

Introduction to Statistics and Research Design

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Two Branches of Statistics

□ Descriptive Statistics

- Organize, summarize, & communicate
- Reduce large amounts of data

□ Inferential Statistics

- Uses sample data to make estimates about larger population



Public opinion on legalization of marijuana:

LEGAL: 44% ILLEGAL: 54% (Gallup Poll)

Sample vs. Population

- Sample: A set of observations drawn from the population of interest...
 - Representative Sample:...that share the same characteristics as the population of interest.
- Population: Includes all possible observations about which we'd like to know something.
- Why use samples?
 - Very rare that we can study every member of a population

Transforming Observations Into Numbers

- Constructs: hypothetical ideas that have been developed to describe and explain human behavior
 - GIGO (Garbage In, Garbage Out)
 - Discrete Observations: Take on specific values; no other values exist between these numbers
 - Example: The number of people on a city bus.
 - Continuous Observations: Can take on an infinite number of potential values
 - Example: Time taken to complete a math problem.

Scales of Measurement

- **Nominal:** Observations have names or categories as values.
 - Example: Race
- **Ordinal:** Observations that have rankings as values
 - Example: NCAA Rankings
- **Interval:** Have actual numbers as values, and distance (or interval) between values is assumed to be equal.
 - Example: Reaction Time
- **Ratio:** Meet all criteria for interval but also have a meaningful zero point.
 - Example: Distance

Scales of Measurement

TABLE 1-1. QUANTIFYING OUR OBSERVATIONS

There are four types of variables that we can use to quantify our observations. Two, nominal and ordinal, are always discrete variables. Interval variables can be discrete or nominal; ratio variables are almost always continuous.

	DISCRETE	CONTINUOUS
NOMINAL	Always	Never
ORDINAL	Always	Never
INTERVAL	Sometimes	Sometimes
RATIO	Seldom	Almost Always

Variables

- Independent Variables (IV): Because variables vary, any IV must have at least two values (levels) that it can take on.
 - IVs are manipulated or observed to determine the effects on the dependent variable
 - Examples: Gender, Caffeine Intake
- Dependent Variable (DV): Observed or measured to discover differences caused by changes in the IV.
 - Examples: Political Views, Exam Scores

Variables

- **Confounding Variables:** Anything that systematically varies with the IV so that we cannot logically determine which variable is at work
 - Example: Did wind or water cause the damage observed after Hurricane Katrina?
- **Extraneous Variables:** Randomly distributed influences that detract from efforts to measure what was intended to be measured.
 - Example: Distractions
- **Noise:** Any influence that makes the relationship between variables less clear

Test Your Knowledge



New Drug May Cure Hangovers

What would the IV and DV be in this study?

What are some possible confounding or extraneous variables in the above new drug study?

Reliability and Validity of Tests

- Reliability: A test is considered reliable if it is consistent.
 - Example: Does your IQ score change from one day to the next?
 - Test-Retest Reliability

- Validity: Does the test measure what it intends to measure?
 - Example: Does the IQ test actually measure intelligence?
 - Predictive Validity

Test Your Knowledge



Your New Awesome Bathroom Scale

Your doctor weighs you at 175 lbs. Every time you get on your new scale at home, it shows 165 lbs. You try over and over with your scale but it always says 165 lbs.

Is this scale reliable? Is this scale valid?

Intro to Hypothesis Testing

□ What is a hypothesis?

- The predicted outcome of an experiment based on a belief about the relation between variables.

□ What is hypothesis testing?

- The process of drawing conclusions about whether a particular relation variables is supported by the evidence.

Operational Definition

- “Specifies the operations or procedures used to measure or manipulate a variable”
 - Example: Self-report scale measuring anxiety
- “Why do I have to take this class?”
 - “Will the effort I put into this class yield personal benefits?”
 - “Have previous students at this college benefited from learning statistics?”
 - Survey alumni...

Operationalizing Hypotheses

CONCEPTUAL VARIABLE	OPERATIONALIZED VARIABLE
Gender	Self-reported gender
Who uses ATMs the fastest	_____
Amount of will power	_____
Level of cigarette smoking	_____
Level of caring by administrators	_____
How bad the parking problem is	Ask students to rate the parking problem on a scale ranging from 1 (no problem) to 5 (the worst problem on campus)
Level of joke-telling ability	_____
Number of friends	_____

Test Yourself

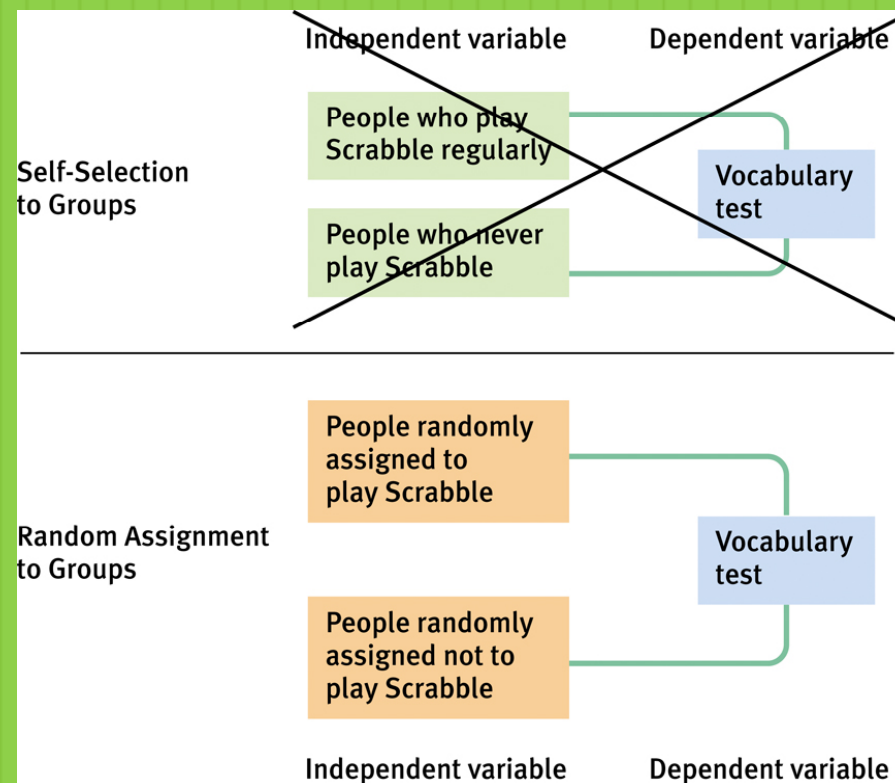
In a study of the effects of cocaine on specific regions of the brain, microscopic amounts of the drug are delivered to specific regions of the brain, using the latest technology. The subjects are laboratory rats and they are randomly assigned to four groups, each group to receive the drug in only one region of the brain. The effects of the drug on arousal are measured by seeing how long a tired animal will remain awake after an injection of the drug.

- Independent Variable(s), Dependent Variable(s), Confounding Variable(s), Extraneous Variable(s), Operational Definition(s), Hypothesis(es)

Types of Research Design: Experiments

- A study in which participants are randomly assigned to a condition or level of one or more independent variables
 - Random Assignment: Every participant in the study has an equal chance of being assigned to any condition.
 - Single-Blind Experiment: Participants do not know the condition to which they are assigned.
 - Placebo Effect: When an expectation of an outcome causes or appears to cause that outcome to take place.
 - Double-Blind Experiment: Neither participants nor experimenters know the participants' assigned condition
 - Demand Characteristics: Inadvertently cueing the participants to certain responses.

Random Assignment

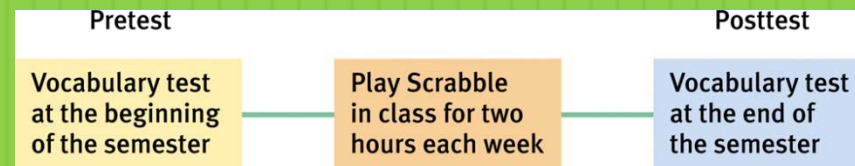


Why do we need random assignment? What does it accomplish?

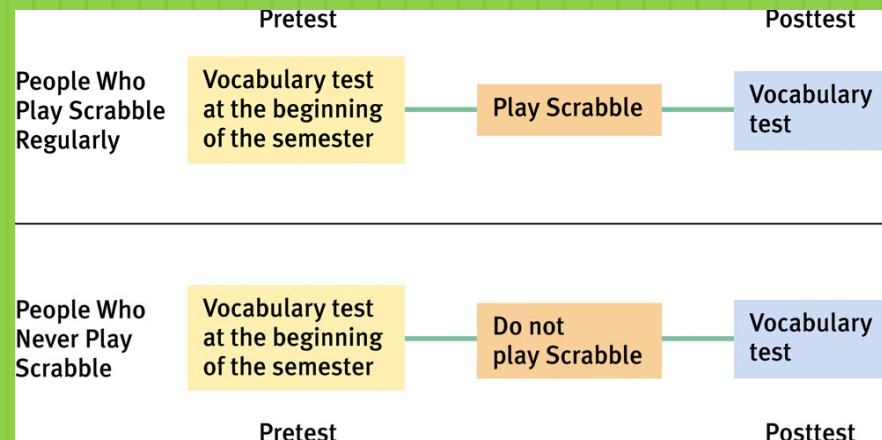
Types of Research Design: Nonexperiments & Quasi-Experiments

- Used when we cannot randomly assign participants to conditions. No true cause-and-effect.

- Nonexperiments



- Quasi-Experiments



Types of Research Design: Between- vs. Within-Groups

- Between-Groups: Participants experience one, and only one, level of the independent variable.
- Within-Groups: The different levels of the independent variable are experience by all participants in the study.
 - Order Effects (Practice Effects): How a participant's behavior changes when the DV is presented a second time.
 - Counterbalancing: Minimizes order effects by varying the order of presentation of different levels of the IV from one participant to the next.