

Experimental Design

1. Randomized assignment
 2. Pre-test (O1)
3. Independent Variable (X)
 4. Post-Test (O2)

Randomized Trial Group

- R

O1

»

X

-

O2

Randomized Control Group

- R

»O1

O2

True Experimental Designs

- “Classical” Experimental Design
- More Complex Versions
- Solomon Four Group Design
- Latin Squares Design
- Factorial Design

Pre-Experimental Designs

- Here something is missing from the true experimental design
- What is usually missing is the control group
- Pre-Experimental Design is used when we have time series or longitudinal data
- 01 02 03 X 04 05 06
- 01 x 02 x 03 x 04 x 05

True Experimental Design

- 1. Basic Research (“pure research”)
- 2. Explanatory
- 3. “Cross-section” of time (t_1 , T_u)
 - Maturation is not considered a key variable
 - In physical science it is assumed Time is Universal
 - In social science it is one very specific time t_1
 - Sometimes t_n is assumed to be T_u

Pre- & Quasi- ED versus non-ED

- Sometimes we cannot have any kind of experimental design, not even pre- or quasi-experimental design
- In order to do experiments on human subjects it would often involve unethical procedures
- Historical social change cannot be manipulated experimentally without enormous human costs
- True Experimental Design is impossible in human history since there cannot be a truly randomized control group

Non-Experimental Design

- Research Design that is not true experimental design and/or pre- & quasi-
- Most social science research is not experimental (true, pre-, or quasi-ED)
- Hence, we use a way of trying to simulate what an experiment might have shown
- The statistical techniques used for non-ED are ultimately based on assumptions from true ED
- The most commonly used statistic in all natural and social sciences is Pearson's "r"

Correlation is not Causation

- When we calculate a Pearson's r we obtain a "co-relationship" or correlation
- Such correlations are NEVER a substitute for theoretical understanding of causation
- Unless you have True ED you cannot use the "data" to determine causation
- Even with True ED (Classical ED) you must interpret the findings
- Interpretation of data always requires theoretical understanding of the research design

More than one IV?

- **The Classical ED always has one and only one IV**
- The IV (Independent Variable) is designated as **X**
- X is understood in **medicine** (e.g. a flu shot will improve the probability of not dying from influenza, in most cases)
- X is also fairly clear in agronomy and **crop science**
- X is also easy to understand in very simple examples (e.g. When King Louis XVI was taken to the **guillotine**-1793-the chopping off of his head caused him to die. But, was X really a heart attack?)
- Crime Scene Investigation (**CSI**) plots often hinge on X not really being the causal factor (e.g. bullet comes from far away on a very long trajectory)

A Second IV?

- The IV is designated as X
- A second IV is often designated as Z
- Then we can start with A, B, C, etc.
- That is because “Y” is often the letter used for the Dependent Variable
- In True (Classical) ED it is $X \text{ --- } Y$
- In Pre- & Quasi ED we still use $X \text{ ---- } Y$
- But when there is no ED we use “x” – “y”
- or x & z --- y, or x, y & a ---- y, etc.

History of Statistics

- **Fechner**, Gustav Theodor (1801-1887)
- 1860 book Elemente der Psychophysik
- “Psycho-physics of human sensitivity to various stimuli (e.g. sound, light, heat)
- Weber-Fechner Law (E. H. Weber !)
- **Fisher**, Ronald Aylmer (1890-1962)
- 1935 Design of Experiments (Edinburgh)

Latin Square Design

- Suppose you want to know whether the order of X, Z and A matters
- You could test X first, Z second and A third
- But you could also test Z first and X second, with A third
- Latin Squares takes all logical combinations of three IVs
- E.g. types of training exercises (X, Z, A)

Solomon Four-Group Design

- Combines: Classical and Pre-ED
- **Classical** Experimental Design
- ie. Randomized Two Group Pre- and Post-Test, and
- **Pre-Experimental** Design
- i.e. Randomized Two Group Post-Test only
- Adding the Pre-ED helps to cover the possibility that the Pre-Test affects Y

Review: Classical ED v. Special ED

- The “**Special**” EDs can be either Pre-ED or Quasi-ED
- “**Special**” ED is also a covering label for combinations of Classical (True) ED and one or more of the others
- In the literature authors often use the term “Quasi” to cover both Pre-ED and Quasi-ED
- The Logic of Method (Methodology) of True, Classical ED (and extensions of it) is what many authors mean by “the Scientific Method”, meaning the Methodology of **Positivist** Science

Research Design

- The term “Research Design” is used to mean even more general considerations than Experimental Design
- The Methodology of any research involves some kind of Research Design which, in turn, may involve some kind of Experimental Design as well
- But some RDs do not involve EDs!
- In Social Science we often do not use any kind of ED because we often do not do experiments!
- However, the Methodology of ED is basic

Research Design without Experiments?

- Most natural science and social science in the 21st century does NOT use ED (tt)
- The Scientific Method(ology) is no longer limited to ED (in all its forms)
- Statistical ideas are now based on more than ways to do something like a TED
- Yet, in the background, the logic of the TED Methodology is important for all Methodologies and Research Designs