Week 6
Quantitative Research Design

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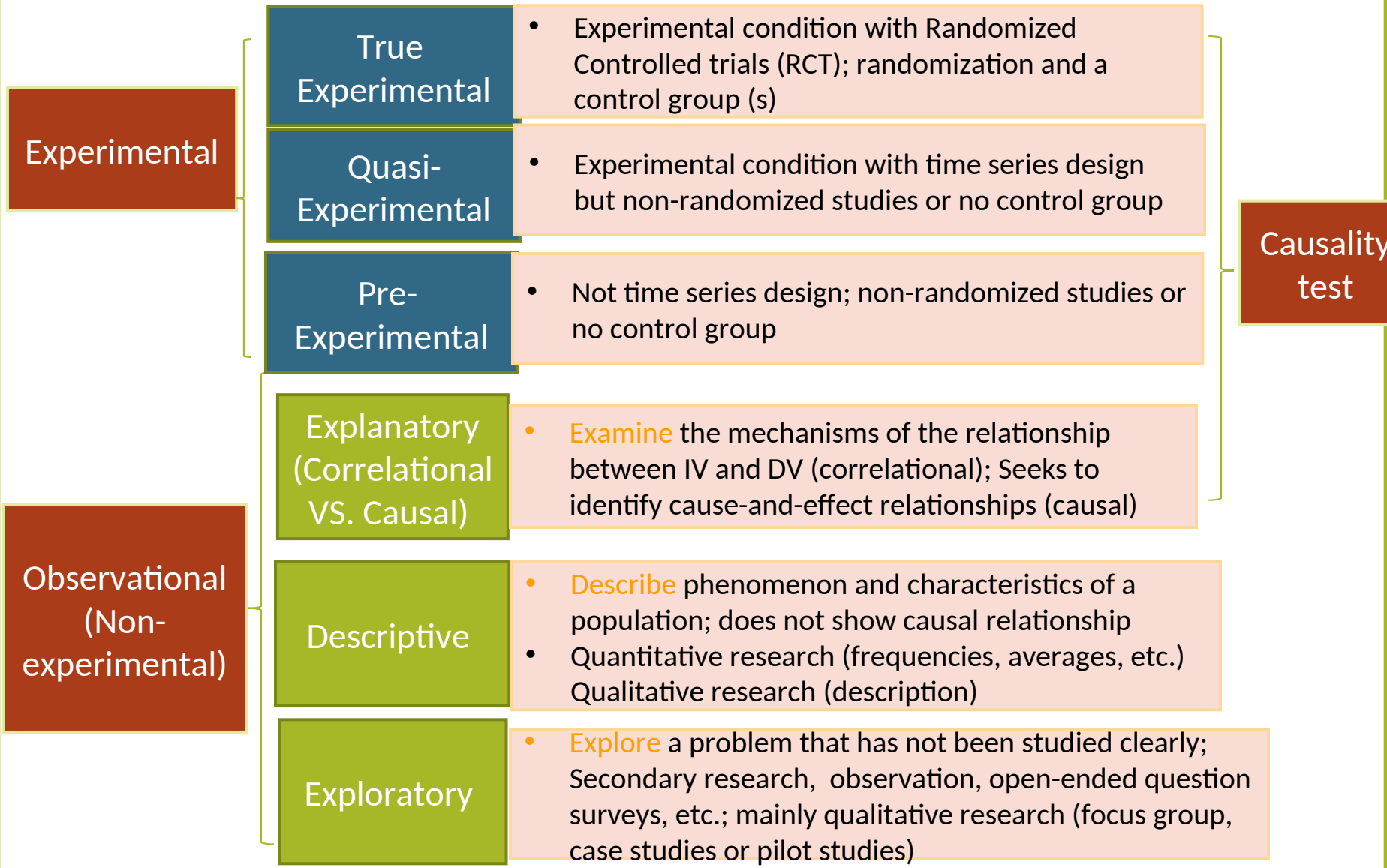
Overview

- Types of Quantitative Research Design
- Criteria for Inferring Causality
- Non- Experimental Design
- Pre-Experimental Pilot Studies
- Quasi-Experimental Designs
- Experimental Designs

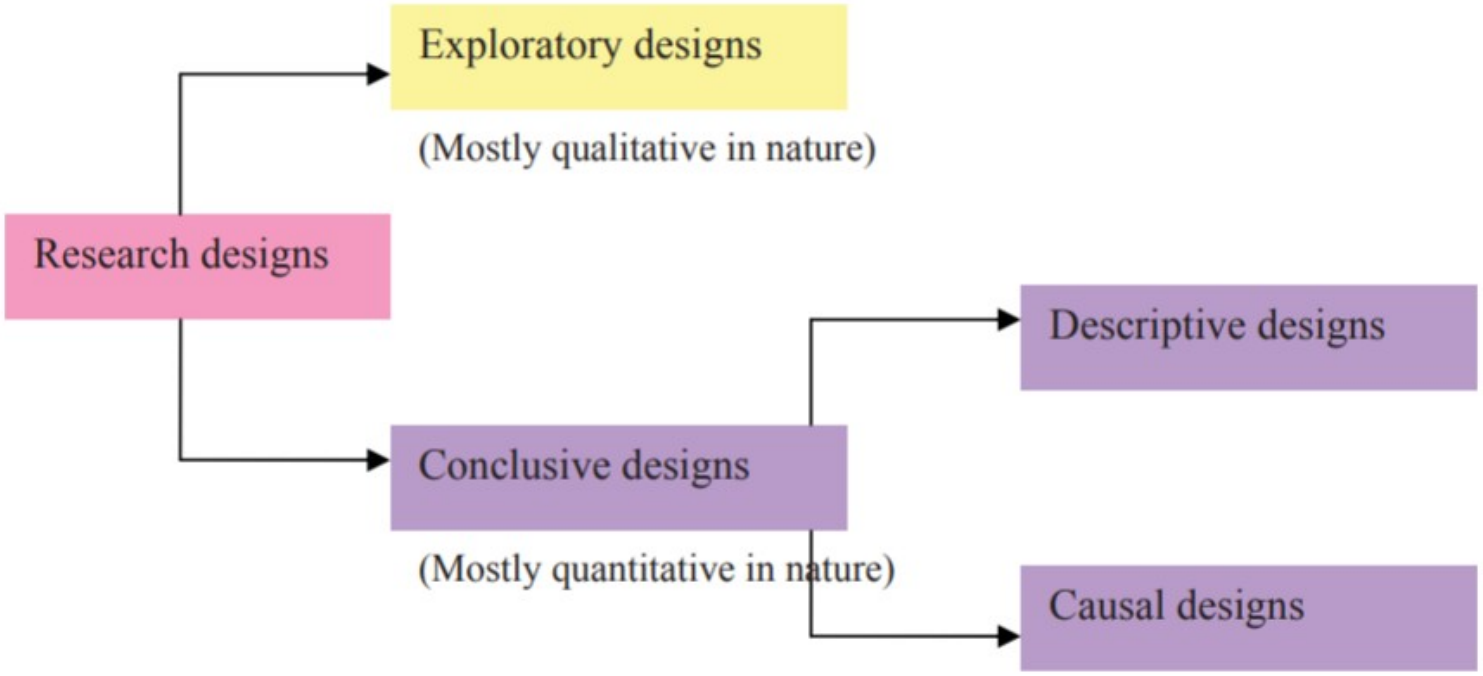
What is Quantitative Research?

- Quantitative research is a systematic and scientific investigation of data and their relationships. (Cohen, Manion & Morrison, 2004)
- Main goal of quantitative study is prediction- correlation or causality
- Objectives are developing and employing mathematical models, theories and hypotheses pertaining to phenomena.

Types of Quantitative Research Design



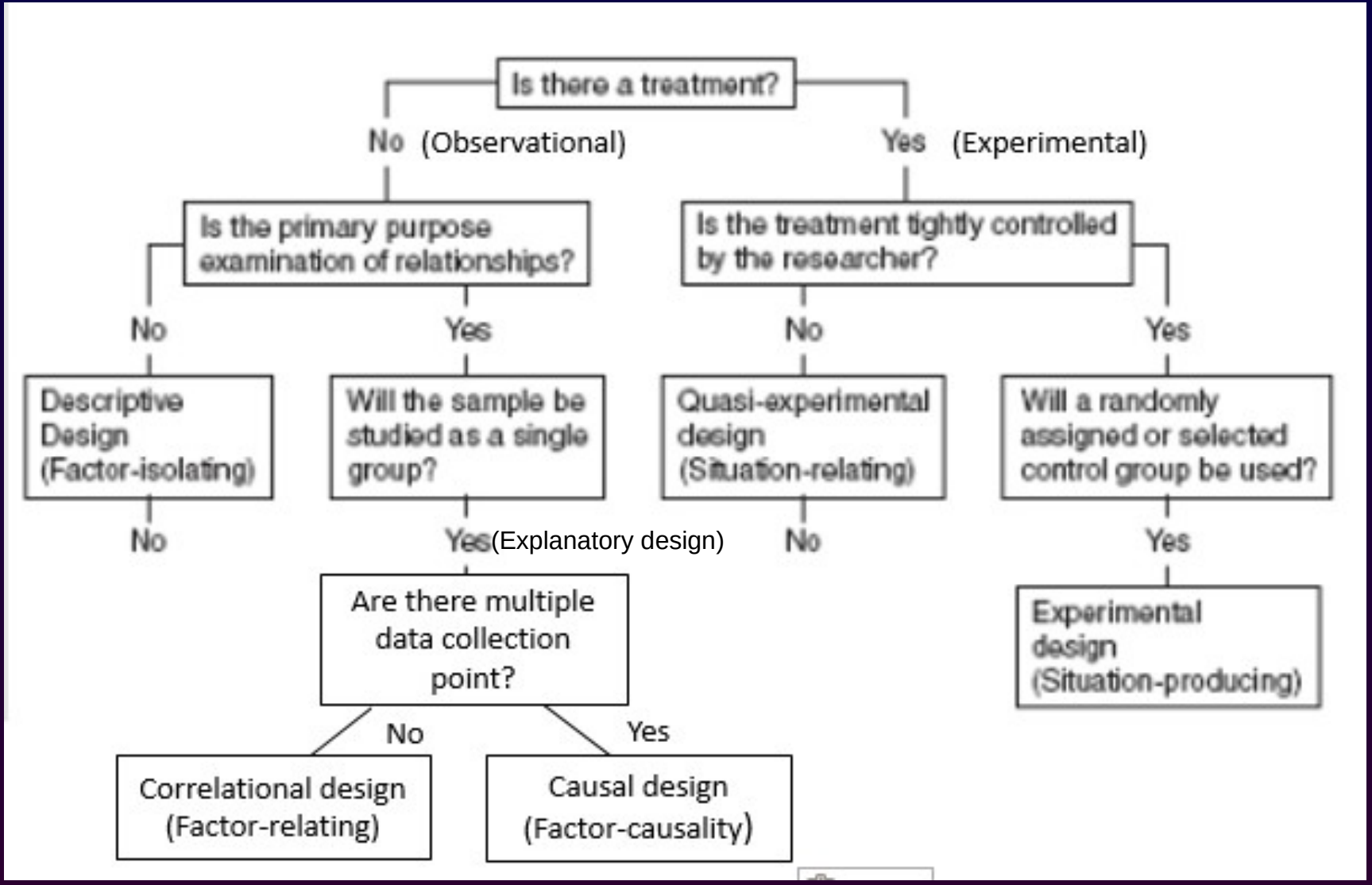
Exploratory VS. Conclusive Design



Discuss

1) How do we decide what to use for our quantitative research?
2) When should we go descriptive?
3) When do we go for correlatiotional research?
4) When do we conduct a causal-comparative research?
5) When do we go for quasi-experimental research?
6) When do we go for experimental research?

Different Quantitative Research



Criteria for Inferring Causality

1) Cause (independent variable) must precede the effect (dependent variable) in time
2) The two variables are empirically correlated with one another
3) The observed empirical correlation between the two variables can not be due to the influence of a third variable that causes the two under consideration

Terms- Randomization

- Controls for *selection bias* in experimental designs
- Participants are divided into groups using procedures based on probability theory
- Improves the likelihood that the control group represents what the experimental group would look like had it not been exposed to the experimental stimulus

Terms- Control Groups

- Used in experimental design
- Often, control groups receive usual care in place of the experimental intervention
  - Compares experimental intervention to treatment as usual
- Ethical considerations require that services be provided to many control groups

I. Non-Experimental Design

Exploratory Research Design

Purposes

1)Formulate a problem or define a problem more precisely

2)Develop hypothesis

3)Gain insights for developing an approach to the problem

4)Establish priorities for further research

Methods

1)Survey of Experts

2)Pilot Surveys

3)Secondary Data Analysis

4)Qualitative Research

Example of Exploratory Research Design

- A fresh or inconclusive murder case will be investigated using exploratory research because it has not been investigated clearly in the past.

- To gain a better understanding of how exploratory research is used to conduct a murder investigation, let us review this popular crime movie titled Murder on the Orient Express**.**

- The **how** consists of the murder weapon, how it was used, the time he was murdered, etc. The last piece of information the detective needed to nail the culprit was the **why**.

Exploratory Research Design

- Topic- Increased rate of charity and crime rate in a community
- Can be answered by both exploratory and exploratory designs.
- Exploratory Research Question: How increased rate of charity affect crime rate in the community?; What is the effect of increased rate of charity on crime rate?
- Explanatory Research Question: Is there an association between rate of charity and crime rate in the community?; What is the effect of increased rate of charity on crime rate?
- Difference- Exploratory design may use observations, secondary data, and/or open-ended questions to understand subjects and phenomenon for future research because this is a relatively new topic, while explanatory may use valid and reliable variables selected based on previous studies

Descriptive Research Design

No testable variables and hypotheses, but rather describing a situation that has not been described before.

Purposes

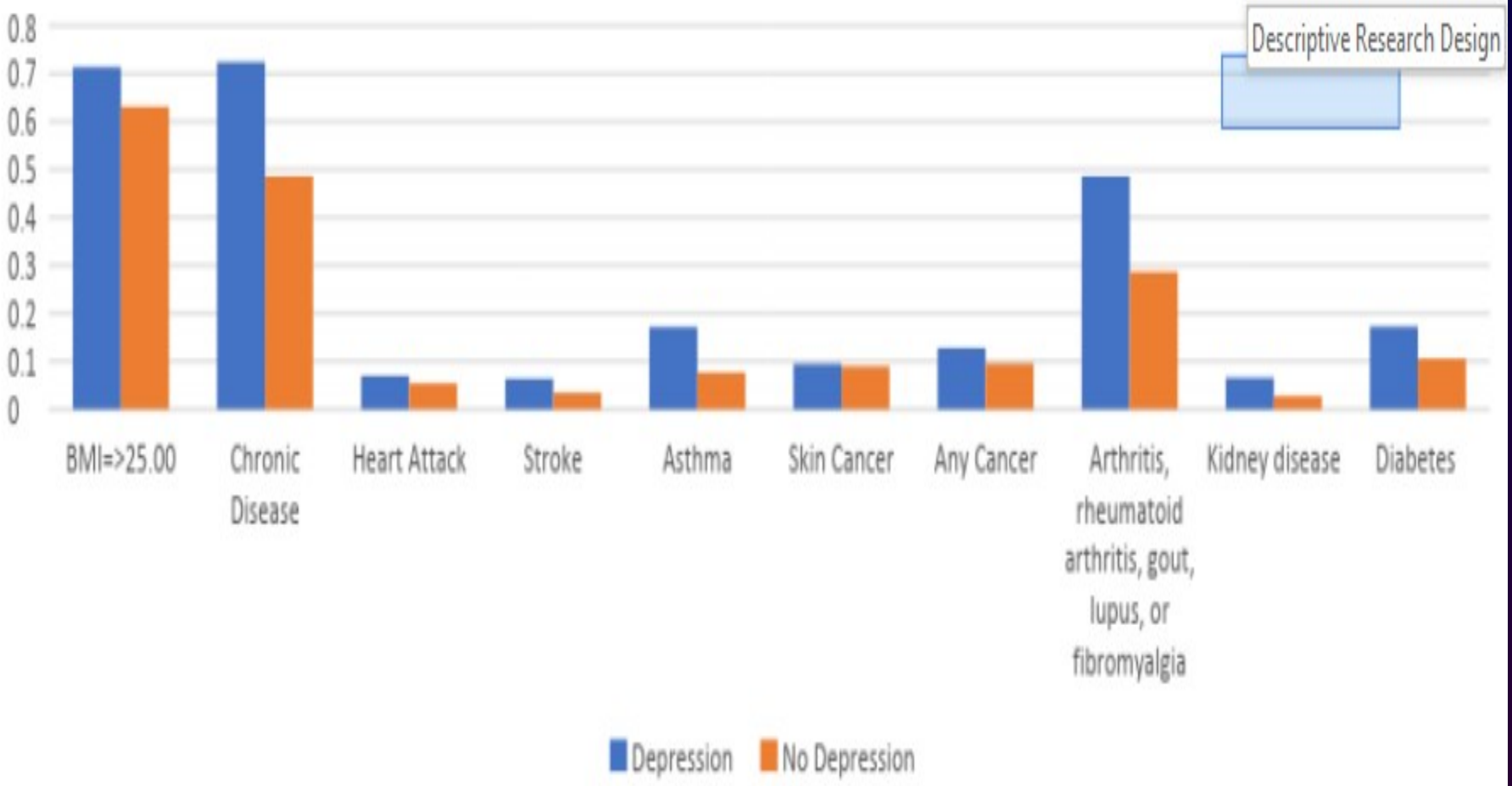
1)Describe the characteristics of relevant groups

2)Conduct comparison = somewhat show associations between two factors. For example, we can estimate the percentage of units in a certain group with a distinctive behavior.

Question:	What proportion of Nyack College male and female students use the top 5 social networks?
Variable:	Use of top 5 social networks (i.e. Facebook, MySpace, Twitter, LinkedIn, and Classmates)
Group:	1. Male, Nyack College students 2. Female, Nyack College students

Methods- Survey, Observation , Interviews, Portfolios

Figure 1: for Health Status in Comparison between People with Mental Illness (MI) and without Mental Illness (MI)



Example of descriptive research

- To describe what factors may contribute to homelessness in NY, research staff conducted a survey in two homeless shelters to collect data. Based on literature review, the survey included history of domestic violence, mental illness, substance use, income and housing status before being homeless, etc.

Explanatory Research Design

Purposes

1) Determine the degree to which two variables are associated

2) Determine what factors affecting a problem by assessing the impact of factors on DV.

3) With longitudinal data, examine causation between two variables

Methods

1) Survey

2) Secondary analysis

3) Interviews

4) Case analysis

5) Observation

- Finding a Causal relationship of two variables depends on the type of data

Example of Explanatory Research Design

- Adolescent pregnancy has been an epidemic plague recently. Previous research indicated that low SES was found among adolescents who had given birth. The purpose of this correlational study will assess the relationship between SES and reproductive health behavior. For this study, reproductive health behavior measure (DV) and SES (i.e. IVs- income, parents' education level, immigration status and health insurance) were used, while other socio-demographic factors (i.e., race, etc.) were controlled. The study sample will be collected from two local high schools in Bergen county, NJ.
- Hypothesis- SES is positively associated with reproductive health behavior.

Explanatory Research design

- Life satisfaction declines in middle age. In the US, two cultural characteristics (collectivistic culture and individualistic culture) are common. The purpose of this study is examining the impact of cultural difference on life satisfaction among middle aged people. This study will conduct a survey that include cultural variations and life satisfaction. An independent t-test will be conducted to investigate whether there are differences in life satisfaction across culture (collectivistic culture VS. Individualistic Culture).
- Research question- Is life satisfaction vary across cultural characteristics?
- Hypothesis- There are differences in life satisfaction scores between two groups.

Environmental Resources

Mental health problems

Crime Rate (?)

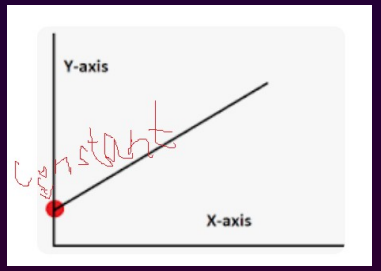
Employment

Education

Poverty

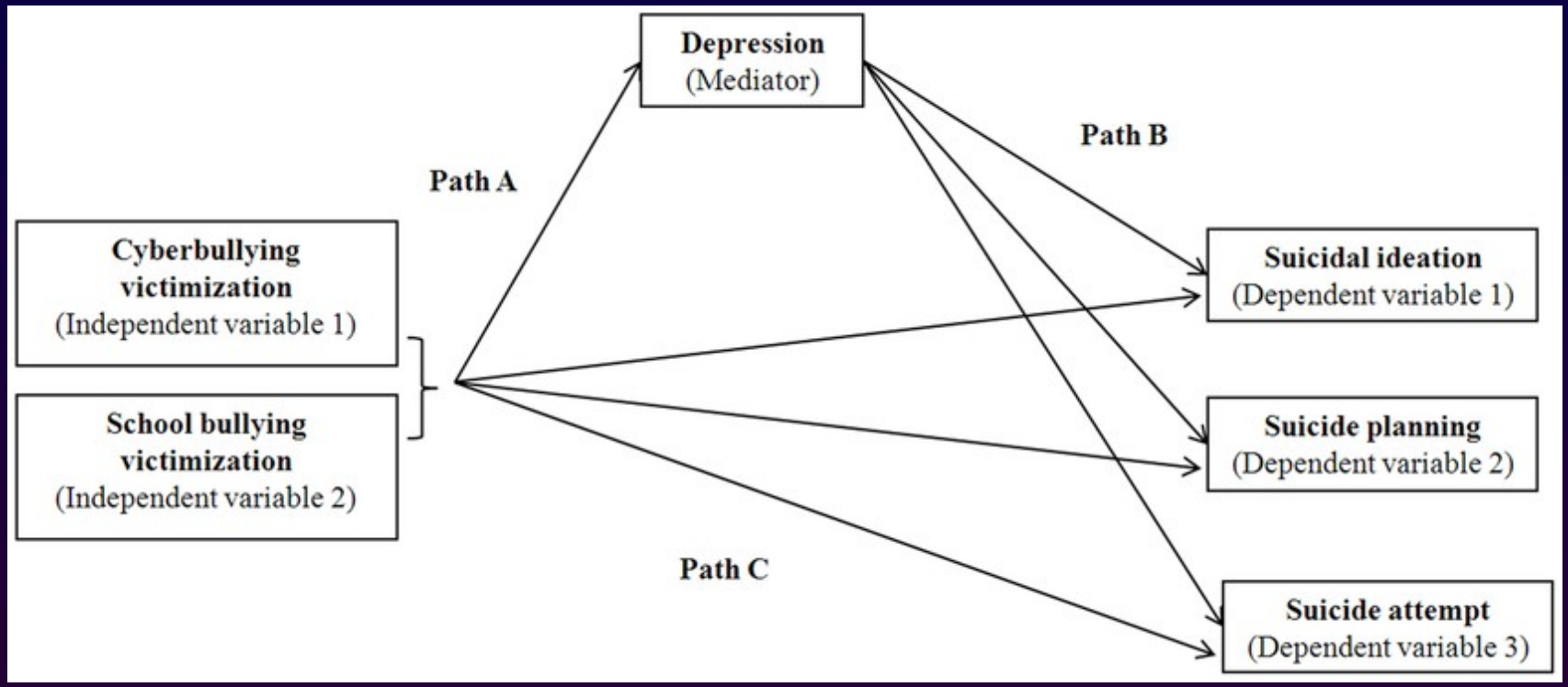
Recidivism (rearrest)

$$y_i = \beta_0 + \beta_1 x_{i,1} + \beta_2 x_{i,2} + \ldots + \beta_k x_{i,k} + \epsilon_i.$$



Explanatory research

- During this critical period of development and adolescent research suicide remains a major public health problem in the US. Experience of school bullying can cause trauma, which in turn increase suicide ideation among adolescents. The purpose of this research is examining relationships among school bullying, trauma and suicide ideation. For this study, experience of school bullying (IV), depression level (MV) and suicide ideation (DV) were identified as variables. A mediation analysis will be conducted to find a mediation effect of depression level between school bullying and suicide ideation.
- Hypothesis- Relationship between IV and DV is mediated by the levels of depression among adolescents.



https://www.researchgate.net/figure/Mediational-model-for-study-of-the-relationship-between-cyberbullying-and-school-bullying_fig5_264389671

II. Experimental Design

Pre-experimental design	Quasi-experimental design	True experimental design
• One shot case design • One group pretest-post test design	• Nonequivalent comparison groups design • Time series design	• Post-test only control design • Pre-test post-test control group design • Solomon four group design • Alternative Treatment Design with Pretest • Dismantling studies
Features • Manipulation of independent variables •Limited control over the extraneous variable •No randomization and control group	**Features** • Manipulation of independent variables •Absence of either randomization or control group	**Features** • Manipulation of independent variables •Presence of both randomization and control group

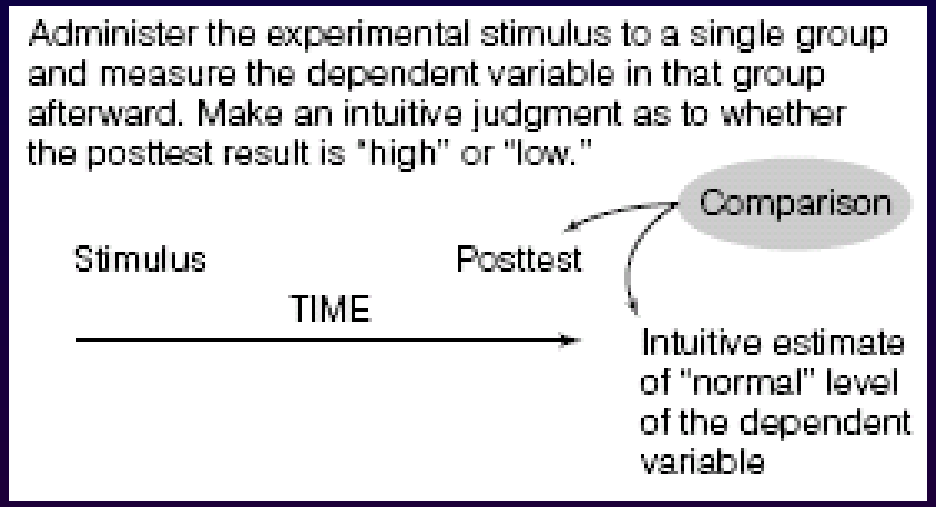
Pre-experimental Pilot Studies

- Very limited degree of internal validity
- Exploratory or descriptive purposes, such as:
  - To generate tentative exploratory or descriptive information regarding a new intervention about which little is known
  - To learn whether it is feasible to provide the new intervention as intended
  - To identify obstacles in carrying out methodological aspects of a more internally valid design that is planned for the future
  - To see if the hypothesis for a more rigorous study remains plausible based on the pilot study results

Common Pre-Experimental Designs

- One-shot Case Study
- One-Group Pretest-Posttest Design
- Posttest-Only Design with Nonequivalent Groups

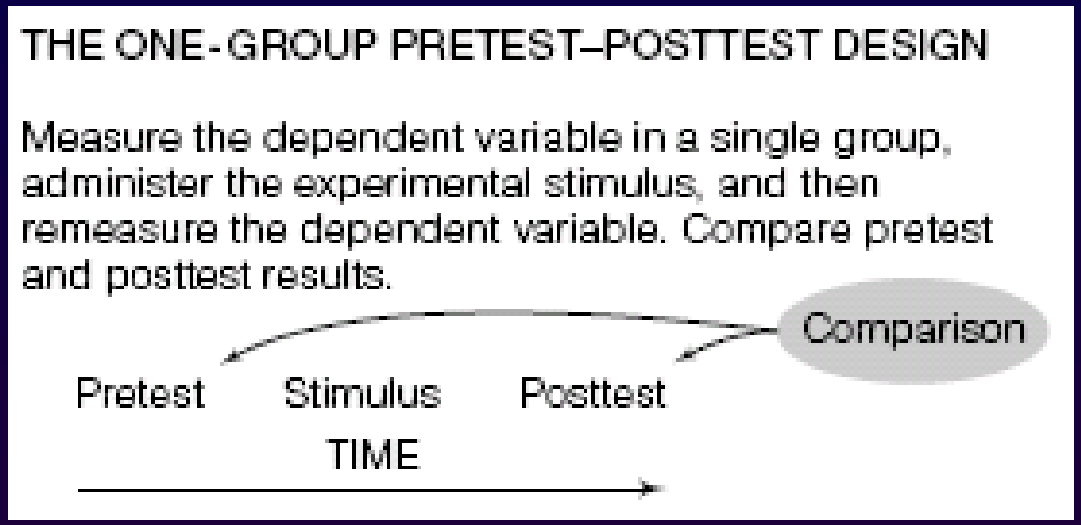
One-Shot Case Study



X 0

Fails to control for any threats to internal validity

One Group Pretest-posttest Design



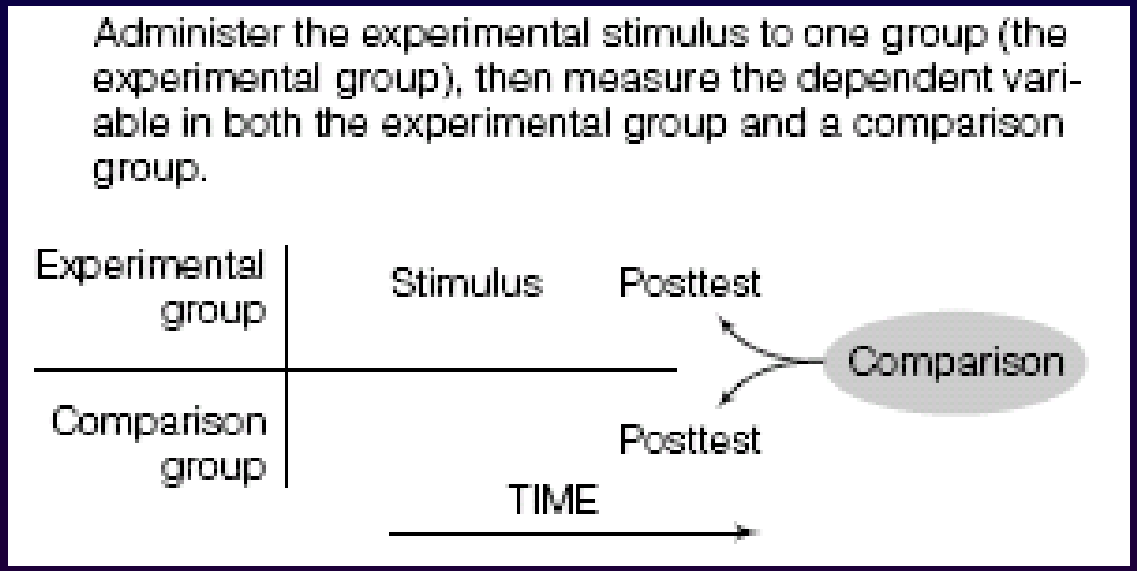
01 X O2

Establishes correlation and time order but does not account for factors other than the independent variable that might cause change in the dependent variable

Pre-experimental Research

- CBT is well-known EBP for treatment of anxiety. Especially youths who experience school bullying suffer from symptoms of anxiety. Previous study indicated that CBT could be effective for adolescents who suffer from anxiety disorder. 35 youths who recently experience school bullying were referred to the local agency. Agency will provide CBT for these youths. The purpose of this study is to examine the effective of CBT for youths who experience school bullying. A researcher will conduct pre- & post-test (paired samples t-test) to examine the effectiveness of CB T by measuring anxiety level of youths.
- Hypothesis- Anxiety level is decreased after the 4-months CBT.

Posttest Only Design with Nonequivalent Groups



X O

O

Can not infer that any difference between the two groups was caused by the intervention

Quasi-experimental Designs

- Designs that attempt to control for threats to internal validity and thus permit causal inferences but are distinguished from true experiments primarily by the lack of random assignment of subjects
- Useful when it is not feasible to obtain a control group
- When conducted properly can obtain a reasonable degree of internal validity
- Three common quasi-experimental designs will be examined:
  - Nonequivalent comparison group designs
  - Simple time-series designs
  - Multiple time-series designs

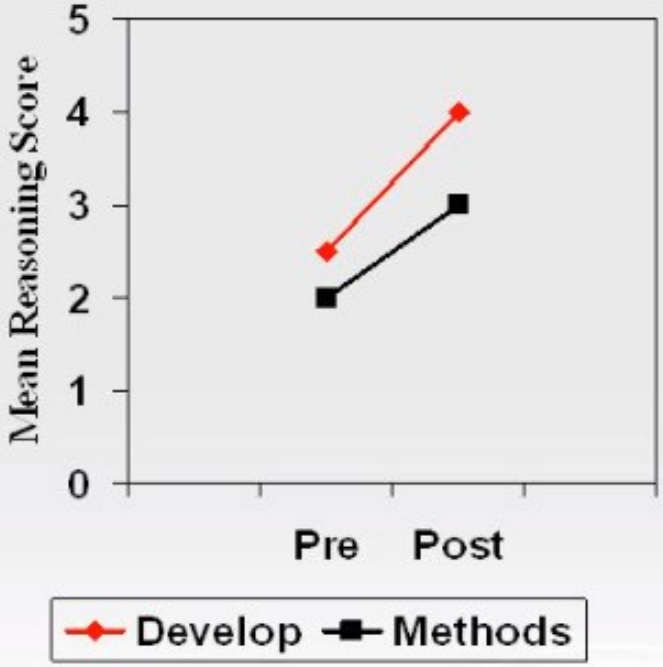
Nonequivalent Comparison Groups Designs

- Two existing groups that appear to be similar are identified or created
- The dependent variable is assessed before and after an intervention is introduced to one of the groups
- Comparison group does not receive the intervention

O_1 X O_2

O_1 O_2

Example of Nonequivalent Comparison Control Designs



- Intervention: critical thinking seminar
- Research Methods students receive the intervention (i.e., participate in the critical thinking seminar)
- Developmental Psychology students are used as a nonequivalent control group

  (i.e., do not attend the seminar)

Time-Series Designs (Single Subject Research Design)

- A simple interrupted time-series design attempts to develop causal inferences based on a comparison of trends over multiple measurements before and after an intervention is introduced and requires no comparison group

$$O_1\ O_2\ O_3\ O_4\ O_5\ X\ O_6\ O_7\ O_8\ O_9\ O_{10}$$

- A multiple time series design- add a comparison group to the simple interrupted time- series designs

$$O_1\ O_2\ O_3\ O_4\ O_5\ X\ O_6\ O_7\ O_8\ O_9\ O_{10}$$
$$O_1\ O_2\ O_3\ O_4\ O_5\ \quad O_6\ O_7\ O_8\ O_9\ O_{10}$$

Single Subject Research (Evaluation) Design (SSRD)

- Also known as Single case, single subject deigns, or *N*-or-1 designs

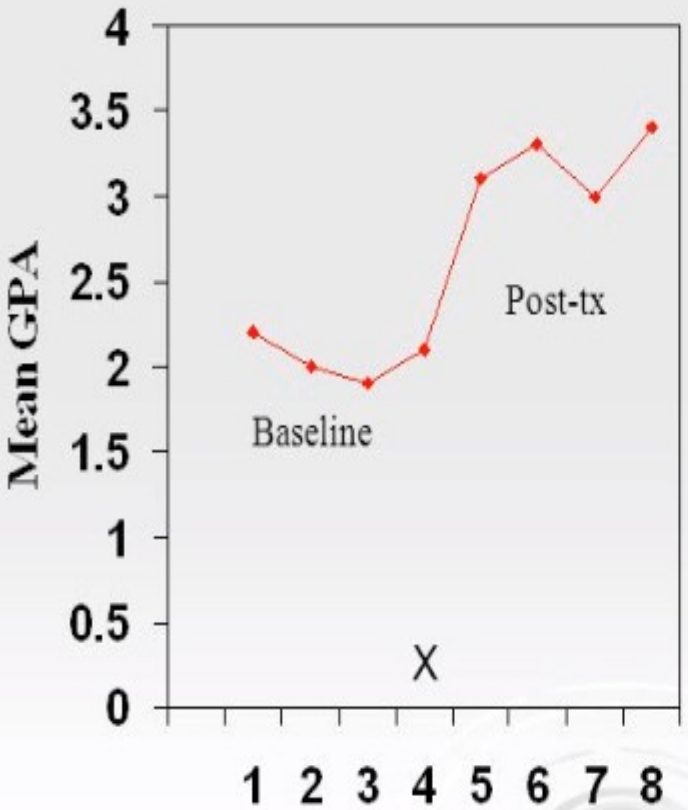
- “SSRDs… are research formats that permit uncontrolled program evaluation and controlled experiments with only one subject, one group, or one system” (Wong, 2015)

- “SSRD refers to the repeated collection of information on a single client or client system over a period of time in a planned systematic fashion” (Campbell, 1992, p.336)

What are Single System Research Designs (SSRD)?

- May be used to evaluate individuals, group work, or communities (micro, mezzo or macro)
- Contain both quantitative and qualitative aspects
- Quantitative- Usually quantitative measurement; presentation of SSRD data as simple line graphs; no inferential statistics
- Qualitative – Using only outcome measures (Narratives) with sufficient reliability and validity; can use simple dichotomous measures (e.g. school attendance, urine test, etc.); can make visual inference from line graphs

Example of Time-series design

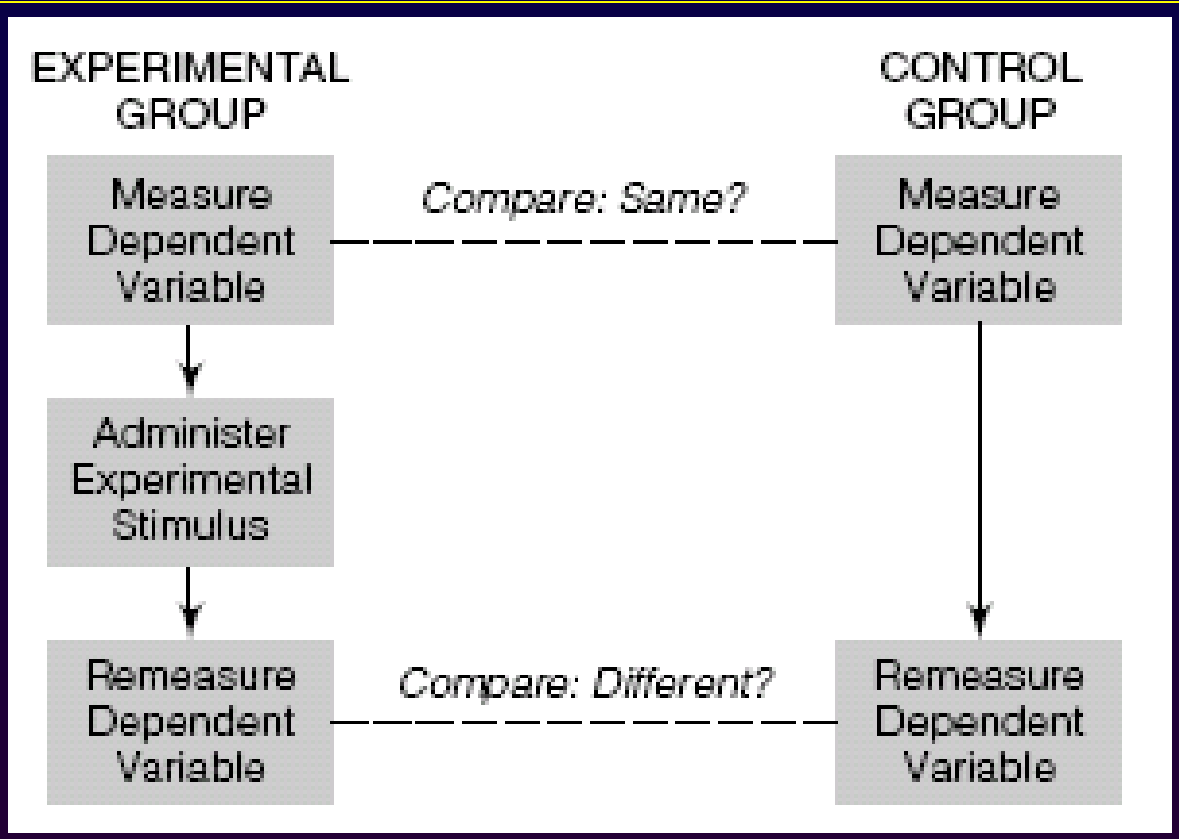


- **Intervention: Course to change students' study habits, implemented during the summer (after semester 4).**
- **DV: semester GPA**

True Experimental Designs

- Best causal evidence comes from designs with strong internal validity
- Experimental designs provide maximum control for threats to internal validity

Diagram of a Basic Experimental Design



R O_1 X O_2

R O_1 O_2

Pretest-Posttest Control Group Design

- $R \quad O1 \quad X \quad O2$
- $R \quad O1 \quad\quad O2$

- Does not control for possible impact of testing and retesting

POSTTEST-ONLY CONTROL GROUP DESIGN

- $R \quad X \quad O$
- $R \quad \quad O$

- Avoids testing/retesting impact
- Pre-testing not possible in some experiments
- Assumes that the process of random assignment removes any significant initial differences between experimental and control groups

Solomon Four-Group Design

- R $O1$ X $O2$
- R $O1$ $O2$
- R X $O2$
- R $O2$

- Assesses amount of pretest-posttest change while checking for testing effects

Alternative Treatment Design with Pretest

- *R* *O*1 *X*A *O*2
- *R* *O*1 *X*B *O*2
- *R* *O*1 *O*2

  - If the first two rows both show approximately the same amounts of improvement, and both amounts are more than in the third row, that would indicate that both treatments are approximately equally effective. But if the third row shows the same degree of improvement as in the first two rows, then neither treatment would appear to be effective. Instead, we would attribute the improvement in all three rows to an alternative explanation such as history or the passage of time.

  - Some experiments use the first two rows of this design but not the third row. They compare the two treatments to each other but not to a control group. They can have conclusive, valid findings if one group improves significantly more than the other. But suppose they both have roughly the same amount of improvement. The temptation would be to call them equally effective. However, with no control group, we cannot rule out threats to internal validity, such as history or the passage of time, as alternative explanations of the improvement in both groups

Dismantling Studies

- R $O1$ $X\text{AB}$ $O2$
- R $O1$ $X\text{A}$ $O2$
- R $O1$ $X\text{B}$ $O2$
- R $O1$ $O2$

- Shows not only whether an intervention is effective, but also which components of the intervention may or may not be necessary to achieve its effects.