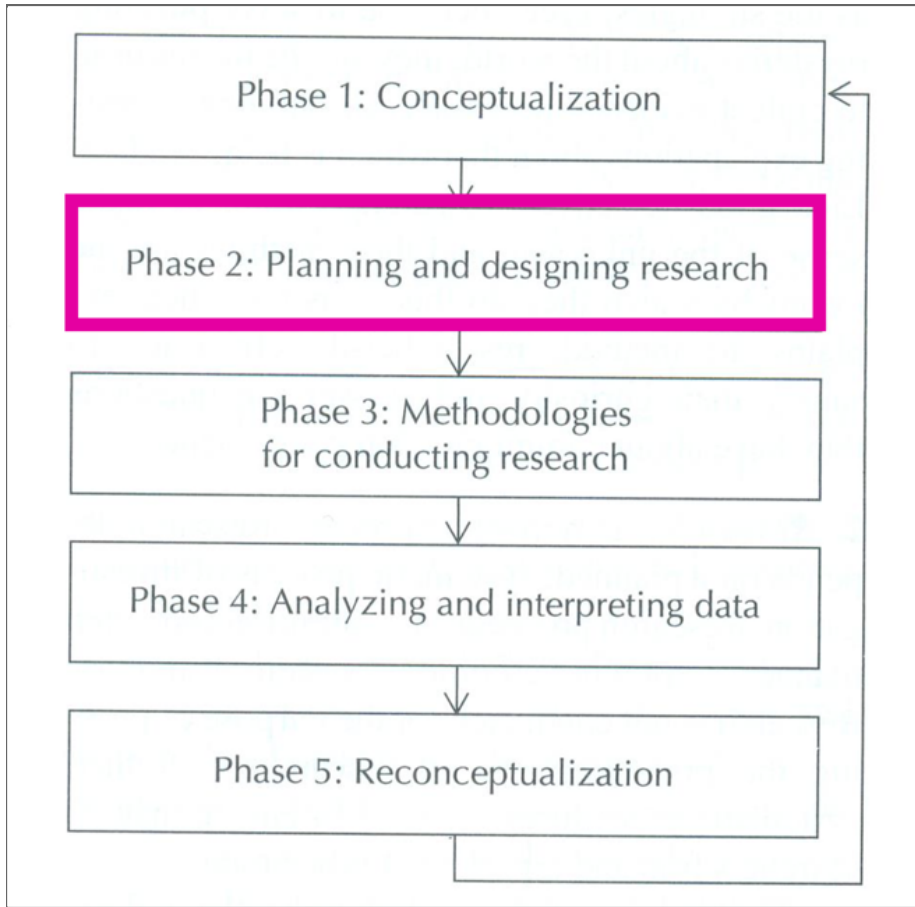# Week 4: Who are you studying?

Dr. T. Kody Frey

Assistant Professor | School of Information Science

Overview

- BRIEF review
- Internal Validity
- External Validity
- Discussion: Sampling!
- Workshop: Navigating the IRB
  - Understanding the online process
  - Submitting your protocols
  - Responding to feedback

Phase 1: Conceptualization

Phase 2: Planning and designing research

Phase 3: Methodologies
for conducting research

Phase 4: Analyzing and interpreting data

Phase 5: Reconceptualization
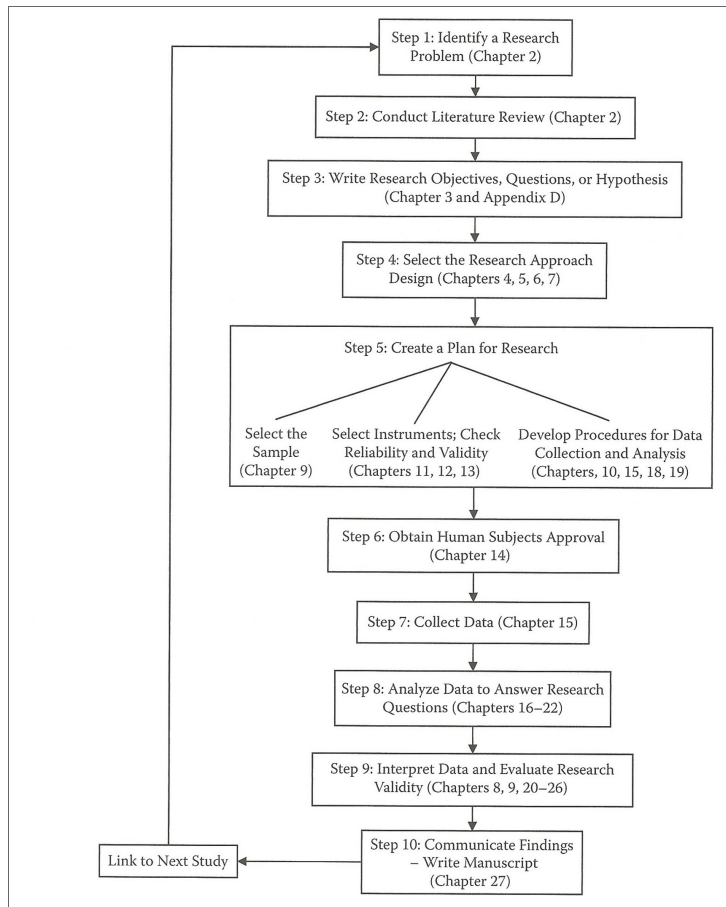
Old Content: Review!

Quantitative Research

What is the PURPOSE of Quantitative Research?
Quantitative research:

- Is *systematic*. It is intentional, replicable, and valid.

- Observes, explains, and predicts

- Tests theories that describe human behavior

- Answers questions of **group differences** or **variable relationships**

What are the STEPS in Quantitative Research?

- Isolate a problem

- Select a design

- Operationalize variables

- Generate a sample

- Collect data

- Analyze data

- Write results

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┌─────────────────────────────────────────────────────────────────────────┐
│                        Step 1: Identify a Research                        │
│                           Problem (Chapter 2)                             │
│                                                                           │
│                  Step 2: Conduct Literature Review (Chapter 2)            │
│                                                                           │
│          Step 3: Write Research Objectives, Questions, or Hypothesis      │
│                        (Chapter 3 and Appendix D)                         │
│                                                                           │
│                  Step 4: Select the Research Approach                     │
│                      Design (Chapters 4, 5, 6, 7)                         │
│                                                                           │
│                  Step 5: Create a Plan for Research                       │
│                                                                           │
│     Select the        Select Instruments; Check    Develop Procedures for Data │
│      Sample           Reliability and Validity     Collection and Analysis │
│    (Chapter 9)        (Chapters 11, 12, 13)        (Chapters, 10, 15, 18, 19) │
│                                                                           │
│                  Step 6: Obtain Human Subjects Approval                   │
│                             (Chapter 14)                                  │
│                                                                           │
│                    Step 7: Collect Data (Chapter 15)                      │
│                                                                           │
│                 Step 8: Analyze Data to Answer Research                   │
│                      Questions (Chapters 16–22)                           │
│                                                                           │
│                Step 9: Interpret Data and Evaluate Research               │
│                      Validity (Chapters 8, 9, 20–26)                      │
│                                                                           │
│  Link to Next Study  ◄──  Step 10: Communicate Findings                   │
│                               – Write Manuscript                          │
│                                 (Chapter 27)                              │
└─────────────────────────────────────────────────────────────────────────┘
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What are the characteristics of a good research problem?
Good research problems are grounded in empirical and theoretical literature, stated clearly, testable, feasible, and of vital interest to *you:*

- Simple

- Observable

- Testable

- Theoretically and Practically Important

Key Terms

What is the difference between a conceptual definition and an operational definition?

These are *not* interchangeable

- **Concept** (Theoretical concept) - a mental representation (more abstract than a construct)

- **Construct** - a set of operational measures that allow for the study of a theoretical concept (less abstract than a concept)

What is the difference between an independent and a dependent variable?

Independent Variable	Dependent Variable

"variables thought to influence changes in another variable (the dependent variable)."

Known as the IV (sometimes called explanatory variable or PREDICTOR variable in non-experimental research)

When more than two independent variables are used in a "factorial design" the IVs are referred to as factors.

"variables are thought to be changed by another variable (the independent variable)."

Know as the DV (sometimes called outcome variable or CRITERION variable in non-experimental research)

What is the difference between a research question and a research hypothesis?

Research Question | **Research Hypothesis**

"a formal question posed to guide research."
The explicit questions researchers ask about the variables that interest them.
When researchers feel confident enough to make a prediction, they advance a hypothesis
"a tentative statement about the relationship between independent and dependent variable(s)."

TABLE 3.1

Examples of Three Kinds of Basic Research Questions/Hypotheses

1. **Basic difference (group comparison) questions**
   - Usually used for randomized experimental, quasi-experimental, and comparative approaches.
   - For this type of question, the groups of individuals who share a level of an active independent variable (e.g., intervention group) or an attribute independent variable (e.g., male gender) are compared with individuals who share the other levels of that same independent variable (e.g., control group or female gender) to see if the groups differ with regard to the average scores on the dependent variable (e.g., aggression scores).
   - Example: Do persons who experienced an emotion regulation intervention differ from those who did not experience that intervention with respect to their average aggression scores? In other words, will the average aggression score of the intervention group be significantly different from the average aggression score for the control group following the intervention?

2. **Basic associational (relational) questions**
   - Used for the associational approach, in which the independent variable is usually continuous (i.e., has many ordered levels).
   - For this type of question, the scores on the independent variable (e.g., anxiety) are associated with or related to the dependent variable scores (e.g., GPA).
   - Example: Will students' degree of anxiety be associated with their overall GPA? In other words, will knowing students' level of anxiety tell us anything about their tendency to make higher versus lower grades? If there is a negative association (correlation) between anxiety scores and grade point average, those persons who have high levels of anxiety will tend to have low GPAs, those with low anxiety will tend to have high GPAs, and those in the middle on anxiety will tend to be in the middle on GPA.
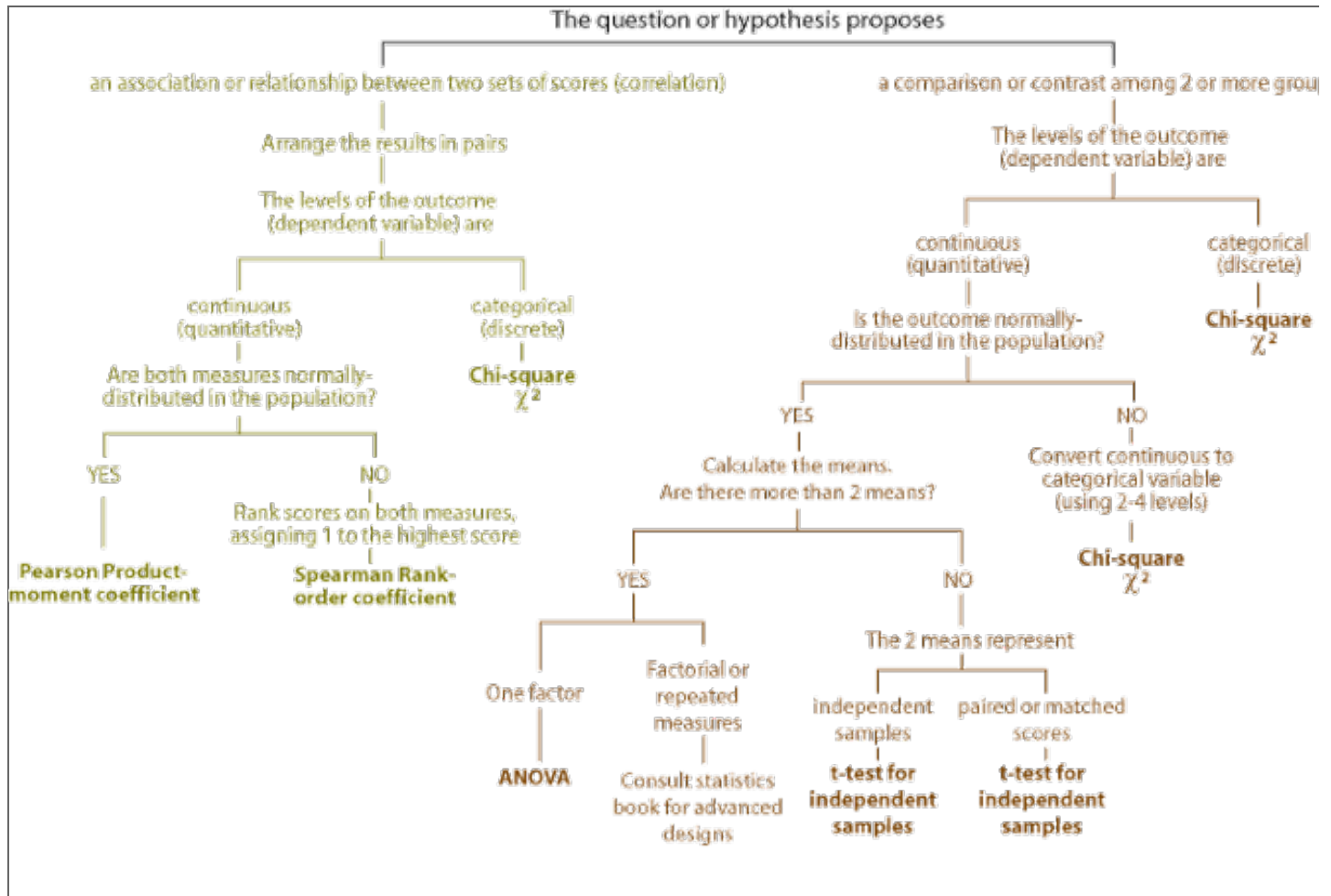
3. **Basic descriptive questions**
   - Used for the descriptive approach.
   - For this type of question, scores on a single variable are described in terms of their central tendency, variability, or percentages in each category/level.
   - Example: What percentage of students make a B or above? What is the average level of anxiety found in 9th grade students? The average GPA was 2.73, or 30% had high anxiety.

Descriptive stats will be covered in Weeks 6-8!

- Frequency Distributions

- Central Tendency

- Measures of Dispersion

- Standard Scores

The statistic that you ultimately employ should correspond with the RQ/Hypothesis:

The question or hypothesis proposes

an association or relationship between two sets of scores (correlation)

Arrange the results in pairs

The levels of the outcome (dependent variable) are

continuous (quantitative) — categorical (discrete)

Are both measures normally-distributed in the population?

YES — NO

Rank scores on both measures, assigning 1 to the highest score

Pearson Product-moment coefficient

Spearman Rank-order coefficient

categorical (discrete)

Chi-square χ^2

a comparison or contrast among 2 or more group

The levels of the outcome (dependent variable) are

continuous (quantitative) — categorical (discrete)

Is the outcome normally-distributed in the population?

YES — NO

Calculate the means. Are there more than 2 means?

Convert continuous to categorical variable (using 2-4 levels)

Chi-square χ^2

categorical (discrete)

Chi-square χ^2

YES — NO

One factor — Factorial or repeated measures

The 2 means represent

independent samples — paired or matched scores

ANOVA

Consult statistics book for advanced designs

t-test for independent samples

t-test for independent samples

Research Tips

- Plan your project carefully
- Think ahead
- Get organized
- **Keep good records**
- Stay calm! (Do not tolerate confusion)
- Give yourself plenty of time

GML Chapter 8

Contents

- Criteria for establishing causation
- Characteristics for evaluating internal validity
- Threats to internal validity

What is Internal Validity?

Internal validity is the extent to which we can infer that that IV caused the change in the DV.
Internal validity depends on the strength or soundness of the design and influences whether one can conclude that the independent variable or intervention caused the dependent variable to change

Randomized experiments are the most likely to provide evidence that the independent variable caused changes in the dependent variable. Randomizing individuals into groups maximizes the likelihood that some shared characteristic or attribute is not influencing the IV-DV relationship.

Causal Relationships

In order to infer that one variable caused a change in another:

- The IV must precede the DV

- The IV must be related to the DV

- There must be no other variables that could explain why the IV is related to the DV

Causation in Descriptive Studies

In purely descriptive studies there is no independent variable and no attempt to find relationships (causal or otherwise) between variables so the issue of causal relationships is not relevant.

Causation in Non-Experimental Studies

The *quasi-experimental*, *comparative*, and *associational* approaches all attempt to identify relationships between variables. In published studies, these three approaches usually satisfy the second criterion; the independent variable is related to the dependent variables.
The first criterion, the independent variable precedes the dependent variable, also is often met, especially in quasi-experiments.

The third criterion for causation, ruling out other possible explanations, is never possible in the comparative and associational approaches and is problematic in all but the strongest quasi-experiments.

TL;DR: If you aren't randomly assigning your participants to conditions, then you have a weak argument for causation.

Evaluating Internal Validity

Internal validity is evaluated based on:

- Equivalence of groups on participant characteristics
- Control of extraneous experiences and environment variables

Equivalence of Groups

Are the groups equivalent in all aspects prior to the induction of the IV?
We ensure this through *random assignment*

Quasi-Experiments | **Comparative** | **Association**

If people cannot be randomly assigned to groups, we can assign the treatment randomly to the people. For ex: assigning classes to specific conditions
Groups being compared by attributes are seldom equivalent to one another.
Can incorporate methods *after* the study to show some effort at internal validity.
There is only one group! Nothing can demonstrate causation.

Extraneous Experiences

What does *random assignment* to groups not eliminate?
Do participants learn information about a study as they go?
Are there environmental conditions that might influence participation?

A good study should be high in both areas!
If not, must be cautious about saying that IVs influenced, impacted, or caused DV to change.

Threats to Internal Validity

Threats to Equivalence of Groups

Regression   **Attrition**   **Selection**

Measurement is often unreliable. Participants who score low on a measure may score higher (closer to the mean) the next time.
Participants drop out for a number of reasons, but it influences group composition.
Problems are created when groups are assigned based on similarities - not randomness.

Threats to Control of Extraneous Variables

- Maturation

- History

- Testing

- Instrumentation

- Interactive Threats

- Ambiguous Temporal Precedence (Time)

Threats RA does NOT eliminate?

- People talk
- Expectation effects (Hawthorne)
- Observer bias

GML Chapter 9

Sampling and External Validity

What is sampling?

Sampling is the process of selecting part of a larger group of participants with the intent of generalizing from the sample (the smaller group) to the population (the larger group).

External validity is the extent to which samples, settings, and variables can be generalized beyond the study.

Why sample?

- Less expensive
- Less time
- Better quality control

Key Concepts

Theoretical population	**Accesible Population**	**Selected Sample**

Actual Sample

All the participants of theoretical interest to the research and to which he or she would like to generalize.
Also called *sampling frame*
The group of participants you actually have access to, perhaps through a list or directory.
The smaller group of participants selected from the larger accessible population by the researcher and asked to participate in the study.
The participants that complete the study and whose data are actually used in the data analysis and in the report of the study's results.

The goal is for our sample to be representative of the target theoretical population.
This maximizes *external validity*

Sampling Designs

Probability Sampling

Everyone has a known, nonzero change of being chosen

Nonprobability Sampling

No method to estimate probability of being included. *Sampling bias* automatically becomes an issue.

Probability Samples

- Simple Random Sample

- Systematic Random Sampling

- Stratified Random Sample

- Stratified with Diff Probs of Being Selected

- Cluster (Random) Sampling

  All involve randomization at some point!

Nonprobability Samples

- Quota Sampling
- Purposive Sampling
- Purposeful Sampling
- Convenience Sampling
- Snowball Sampling

Why Nonprobability Samples?

- Cost

- Efficiency

- Probability sample maybe not possible

- Sometimes inference is not the goal (causation is)!
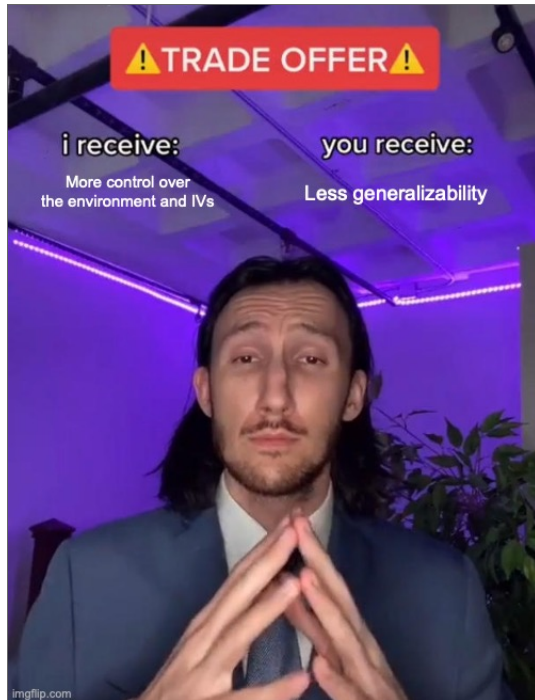
When are Samples Unrepresentative?

- When the sampling frame is picked for convenience
- Anytime you use a Nonprobability design
- When you have a poor response rate
- When you experience attrition

Does the NUMBER of people matter?

YES! Very much so.
Larger samples will identify effects that smaller samples will not.

The general rule of thumb is that representativeness is more important than sample size.
A huge sample that is not representative will still be misleading.
Can calculate *power* to determine an appropriate size.

Evaluating External Validity

A good study should be high in external validity!
If it isn't, must be cautious about generalizing the results to the larger population.

Population external validity

- Was the *sampling frame* representative of the theoretical pop?
- Was the *selected sample* representative of the population?
- Was the *actual sample* representative of the population?

  Can you identify each key area in the study?

Ecological external validity

Whether the conditions, settings, times, testers, or procedures are rep of natural conditions and so forth and, thus, whether results can be generalized to real life outcomes.
AKA is the research environment similar to the natural environment? Does the manipulation of the IV feel real to the participants?

To Summarize

Random selection is important for high external validity.
Random assignment is important for high internal validity.

Application

Let's say your group wants to study men and womens' reactions to violent crime shows on national TV.

- What is the IV? DV? Constant?
- What would be an appropriate sampling technique for your group?
- What are some problems that could affect *internal* validity?
- What are some problems that could affect *external* validity?

Frey Facts

Quant methods are not always about getting it right, but about defending your choices.

Summary

- Review
- Internal Validity
- External Validity

What's Next?

Next week will focus primarily on manipulated independent variables in the form of experimental and quasi-experimental designs. We will also cover issues when conducting survey or other types of observational research and when independent variables differ across perspectives.

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