Week 8 Lecture - Bivariate Correlation

Undergraduate Research Methods in Psychology

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1 Chapter Overview

1.1 Learning Objectives

- Explain that measured variables - not any particular statistic - make a study correlational.
- Interrogate the construct validity and statistical validity (and, of lower priority, external validity) of an association claim.
- Explain why a correlational study can support an association claim, but not a causal claim.
- Be able to understand the defining characteristics of a correlational, bivariate research design
- Be able to use appropriate vocabulary and logic used in describing and assessing bivariate designs

1.2 Chapter Overview

- Moving forward, much of the content will be about applying chapters 1 - 7 to different research _____. Make sure you review vocab from the first half of class, as it will often come back in these upcoming lectures.
- "Bivariate" $\rightarrow$ means _____ variables
- Two, **measured** variables $\rightarrow$ likely an _____ claim being made
- *Review:* Remember the vocabulary we should expect with associative claims between
  - Example: _____, "associated with", "correlated with", etc.

Discuss: Any other examples of vocab normally used with associative claims?

2 Bivariate Correlation

2.1 Overview

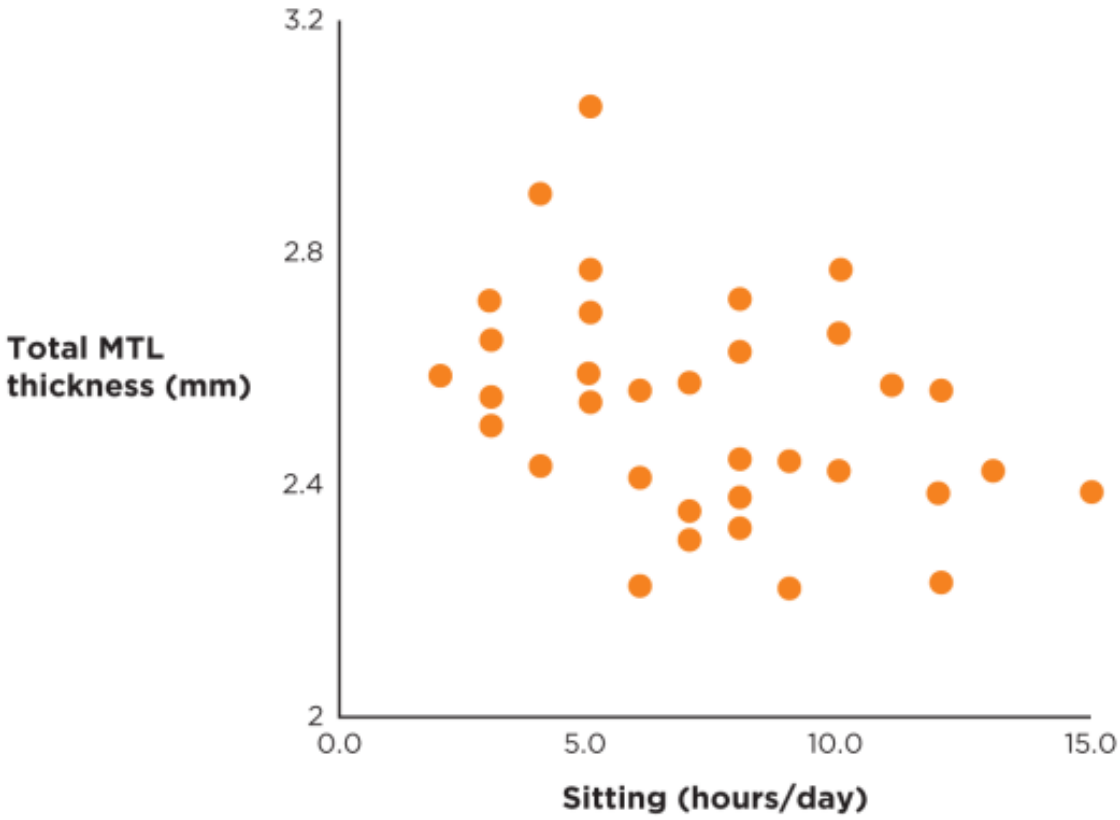
- *Review:* Recall that there are three possible association / _____ descriptions between two variables:
  - Positive
  - Negative
  - _____/no relationship
- Also recall that these are descriptors for _____ or straight-line relationships - we'll discuss how curvilinear relationships are a bit more complicated later today

2.2 Association Between Two Continuous Variables

- Example:
  - Two self-report measurements continuous outcome are strongly, positively correlated with one another
  - *Review:* what type of validity is this possibly associated with?

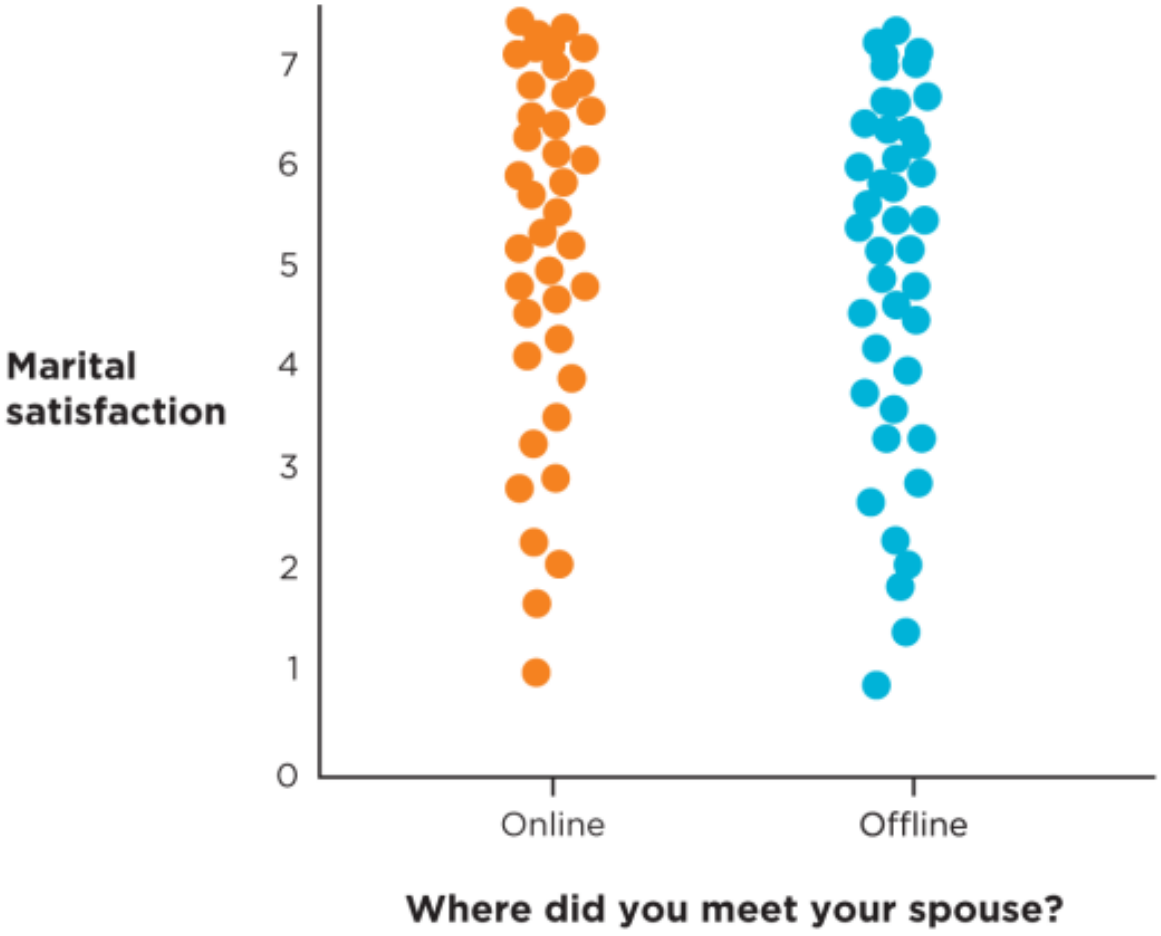
> Discuss: What statistic do we use for association between two continuous variables, and what value would indicate a strong, positive relationship?

- *Review:* When using correlation between two continuous variables, _____ are the most appropriate graphing method



2.3 Association Between Categorical and Continuous Variables

- The prior example shows how to work with continuous variables, what about when we have one _____/discrete and one continuous variable?
- One option: A sort of _____ scatterplot by the categorical variable



Discuss: What do you think is the direction and strength of relationship here?

- In most cases, we will probably prefer other _____ to graphical display information when we have categorical and continuous variables, as the split scatterplot can be somewhat confusing or difficult to interpret.
- Another option: A _____ graph

Discuss: What do you all think those small, black bars mean? What sorts of helpful information could they tell us about differences between the groups?

2.4 Fully Correlation Design

- A _____ design is one that results from all relevant variables being measured, *not* based on what scale of measurement was used, statistic, or graph.
- The designs that we discuss are largely defined by whether variables are measured or manipulated *and* the _____ we hypothesize between the variables (i.e., what claim we are attempting to make)

3 Critical Association Claims

3.1 Construct Validity

- *Review:* construct validity is all about the _____ reliability and validity of the tools we use to measure a phenomenon.
  - 3 reliabilities: test-retest, _____, and internal
  - 5 validities: _____, content, criterion, convergent, divergent/discriminant
- Use the terms and suggestions from chapters 5 and 6 to _____ this!
- Example: One of the items on one of my measures may not be measuring the same constructs as the others due to questionable use of the word “not” in the item.

📢 Discuss: How would we identify an item not well correlated with other items of the same construct (hint: what statistics and what measurement validity type)? What vocabulary do we use to describe this problem presented by ’not’ in the question?

3.2 Statistical Validity

- Statistical validity has multiple components to be looking for:

3.2.1 Effect Size

- Effect size is all about the *magnitude* of the results we found, it is not the same as _____.
- Assessing r correlation _____ effect
  - General guideline for behavioral sciences: 0.10 (weak), 0.20 (moderate), 0.30 (powerful), >0.40 (very powerful)
- We may also use _____
  - This refers to the amount of _____ that one variable accounts for in another

- Low effect size $\rightarrow$ possible _____ or non-meaningful effect
- High effect size $\rightarrow$ possible meaningful/_____ effect
- Example: My continuous variables x and y have an r = 0.50 and r^2 = 0.25
  - This would be considered a very strong or powerful effect

3.2.2 Precision

- *Review from stats class:* What do we call the intervals in which 95% of estimates will fall? _____ intervals
- Common _____: CI 95%:[Low-end Estimate, High-end Estimate]
- Larger sample size $\rightarrow$ usually _____ confidence intervals
- More precision = "better", more _____ estimate
- Example: For an r statistic of 0.30, I have CI 95%:[0.28, 0.32], this shows a precise estimate with _____ confidence intervals

3.2.3 Replication

- A question we should ask: has this association been shown before in the _____?
- We may _____ the study and measurements again on a new group and see if we get a similar value
- *Review:* This is a good use case for literature _____ and meta-analysis articles, as they can compile different studies investigating the same association. Remember, we are looking for the _____ of evidence in favor of a claim.

Discuss: What have you all heard about replication in science in your other classes?

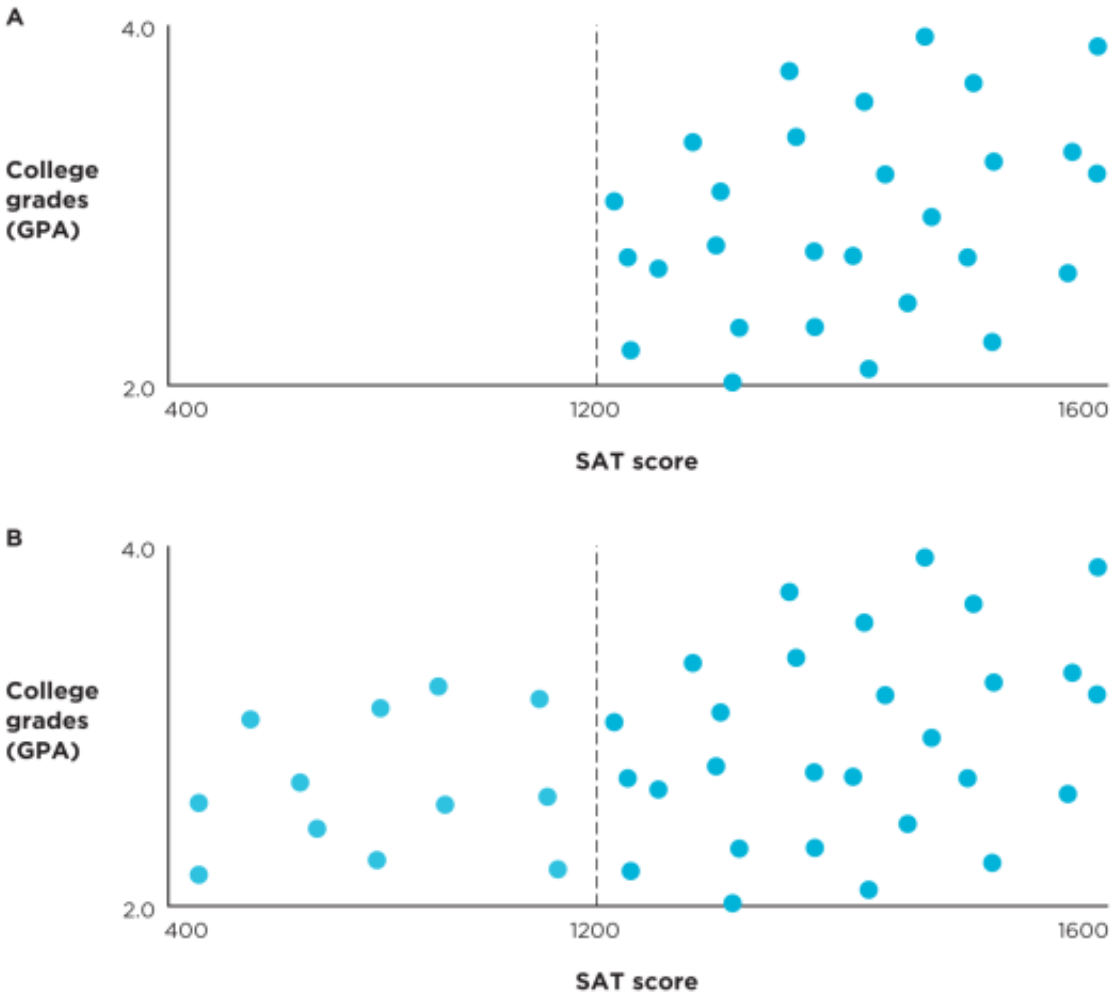
3.2.4 Outliers

Discuss: Based on what you all know from previous classes, what is the definition of an outlier?

- An outlier, especially one _____ on both variables, can greatly sway the relationship of two variables.
- However, we should not simply _____ out outliers because they are inconvenient findings.
  - Instead, we may consider **robust/non-parametric** _____ that can work around them as is
- Depending on who you ask, any value 3 or 4 standard deviations away from the mean would be considered an outlier.

3.2.5 Restriction of Range

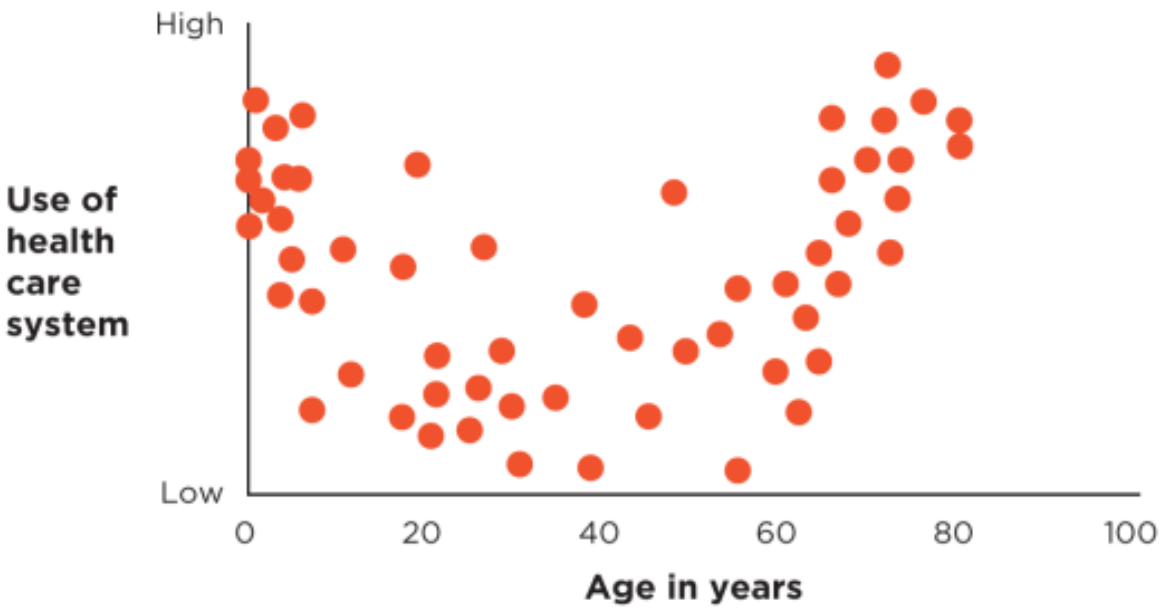
- This is when we do not have points across the full number of _____ levels on one or both of our variables



- Example: the possible scores on the test are 0 - 100, but all students only got between 70 and 85 $\rightarrow$ this is restriction of range problem.

3.2.6 Curvilinear Relationships

- r assumes a _____ relationship between the two variables, but this is not true of all relationships in reality



3.3 Internal Validity

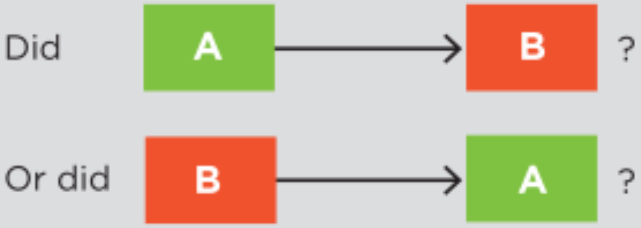
- For association claims, we do not need to be concerned with meeting standards of internal validity, because a correlative design cannot explore _____ relationships.

> Discuss: What research design can investigate a causal relationship

- *Review:* What is the common phrase we use to describe the relationship between correlation and causation?
  - Correlation does not _____ causation
  - Put simply, association alone does not tell us one "caused" the other!
- *Review:* What were the 3 causation criteria to establish a causal claim?
  - Covariance
  - _____ Precedence - **directionality problem**
  - Internal validity - **third-variable problem**

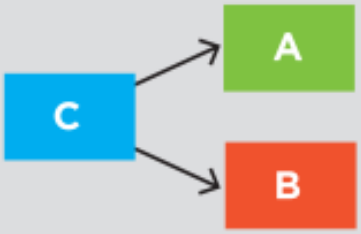
1. *Covariance:* Do the results show that the variables are correlated?

2. *Temporal precedence* (directionality problem): Does the method establish which variable came first in time?



(If we cannot tell which came first, we cannot infer causation.)

3. *Internal validity* (third-variable problem): Is there a C variable that is associated with both A and B, independently?



(If there is a plausible third variable, we cannot infer causation.)

- Example: I am measuring the relationship between exercise and feeling of self-worth, both _____ as continuous
  - High, positive correlation between the two - can I say exercise causes higher self-worth? _____!
  - Say energy level is correlated with both exercise and feeling of self-worth, then what really is the cause?

  - What is the so-called *third-variable* here? _____ level

3.4 External Validity

Discuss: What matters more for 'good', representative sampling: size of sample or methodology?

- Bad external validity does not necessarily _____ a claim, but just limits its generalizability
- Example: I use quota sampling to gather my participants, and find an r = 0.60 relationship between the variables
  - What direction and strength of relationship is this? _____ and _____.
  - Is this a biased or unbiased sample? _____! As it is non-probabilistic
- _____ are some third variable that plays a partial role in the relationship between two variable
  - These may result in a broader, more complicated theory around certain constructs
  - But most psychological constructs are complex!

4 Key Points

4.1 Key Points

- Bivariate, correlational designs are those that focus on the relationship between two measured variables, i.e., investigating an association claim
- Assessing a study using this design is a function of (mostly) external, statistical, and construct validity. Internal validity doesn't really apply, as we are missing the critical criteria necessary for a causal claim.

- We have several ways to graphically and statistically represent the relationship between two variables, but we also have several considerations such as effect size and precision of our estimate.
- We began to discuss some of the nuance in assessing internal validity, we'll return to this as we creep closer to experiments!