

EDP308: STATISTICAL LITERACY

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Overview

- Different Types of Variables
 - ▣ Independent Variables
 - ▣ Dependent Variables
 - ▣ Confounding Variables
- Research Design
 - ▣ Experimental
 - ▣ Quasi Experimental
 - ▣ Correlational
 - ▣ Descriptive
- Testing... Examples

Different Types of Variables

The Variations!

What are variables?

What kind of variables need to be considered in research?

Variables Vary

- Variables are things that vary.
- We measure variables and this collection of measurements makes up our data.
- There are different things to measure...
 - ▣ For example, we can measure:
 - 1) how much someone sweats and
 - 2) how hot it is outside



How do these two different variables relate to one another? How are they different?

Texas Heat

- Let's say we want to know how heat affects how much someone sweats
- You the researcher can ask someone to stand outside in the Texas summer heat, and we can measure:
 - ▣ 1) how much someone sweats and
 - ▣ 2) how hot it is outside

In this example, which variable do you depends on the other one?

Texas Heat

- How much you sweat in the Texas heat **depends** on how hot it is outside...
- How hot it is outside is **independent** of how much you sweat...



IVs & DVs

Independent Variable (IV)

- In an experiment, the variable you control and manipulate
- The variable with the dial or the switch



Dependent Variable (DV)

- The variable that **DEPENDS** on the IV
- The variable you are interested in seeing how it responds to the independent variable



Also known as...

- Independent Variables are also known as **EXPLANATORY** variables because, ideally, they explain why the...
- Dependent variable (aka **RESPONSE** variable) responds the way it does
- Independent variables are the things that make the dependent variable respond a certain way.
 - ▣ Independent variables are independent of the dependent variable

Hypotheses: IVs and DVs

Identify the Independent and Dependent Variables:

- Eating McDonalds 3x a day will increase BMI.
- Exercising 30 minutes a day will decrease your weight.
- Well-being will increase with daily meditation.
- Meta-cognition will increase from 4-weeks of journaling.
- Studying for an hour a day will raise your class grade.
- Giving multiple IV and DV examples will increase student understanding of IV and DV.

Confounding Texas Heat

- Heat can certainly explain some of how much you sweat outside when it's hot, but what else might affect how much you sweat?



Confounding Texas Heat

- Heat can certainly explain some of how much you sweat outside when it's hot, but what else might affect how much you sweat?
 - ▣ What are you wearing while standing outside?
 - ▣ Are you in the shade?
 - ▣ Are you engaged in some exercise like running?
 - ▣ Do you have a thyroid problem or other health issues?



These are **confounding** variables...

Confounding Variables

Confounding variables are other variables that you didn't account for that might affect your dependent variable

□ Confounding Variable

- A variable that relates to the IV and DV that can obscure or accentuate a relationship between the IV and DV

■ Example:

- Anti-Depressant Drug → Subject Feels Better
- Anti-Depressant Drug (+ Nice Researcher) → Subject Feels Better

■ Example:

- Age → Increased Income
- Age (+ years of education) → Increased Income

■ Example

- Lower education → Higher chance of incarceration
- Lower education (+ lower socioeconomic status) → Higher chance of incarceration

Identify Potential Confounders

Identify Possible Confounding Variables:

- Eating McDonalds 3x a day will increase BMI.
- Exercising 30 minutes a day will decrease your weight.
- Well-being will increase with daily meditation.
- Meta-cognition will increase from 4-weeks of journaling.
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Research Design

Experimental:

Experiment with Random Assignment, Quasi-Experimental

Correlational:

Observational Study

Descriptive:

Case Study, Observation, Survey

Historical Moment: Gertrude Cox

- **Gertrude Mary Cox** (Jan. 13, 1900 – Oct. 17, 1978)
- American statistician and the founder of the department of Experimental Statistics at North Carolina State University, then later a director of the Institute of Statistics among many other titles.
- One of her greatest skills was her ability to organize and implement programs focused on teaching others the fundamentals of research and statistics.
- Considered a “statistical frontierswoman”



Historical Moment: Gertrude Cox

- ❑ **Gertrude Mary Cox** (Jan. 13, 1900 – Oct. 17, 1978)
- ❑ She was a strong advocate for the paramount connection between statistical analysis and cutting edge computing. She would approve of you all learning R.
- ❑ Because she was so good at communicating the need and importance for good research design and data analysis, she was well known for being able to secure funding (i.e. grants) from many sources.
- ❑ She also loved travelling particularly to developing countries to offer advice and even help establish a statistics program in Egypt.



Experimental Design

- A true experiment involves:
 - **Manipulation** of an independent variable
 - Control and Experimental group
 - Control gets no treatment, drug, independent variable
 - Experimental will receive treatment, independent variable
 - **Random assignment** of participants
 - Participants are **randomly** assigned to either control or experimental group
 - Experimental Examples where the research controls:
 - Does 200mg of caffeine increase course grade?
 - Does two hours of exercise per week reduce weight?
- Experiments are the main way to establish CAUSATION, everything else is ASSOCIATION!
 - There are other ways, but that is called Causal Inference, and that is beyond the scope of this class...

Quasi Experimental

- Subjects are NOT randomly assigned to different conditions. They are assigned to groups based on something pre-existing about the subject, it is just something about them
- Involves manipulation of an independent variable but no random assignment
 - ▣ Ex. Two classes at the same school, you use a new teaching method in one class, but the regular teaching method in the other
 - Seems similar to experimental, but here the students were already in their classes and were not assigned by researcher
- Sometimes causation is implied (again with causal inference) but still not as strong as True Experimental design
 - ▣ But in some cases, it is unethical or impractical to run a true experiment... So quasi is our alternative.

Correlational

- Variables are only OBSERVED, no researcher manipulation of any variables
- Need two quantitative variables
- You observe (or ask) people questions about two different things to see if the two things are related
 - Example:
 - Is there an ASSOCIATION between amount of caffeine consumed and course grade?
 - Is there an ASSOCIATION between the time in the semester and stress?
- The mantra of all researchers:
CORRELATION DOES NOT EQUAL CAUSATION!

Descriptive

- Case Study
 - ▣ An interesting medical case described in detail by someone, makes an interesting story but not very useful for understanding populations
- Naturalistic Observation
 - ▣ Observing someone/something in their natural habitat and describing it
- Survey
 - ▣ Asking lots of questions to get an idea for more rigorous studies

Testing... Examples

Testing...

A researcher is interested in whether a graduate student-taught class improves the students' scores (on a final exam) over those of students taught by a professor. Students were randomly assigned to one of the two classes.

Experimental, Quasi, Correlational, or Descriptive?

Independent Variable?

Dependent Variable?

Testing...

A researcher is interested in whether a graduate student-taught class improves the students' scores (on a final exam) over those of students taught by a professor. Students were randomly assigned to one of the two classes.

Experimental

Independent Variable? Student vs. Professor

Dependent Variable? Final Exam Score

Testing...

I am interesting in testing whether group work in class improves test grades. I have two classes, one in the morning and one in the evening. I decide to have the morning class do group work, but not the afternoon class. I then compare the average test grades for both classes.

Experimental, Quasi, Correlational, or Descriptive?

Independent Variable?

Dependent Variable?

Testing...

I am interesting in testing whether group work in class improves test grades. I have two classes, one in the morning and one in the evening. I decide to have the morning class do group work, but not the afternoon class. I then compare the average test grades for both classes.

Quasi, I didn't control which students were in the morning vs the evening class

Independent Variable? Group work

Dependent Variable? Test grades

Testing...

Do the number of hours spent studying relate to the level of stress in college students?

Experimental, Quasi, Correlational, or Descriptive?

Independent Variable?

Dependent Variable?

Testing...

Do the number of hours spent studying relate to the level of stress in college students?

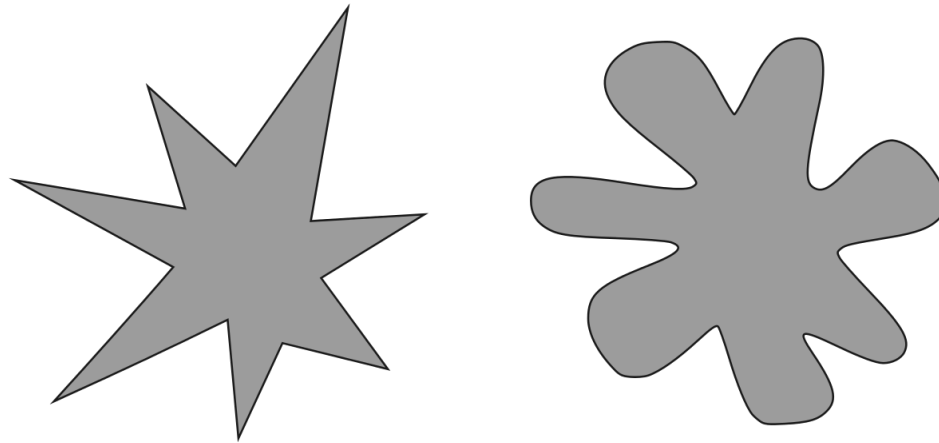
Correlational

“Independent Variable”? Hours Studying or Stress

“Dependent Variable”? Stress or Hour Studying

Testing...

A researcher is interesting testing whether people with autism perceive shapes and sounds differently than neurotypical people. The researcher administers the Kiki Bouba test and records the responses then compares them.



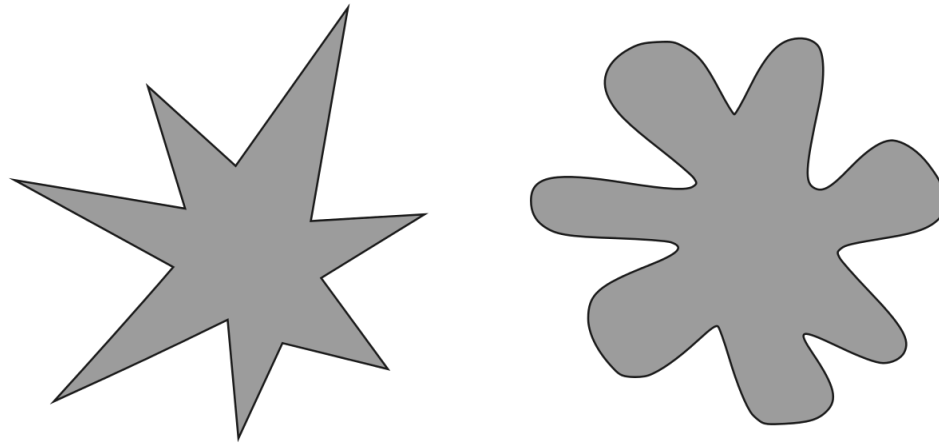
Experimental, Quasi, Correlational, or Descriptive?

Independent Variable?

Dependent Variable?

Testing...

A researcher is interesting testing whether people with autism perceive shapes and sounds differently than neurotypical people. The researcher administers the Kiki Bouba test and records the responses then compares them.



Descriptive (no manipulation, comparing differences)

Independent Variable? Autism Diagnosis vs. Neurotypical

Dependent Variable? Responses to Kiki Bouba Test

Up Next...



- We start looking more into the different types of variables and the different ways to measure them.

Variables and Measurement