Designing Research Studies
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Baseline Questions

• What designs have you heard of?
• How does each one work?
• What questions is each good for?
• Have you helped with a research study?
How well do you need to know statistics?
Ethics

WE OFTEN ARE ASKED HOW WE PROCESS OUR RESEARCH.
FIRST, WE CHECK ALL OF THE RESULTS.
SECOND, WE THROW AWAY THE ONES WE DON'T LIKE.
THIRD, WE TABULATE THE REMAINDER.
Standard deviation
Popular research methods

But if it's not participatory action research, what is it?

Hm... dictatorial inaction research?... alienated sedentary research?

Autocratic twiddle-your-thumbs research?
Paralysis by analysis

“...since Mary presented her report. It’s the worst case of paralysis by analysis I’ve ever seen!”
Grants

I’ve applied for a research grant to discover new ways to get funding
Activities

• Design a study to answer my research question
  • To what extent is the quality of college teaching related to interns’ practices?

• Design a single-subject study to answer my efficacy question
  • How effective is email feedback to college teachers on student engagement?

• Design a qualitative study to answer the question
  • How do early interventionists feel about the supervision and coaching they receive?

• McWilliam and Associates: Your research idea
Videos

• Fuzzy research designs: https://www.youtube.com/watch?v=eKLZV_5E5u0
Top 9 Things You Need to Know

• Correlation: rank order
• Regression: correlation (line), continuous data
• Single-subject: replication
• Group difference: Cohen’s d
• Qualitative: garden path
• Mixed methods: Both good
• Experimental: RCT \textit{and} SCRD
• Interesting study: triangle
• ANOVA: discrete data
Correlation : Rank Order

- In our group,
- Average daily time watching TV
- 1-10 interest in politics
- Show rank order
- Show scatter plot
Regression: Correlation

- **R family**
  - Continuous data
  - Predictors and outcomes

- **D family**
  - Discrete data
  - Differences
Single-Subject: Replication

- It all begins with an L and a dashed line
- Each subject is his or her own control
- Time series data
- Experimental
  - Experimental control, or “functional relationship”
- Visual analysis and other methods
- Extremely tight control
- Often 1 IV and 1 DV
- Underappreciated by non-special-educators
Group Difference: Cohen’s $d$

- Mean
- Standard deviation
- $(M2 - M1) / SD_{pooled}$
  - Pooled = averaged
  - $(SD1 + SD2) / 2$
You do actually have to know a bit about how standard deviations work!
Cohen’s $d$

<table>
<thead>
<tr>
<th>$M$ Score 1</th>
<th>$SD$ Score 1</th>
<th>$M$ Score 2</th>
<th>$SD$ Score 2</th>
<th>$d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>10</td>
<td>105</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>.5</td>
<td>8</td>
<td>.6</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>3</td>
<td>14</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td>.4</td>
<td>3.9</td>
<td>.6</td>
<td></td>
</tr>
</tbody>
</table>
Qualitative: Garden Path

• “The following themes emerged”
• Peonies, daffodils, cone flowers, roses
• Headline method
  • Hypotheses
  • Confirming and disconfirming tables
Mixed Methods: Both Good

• Qual first
• Qual second
Experimental: RCT and SCRD

• Causality
  • Ruling out other explanations for effects
  • RCT: Randomization and lack of systematic bias
  • SCRD: Design (graph) shows experimental control, or “functional relationship”
Interesting Study: Triangle Method

- [http://naturalenvironments.blogspot.com/search/label/triangle%20method](http://naturalenvironments.blogspot.com/search/label/triangle%20method)
- Mediator or moderator
ANOVA: Discrete Data

- Main effect (High vs. low)
- Main effect (Group 1 vs. Group 2)
- Interaction effect
To Review: Top 9 Things You Need to Know

• Correlation: rank order
• Regression: correlation (line), continuous data
• Single-subject: replication
• Group difference: Cohen’s d
• Qualitative: garden path
• Mixed methods: Both good
• Experimental: RCT and SCRD
• Interesting study: triangle
• ANOVA: discrete data
Activity

• Design a study to answer my research question
  • To what extent is the quality of college teaching related to interns’ practices?
Big Four

- Group comparison
- Single-Subject
- Correlational/Regression
- Qualitative

5th: Mixed methods
6th: Psychometric
Quantitative Overview

• Between-subjects approach
  • Pretest & posttest designs
  • Posttest designs

• Regression-discontinuity approach

• Within-subjects approach
  • Repeated-measures approach

• Factorial designs (e.g., ANOVA)
**Between-Subjects Approach**

**Diagram 2.1** Pretest and Posttest Control Group Design

<table>
<thead>
<tr>
<th>Group</th>
<th>Pretest</th>
<th>Treatment</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>O₁</td>
<td>X</td>
<td>O₂</td>
</tr>
<tr>
<td>2</td>
<td>O₁</td>
<td></td>
<td>O₂</td>
</tr>
</tbody>
</table>

Note: In regard to design notations, a dashed line (- - -) would separate Groups 1 and 2 in the design structure if the participants were not randomly assigned to conditions, which indicates quasi-experimental research.
### Posttest Control Group Design

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**Time ▶**
Randomized Control Trials

- Equality of groups
- How different are they?
- How about mediators and moderators?
Establishing Cause & Effect (Cook & Campbell, 1979)

• Covariation (the change in the cause must be related to the effect)
• Temporal precedence (the cause must precede the effect)
• No plausible alternative explanations (the cause must be the only explanation for the effect)
Regression-Discontinuity Approach

Assign to treatment or control based on pretreatment scores
Factorial Designs

• 2 x 2
• 2 independent variables
• 2 levels
• DV: MEISR score in $M\%$ ($SD$)

<table>
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<tr>
<th>Severity of Disability</th>
<th>High SES</th>
<th>Low SES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe-Profound</td>
<td>58</td>
<td>26</td>
</tr>
<tr>
<td>Mild-Moderate</td>
<td>69</td>
<td>42</td>
</tr>
</tbody>
</table>
ANOVA

• Main effect for SES
• Main effect for severity
• SES x Severity interaction

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Within-Subjects Designs

- Time series
- Random or nonrandom
Single-Case Research Design

• AB design
• ABAB design
• Multiple-baseline design
• Changing-criterion design
• Alternating-treatments design
AB Design
ABAB Design
Multiple-Baseline Design
Figure 2. Percentage of achieved CEC ratings (BL = Baseline, TS = Tip Sheet, IC = Intensive Consultation, DS = Daily Supervision, GFP = Graphic Performance Feedback, IPF = Immediate Performance Feedback, GS = Goal Setting).
Changing-Criterion Design

![Graph showing number of math problems completed over days, with a transition from Baseline to Intervention phase. The graph displays an upward trend in problem completion over time.]
Changing-Criterion Design

Figure 3. Tim’s daily point goals and number of total daily points earned in a changing criterion design for daily behavior report card.
Alternating-Treatments Design
Activity

• Design a single-subject study to answer my efficacy question
  • How effective is email feedback to college teachers on student engagement?
Qualitative Research

- Data are narrative, verbal (including written), pictorial....

- Analysis is “grounded”
  - “Grounded theory is a method in the social sciences involving inductive reasoning, in contrast to the hypothetico-deductive model of the scientific method.”
Analysis

Codes -> Sub-Categories -> Categories -> Theory
Qualitative Analysis

• Garden-path “findings”

• Verification

• Linkages
Activity

- Design a qualitative study to answer the question
  - How do early interventionists feel about the supervision and coaching they receive?
Psychometric Studies

• Reliability of scores
• Validity of scores
• Item response theory
  • Factor analysis
  • Rasch analysis
Activity

• McWilliam & Associates
  • Your research ideas
Dev. & Innovation 4 yr $1,400,000
Exploration - Primary data collection & analysis 4 yr Same

Factors

Child Characteristics

Gain Char.

Service

Pros.

Visit

Minutes

Disc.

Princess II

Janet Con

La Qok (5 scores)

Family Princess

MEIST

Recruit progs/pros
in AL, ME, MS, OR,
MO, IL