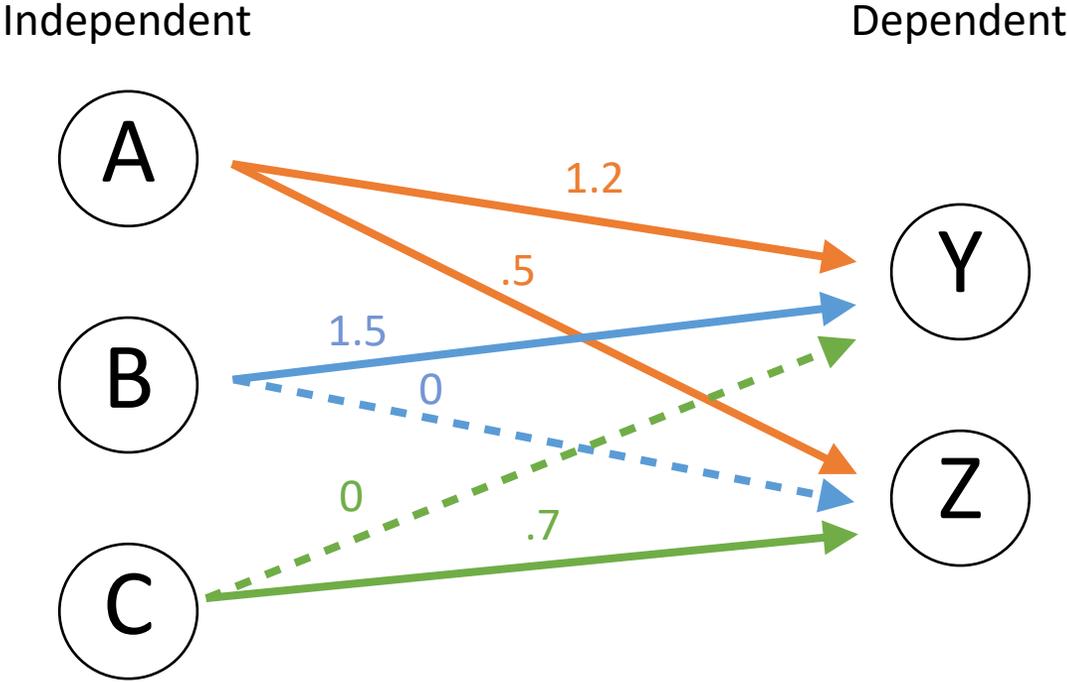
- The thing we're interested in researching
- The *cause* or thing that *changes* in the experiment
- Typically the **treatments** or **conditions** of the experiment

- Dependent Variables

- Outcomes or effects of the change
- This is *dependent* on the participants behavior resulting from the change in an independent variable

*How do changes in independent variables induce changes in dependent variables?*

# Dependent vs. Independent Variables



# Dependent vs. Independent Variables

- Independent Variables

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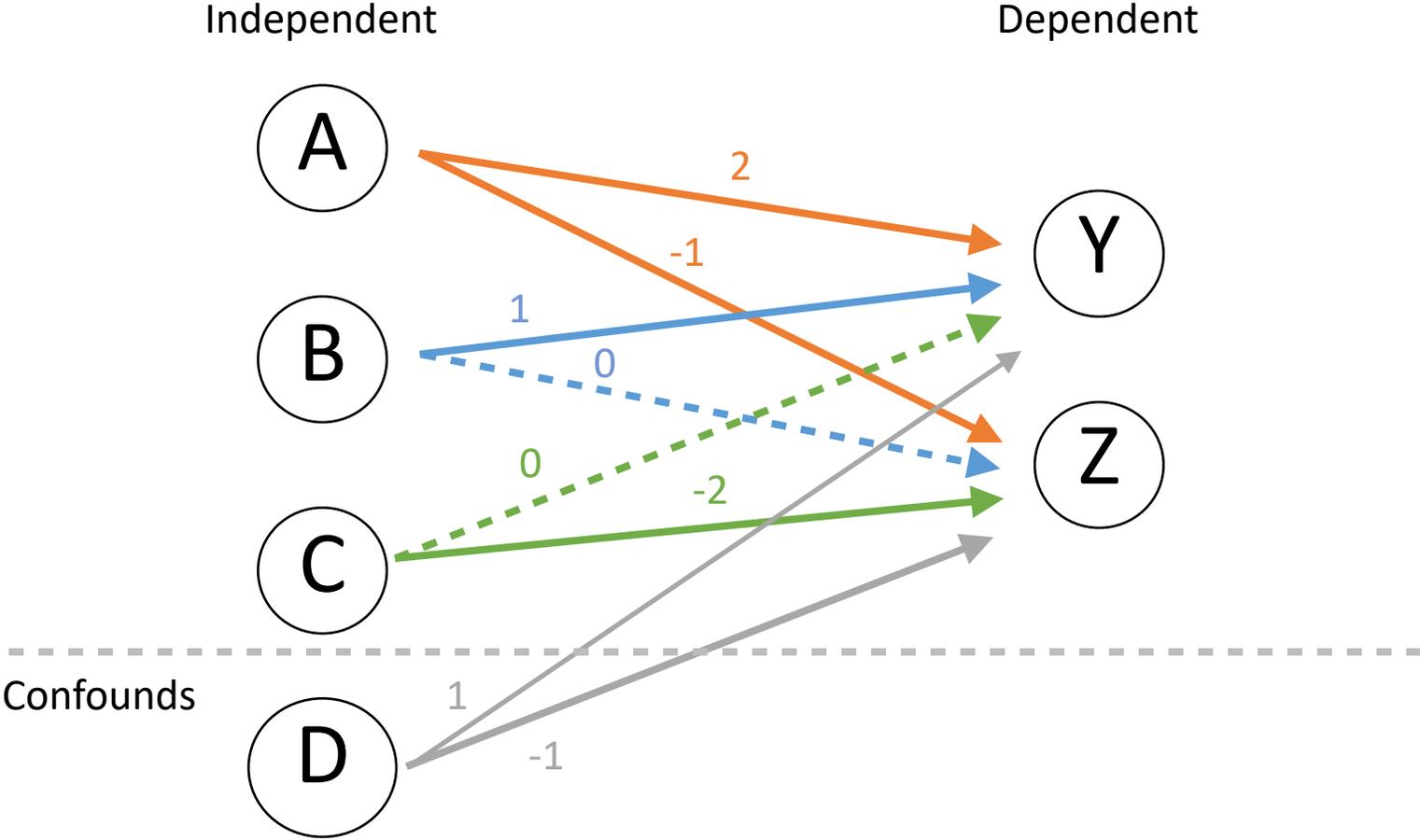
- Outcomes or effects of the change
- This is *dependent* on the participants behavior resulting from the change in an independent variable

*How do changes in independent variables induce changes in dependent variables?*

- Confounding Factors

- Variances between participants we're not interested in
- Need to control or account for

# Dependent vs. Independent Variables



# Matching hypothesis to experiments

- There isn't a limit to the number of hypothesis (or RQ) that can be evaluated in an experiment, but the power and focus of that experiment could be diluted by evaluating too many factors
- *Exercise: Can we design an experiment for each or combinations of the hypotheses we came up with?*
  - *<break out again, 10-minutes>*

# Experiments to Hypothesis (report out)

- H1:

- *Ind. Var:*
- *Dept. Var:*
- *Confounding factors:*
- *Experiment:*

- H2:

- *Ind. Var:*
- *Dept. Var:*
- *Confounding factors:*
- *Experiment*

# Studies and Experiments

- We're going to be reading a lot of studies, measurements, experiments, etc.
- How do you evaluate these?
- How do you design a good one?

# Validity

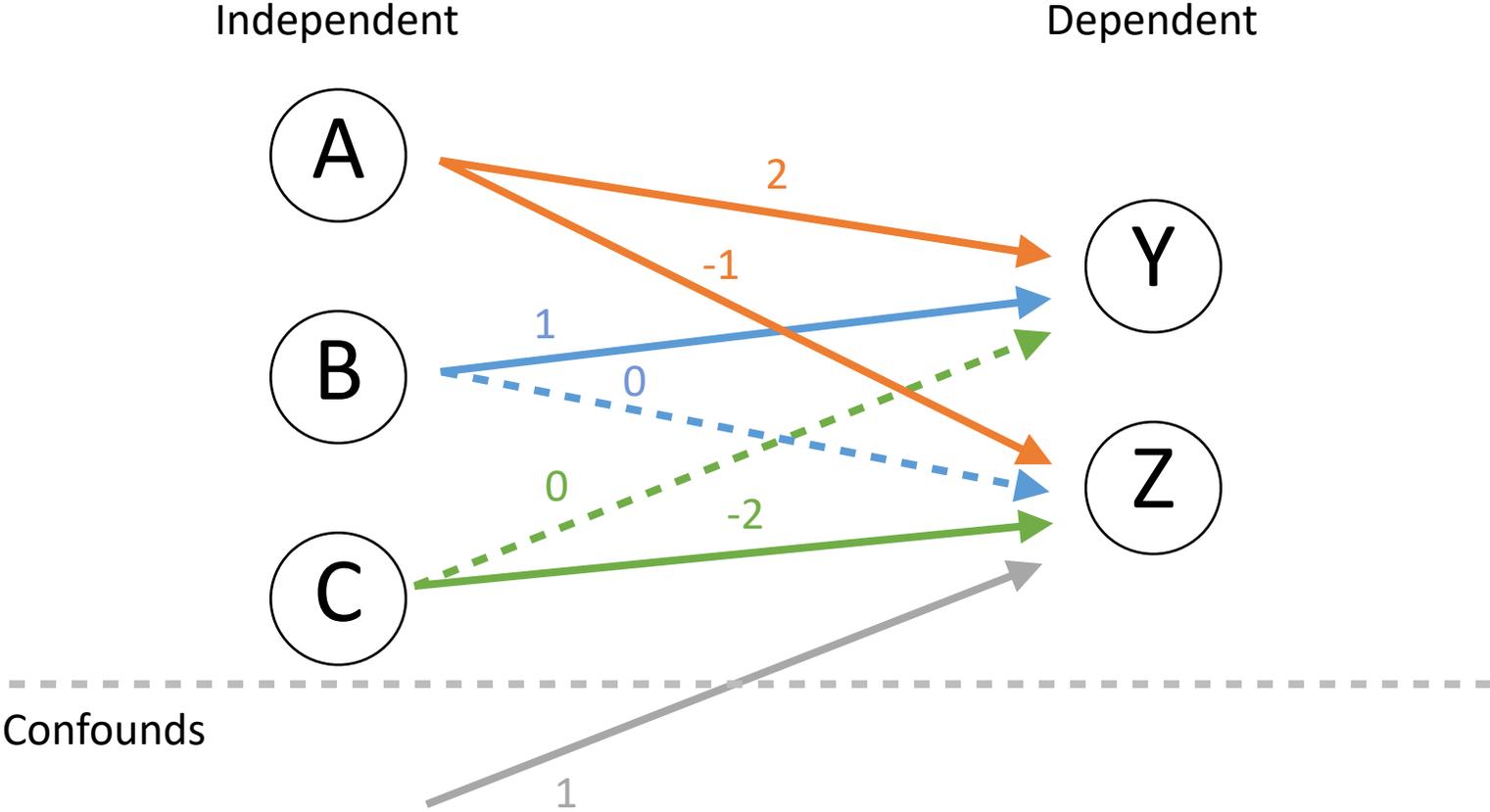
# 1. Internal validity

- Results are consistent and comparable
- Especially important for experiments
- Conditions shouldn't vary in anything except the variable under test  
(*no confounds*)
  - Orthogonal / one variable at a time
  - Randomized assignment
  - Blinding

# Threats to internal validity

- Learning/ordering effects

# Learning/Ordering Effects



# Threats to internal validity

- Learning/ordering effects
- Placebo effect
- Bad randomization
- Self-selection
- Dropouts
- Errors in measurement

## 2. External validity

- What population does your sample represent?
  - Race, gender, age, nationality, education, others
- What environment does your study represent?
  - Carefully controlled study vs. real world

# Threats to External Validity

- Poor sampling
- Non-response/self-selection, dropout
- Unrealistic environment
- Priming or prompting
- Social desirability, demand effects

# Internal vs. external

- Often tension between them. Why?

# 3. Construct validity

- Often difficult to directly measure the concept(s) of interest
  - How would you measure tech-savviness?
  - How would you measure privacy sensitivity?
- Do our metrics measure what we intended?

# Analyzing your construct(s)

- Is there a gold standard? Use it
- What else should it correlate with?
- Is it reliable?
  - Inter-item, inter-rater, test-retest
- Floor and ceiling effects

# Research Methods (a sample)

- Qualitative

- Collection methods:
  - Interviews/Focus Groups
  - Diary Studies
  - Surveys (open text)
- Analysis methods:
  - Thematic Coding

- Quantitative

- Collection methods:
  - Surveys (closed text)
    - Likert Responses
  - Behavioral observation
  - Artifact analysis
  - Experimental design
- Analysis methods:
  - Significance Testing
  - Regression

# What we did today!

- Research questions and hypotheses
- Is my study valid?

# What's next?

- Qualitative methods
  - Goals
  - Interviews/Focus groups
  - Diary Studies
  - Qualitative Coding