Experimental, Quasi-Experimental, and Ex Post Facto Designs

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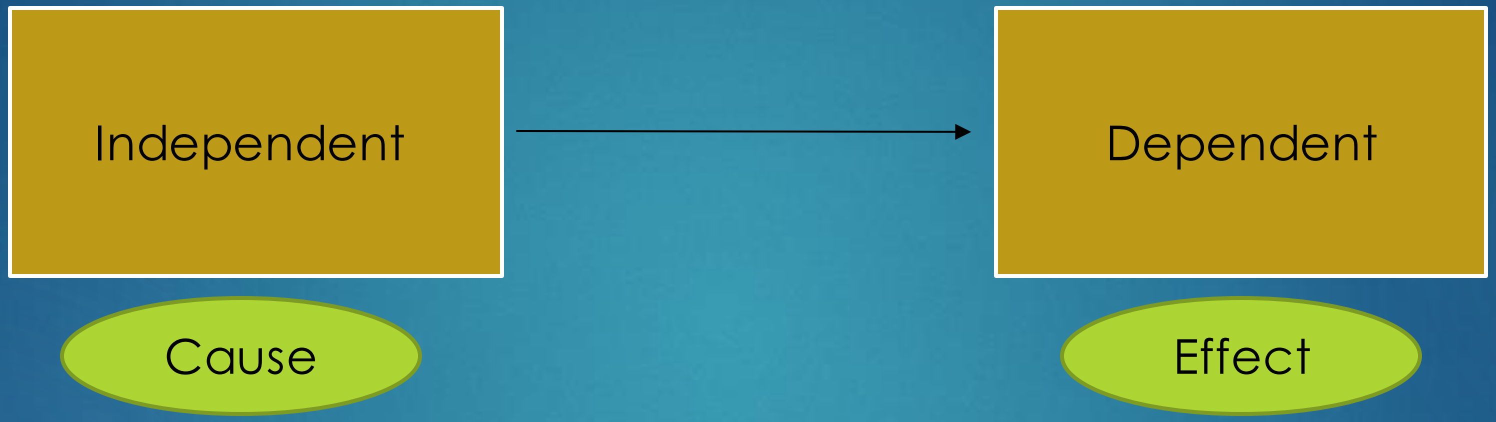
Independent VS Dependent Variable



- The **independent variable** is the **cause**. Its value is *independent* of other variables in your study.
- The **dependent variable** is the **effect**. Its value *depends* on changes in the independent variable.

Note: There can be multiple independent and dependent variables exist in an experiment

Internal Validity

Internal Validity

- The **internal validity** of a research study is the extent to which its design and the data it yields allow the researcher to draw defensible conclusions about cause-and effect and other relationships within the data
- With internal validity, results are more convincing
- Cause-and-effect can be concluded

Suspect Study #1

- A Study how humor effects soda sales
- Group 1 sees a famous/unfunny actor describes the taste
  - Takes place during March, April, May
- Group 2 sees a humorous scenario involving teens spraying soda in the summer
  - Takes place during June, July, August
- Soda sales are higher during June-August
- Does humor sell soda? Does summer play a role?

Suspect Study #2

- A test concerning a new method of teaching reading to children
- Ask for volunteers from 30 teacher
- 14 receive training, 16 do not
- Test scores are higher for students using the new method
- Does this prove the new method is better?
- Are the volunteers different from the non-volunteers?

Suspect Study #3

- A study for the effects of classical music on typists
- The psychologist meets with typists to explain the study
- Each day for a month, music is played for the typists
- At the end of the month, 30% increase in productivity
- Does it matter that the participants know they're in a study?
- Does it matter that they know the hypothesis?

Confounding Variables

Hawthorne and Novelty Effects

- Participants will change their behavior if they know they're in a study
- Some may change simply because they know they're being observed
- Some may want to help researcher
- The **Hawthorne Effect** is an example of reactivity
- **Reactivity** is a change in behavior of a participant because they know they're being observed
- Simple changes in an environment can cause behavior changes – **novelty effect**
  - A change, when reverted, can also modify behavior

Confounding Variables

- Confounding Variables
  - Compare two groups that may differ in ways in addition to intervention
  - Assess only one group before and after intervention
- There are famously 7 potential threats to internal validity
  - History, Maturation, Testing, Instrumentation, Statistical Regression, Selection, Attrition
- There are also 7 ways to control for confounding variables

Potential Threats to the Internal Validity

- Certain intervention will change the states of confounding variables and thus pose threat to the internal validity.
- **1. History:** Intervention changes the dependent variable after its pre-assessment but before the post assessment.
  - *Example*: A certain noteworthy accident happened and totally changed people's views on a political candidate
- **2. Maturation:** A change in participants' characteristics or abilities Is simply the result of the passage of time.
  - *Example*: Children might take normal developmental gains in eye-hand coordination
- **3. Testing:** Taking a test at one time influences participants' performance during the experiment.
  - *Example*: Multiple choice can enhance the test-taking ability of a participant

Potential Threats to the Internal Validity

- **4. Instrumentation:** A change occurs in how an assessment instrument is administered or scored from one time to the next.
  - *Example:* A testing equipment is broken during the experiment.
- **5. Selection:** A bias exists in how members of different groups in a study chosen.
- **6. Attrition:** Members of different groups drop out of a study at proportionally different rates.
  - *Example:* One group loses 5% of its members before the final assessment while the other group loses 30%.
- **7. Statistical Regression:** Extreme performers during testing become mean scorers when tested again

Controlling for Confounding Variables

#1 – Keep some things constant

- When a factor is the same for all, it cannot be the source of differences in results
- Participants may be selected to share characteristics
- Too much restriction can affect external validity

#2 – Include a Control Group

- In the typing example, music group couldn't be compared
- Control group: Participants that receive no treatment meaning minimal impact on dependent variable
- Experimental/Treatment group: Participants receive treatment, impacting dependent variables
- People in control may get placebo: fake treatment that seems impactful to participants but isn't. There are ethics:
  - Participants must know someone is getting a placebo
  - If placebo is for health treatment, participants should receive effective treatment after testing
  - If situation is life-threatening, the researcher must decide if anything can be gained from control and if that is worth human lives

#3 – Conduct a Double-Blind Experiment

- Double-Blind Experiment: participants and researchers are not told who is receiving real and fake treatment
- Administrators do not tell researchers who receives what
- Some make administer equally convincing treatments and placebos

#4 – Randomly assign people to groups

- Random selection of participants increases the likelihood that sample results reflect population results
- Randomly assigning people to groups is also beneficial
- If certain qualities are difficult to keep consistent or measure, random group assignment helps
- Random selection lets us say that groups are similar and differences between them are due to chance

#5 – Use pretests to assess equivalence before treatment

- Random assignment may not be possible for predetermined-groups (school, office, etc)
- Instead try to assess qualities to determine similarity of groups
- Matched Pairs: find pairs of people who share similar characteristics and place in different groups
  - Grouping by age, sex, IQ, etc
- Only rule out assessed variables that are deemed equivalent

#6 – Expose participants to all experimental treatments

- Use participants as their own control
- Any independent variable that is varied for each participant is called a within-subjects variable (also called repeated-measures variable)
- If you're testing lecture style vs information retention, test all groups with lectures of each style

	First Part	Middle Part	Last Part
Group 1	Attention	Imagery	Control
Group 2	Control	Attention	Imagery
Group 3	Imagery	Control	Attention

#7 – Statistically Control for Confounding Variables

- Some researchers can control for known confounding varibles
- Partial correlation, analysis of covariance, structural equation modeling
- Statistical control is not a substitute for design control

Types of Design

- Different kinds of research designs have emerged. Each has their own extent to which they modify independent variables and control for confounding variables. Therefore, each has their own degree of internal validity
- 5 kinds general kinds of possible designs are discussed
- Pre-experimental, true experimental, quasi-experimental, ex post facto, and factorial
- Note: Tx=treatment, Obs=Observation, ____=Nothing occurs, Exp=experience that some have/haven't had

Group	Time->		
Group 1			
Group 2			

Pre-Experimental Designs

One-shot Experimental Case Study

- A treatment is introduced and then observation is made to determine the effect of treatment
- Low internal validity
  - Effects may be results of preconditions or from environment
- Many misconceptions start with these kinds of studies
- If a child walks on grass and then is sick, did the grass cause sickness? Perhaps it was cold

Group	Time->	
Group 1	Tx	Obs

One-Group Pretest-Posttest Design

- Pre-experimental assessment, treatment, post-experimental assessment
- Test pests on corn before treatment, treat, test pests on corn after treatment
- Change can be recorded, but effects are still hard to determine

Group	Time ->		
Group 1	Obs	Tx	Obs

Static Group Comparison

- Uses an experimental and control group
- Give treatment to experiment, no treatment to control
- After treatment, assess each group and compare
- No attempt at equivalent groups or examination of similarity

Group	Time ->	
Group 1	Tx	Obs
Group 2	_____	Obs

True Experimental Designs

Control-Group Pretest-Posttest Design

- Two groups with one being experiment and another one is control group.
- The groups are randomly assigned
- Assessment are taken once before experiment and once after
- Solve two issues
  - See if a change happened after treatment
  - Eliminate most other possible explanations

	Group	Time ->		
Random Assignment	Group 1	Obs	Tx	Obs
	Group 2	Obs	___	Obs

Solomon Four Group Design

- The pre-experiment assessment could influence the result. (confounding variable)
- We treat the assessment as another variable.
- Create 4 groups to analyze this effect.
- Improves generalizability by allowing for more group comparison

	Group	**Time ->**		
Random Assignment	Group 1	Obs	Tx	Obs
	Group 2	Obs	___	Obs
	Group 3	___	Tx	Obs
	Group 4	___	___	Obs

Control-Group Posttest-Only Design

- In some situations, it is impossible to do pre-experiment assessment
  - Thunderstorm, crop growth,etc
- Random Assignment is absolutely critical, otherwise this is only a static group comparison

	Group	Time -->	
Random Assignment	Group 1	Tx	Obs
	Group 2	___	Obs

Within-Subjects Design

- A *subject* is a more general term than participant
  - Rats, dogs, etc
- All participants receive treatment and control conditions
  - Ideally, two different treatments
  - Administered in close proximity
- The treatment should not "spread" beyond targeted behavior
- Study difference between treatments

	Group	**Time -->**	
Random Assignment	Group 1	TxA	ObsA
		TxB	ObsB

Quasi-Experimental Designs

Quasi-Experimental Designs

- Randomness is important in design
- Sometimes, true randomness is not possible
- Not all confounding variables can be controlled, so some alternative explanations cannot be ruled out

Nonrandomized Control-Group Pretest-Posttest Design

- Compromise between static group and control group pre/post test
- No random group assignment, so no guarantee of similar group structure
- Addition of preassessment can confirm if two groups are similar, at least with respect to the dependent variable
- Using matched pairs can strengthen design

Group	Time ->		
Group 1	Obs	Tx	Obs
Group 2	Obs	____	Obs

Simple Time-Series Design

- If we take a series of observations, we can notice any trends
  - Called Baseline Data
- If, after treatment, the observations change, we could reasonably conclude that the treatment caused the change
- The discovery of penicillium was found this way
  - Alexander Flemming observed a culture on a plate. After introducing penicillin, the nearby mold disappeared

Group	Time ->								
Group 1	Obs	Obs	Obs	Obs	Tx	Obs	Obs	Obs	Obs

Control-Group Time-Series Design

- Similar to the previous design, but a control group is added that doesn't receive treatment
- Slightly improved internal validity
- If an outside event caused the change rather than the treatment, we would expect those changes to occur in the control group as well

Group	Time ->								
Group 1	Obs	Obs	Obs	Obs	Tx	Obs	Obs	Obs	Obs
Group 2	Obs	Obs	Obs	Obs	____	Obs	Obs	Obs	Obs

Reversal Time-Series Design

- Within-subjects approach as a way of minimizing probability of outside effects causing changes
- The treatment is sometimes present, sometimes not but with regular assessments
- An example is provided of 'liking' a friends post on facebook vs how often they post

Group	Time ->							
Group 1	Tx	Obs	____	Obs	Tx	Obs	___	Obs

Group	Time ->							
FB Friends	Like	Count Posts	____	Count Posts	Like	Count Posts	___	Count Post

Alternating-Treatments Design

- Similar to previous, but with different treatments
- In between phases of not treating, change treatments
- Over a long time, we would hopefully see different effects from different treatments

Group	Time ->									
Group 1	Tx1	Obs	___	Obs	Tx2	Obs	___	Obs	Tx1	Obs

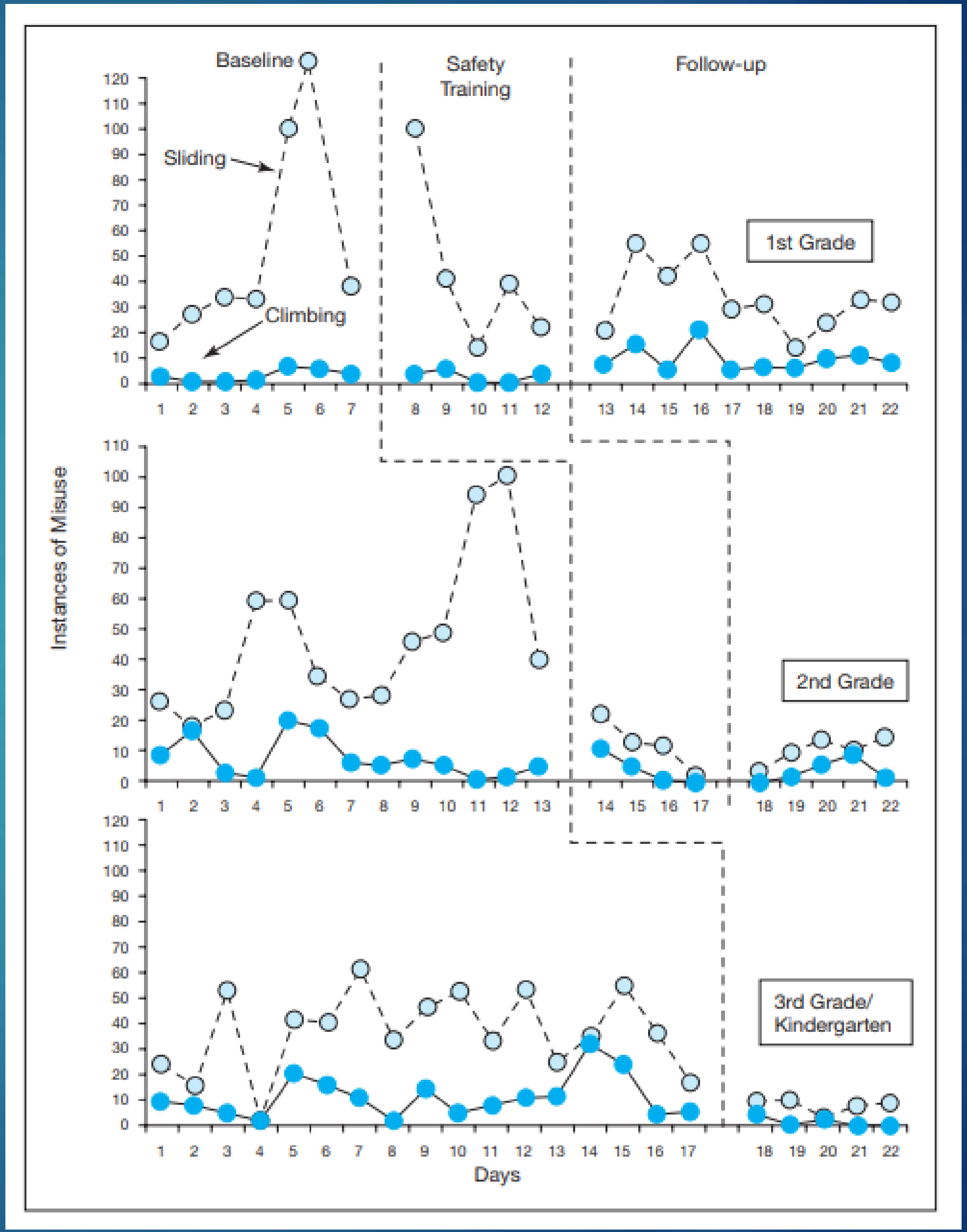
Multiple-Baseline Design

- Based on the assumption that the effects of a single treatment are temporary/limited
  - Won't work if treatment is expected to have long-lasting results
- If a treatment stands to benefit the participants, it may be more ethical to include all
- Perform a simple time-series design, but have differing baselines

Group	**Time ->**					
Group 1	Baseline		Treatment			
	__	Obs	Tx	Obs	Tx	Obs
Group 2	Baseline				Treatment	
	__	Obs	__	Obs	Tx	Obs

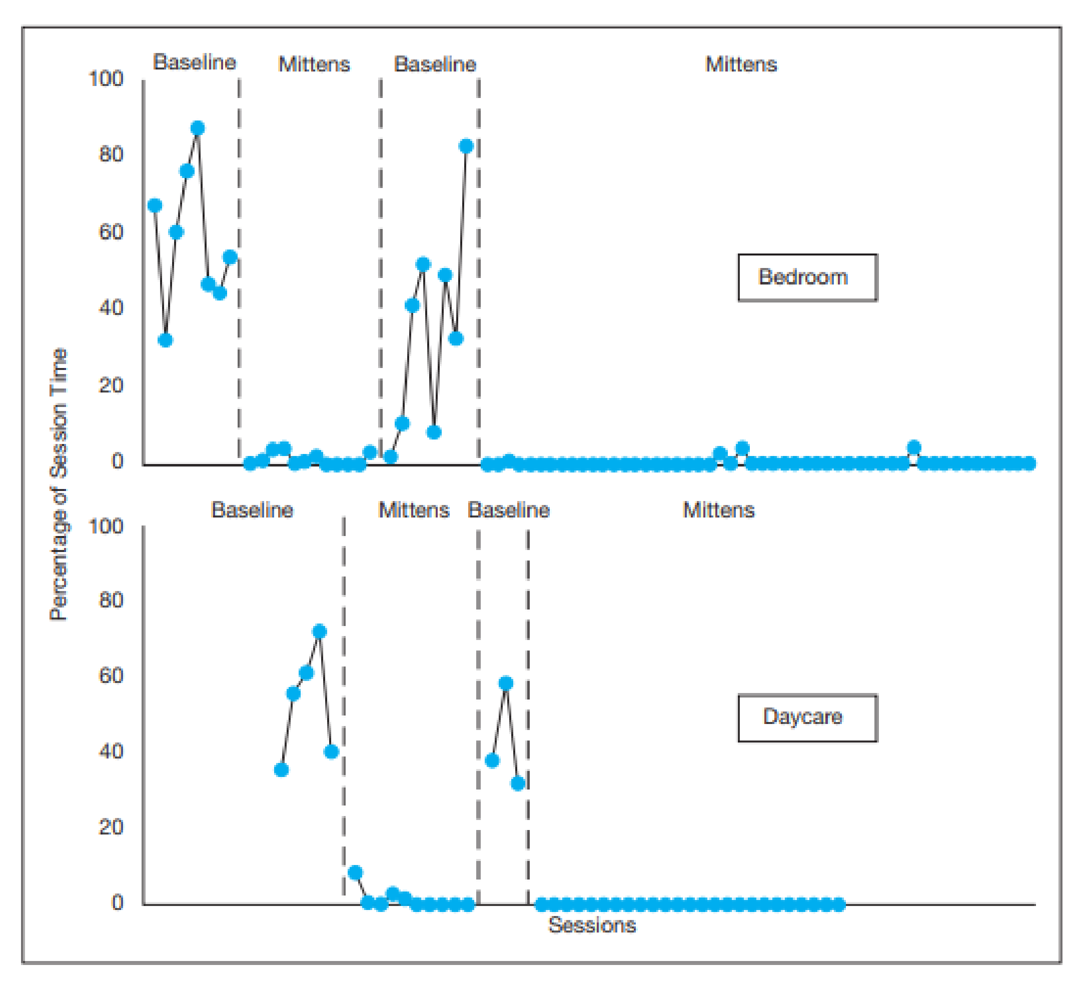
Example

- Would playground safety instruction decrease risky behavior
- People observed children's behavior before and after instruction
  - This was done double-blind
- In 2nd/3rd case, the risky behavior was reduced following the training
- First graders did not see much improvement. May be due to external factors like instructors first time



Single-Case Intervention

- Single-case Intervention: a reversal time-series, alternating treatment, and multiple baseline design might be used with a single individual or group
- Example shows a combo reversal and multiple-baseline design
- Other cases with multiple groups called multiple-case intervention research



Ex Post Facto Designs

Ex Post Facto

- Used in situations where it is impossible or unethical to manipulate certain variables.
- Ex Post Facto Designs: (*ex post facto* means after the fact) Research identifies events that have already occurred or conditions that are already present and then collects data to investigate a relationship between those factors and subsequent behaviors
  - Ex-Hurricane
- Independent and dependent variables can clearly be identified
- However, there is no modification of independent variables
- The "cause" has already occurred

Simple Ex Post Facto Design

- Timing is critical as it determine what you are studying
  - For illness, time can change symptoms
- Called Experience (EXP) since it was not an issued treatment

Group	Time -->	
	Prior Events	Investigation Period
Group 1	Exp	Obs
Group 2	___	Obs

Factorial Designs

Two-Factor Experimental Design

- Factorial Design: two or more independent variables are tested
- Here, only two independent variables are studied
- Treatments related to the two variables may occur simultaneously or sequentially
- Similar to the Solomon four-group design
- Study not only variables, but interaction of variables

		Treatment Related to variable 1	Treatment Related to Variable 2	
Random Assignment	Group 1	Tx1	Tx2	Obs
	Group 2	Tx1	___	Obs
	Group 3	___	Tx2	Obs
	Group 4	___	___	Obs

Combined Experimental And Ex Post Facto Design

- Studies how two manipulation variables can influence a particular dependent variable and how a previous experience might interact with such manipulation
- In this case, experience acts as a moderating variable that modifies treatment
- Two groups are selected from population based on prior experience (ex post facto part)
- There are many combinations of experimental and ex post factor designs
  - Ex: Within-subjects+Ex post facto (maps vs degree study)

Group	**Time ->**				
	Prior Events	Investigation Periods			
Group 1	ExpA	Random Assignment	Group 1a	TxA	Obs
			Group 1b	TxB	Obs
Group 2	ExpB	Random Assignment	Group 2a	TxA	Obs
			Group 2b	TxB	Obs