Research Methods
RES 800

Experimental Design

What We Will Cover in This Section

- Overview.
- Basic requirements.
- Between subjects designs.
- Within subjects designs.
- Factorial designs.
- Pre-experimental designs.

Field Research Example

- In 1984 Pittsburgh National Bank had a problem with their tuition reimbursement program.
- They were paying tuition and fees for employees seeking bachelors degrees.
- Approximately 45% of the people did not want to work in the field in which they majored.
- The bank was prepared to scrap the program.

Experimental Design #1

	Independent Variable	Dependent Variable
Experimental Group	342 people who attended workshop	Job posting Applications 70% Promotions: 12% Salary/grade change: 91%
Control Group	450 people who did not attend the workshop.	Job posting Applications 23% Promotions: 3% Salary/grade change: 66%

Experimental Groups

EXPERIMENTAL GROUP

The group that gets the treatment you are interested in.

CONTROL GROUP

Additional group included in the experiment against which experimental treatments can be compared.

Control Group Considerations

- May get something different than the experimental treatment.
  - Aspirin vs. Sugar pill in treatment of knee joint pain.
- May be different levels of the experimental treatment.
  - Is it easier for a person to read an automobile dashboard at night with a red illumination or green illumination?

Experimental Variables

DEPENDENT VARIABLE

The variable that is measured in an experiment.

INDEPENDENT VARIABLE

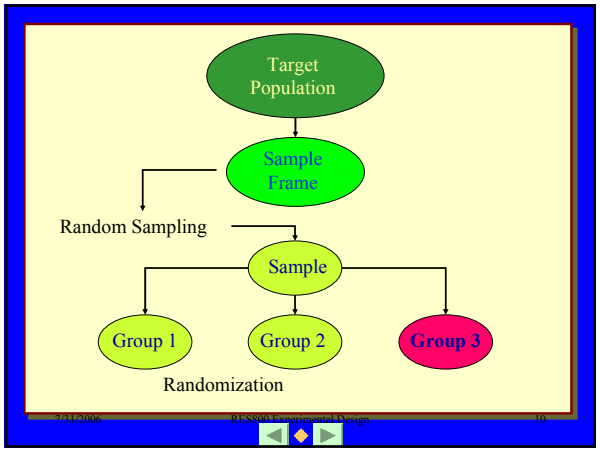
The treatment that the experimenter manipulates or controls.

Basic Design

Treatment Groups	Independent Variable	Dependent Variable
Group 1	Treatment (s) controlled by the experimenter	Measurement(s) made after the treatments are applied.
Group 2		

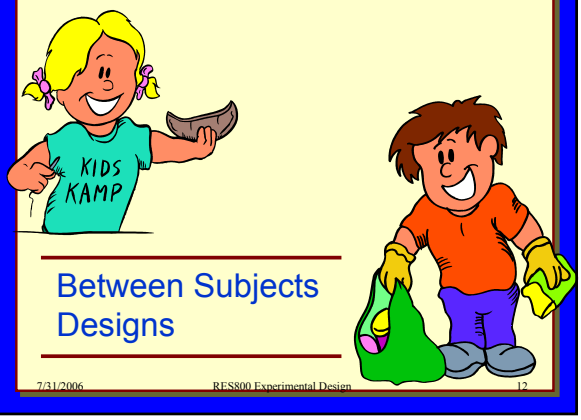
Basic Requirements

- Two or more groups.
- Participants randomly assigned to treatment groups.
- One or more experimental treatment conditions.



Characteristics of Good Treatments

- Construct valid.
  - Right operational definition.
- Strength
- Reliable.
- Multiple levels.
- Multiple stimuli.



Between Subjects Designs

Basic Characteristics

- Two or more treatment conditions.
- Subjects exposed to only one treatment condition and one treatment level.

Randomized Post-test Only Control Group

	Independent Variable	Dependent Variable
SS_1 SS_2 SS_3	Treatment 1	Measure
SS_4 SS_5 SS_6	Treatment 2	Measure

Randomized Pre-test Post-test Control Group

	Pre-test	Independent Variable	Post-test
SS_1 SS_2 SS_3	Measure A	Treatment 1	Measure A
SS_4 SS_5 SS_6	Measure A	Treatment 2	Measure A

Pre-test, Post-test

Benefits.

1. Evaluate the assumption that the groups are alike.
2. Look at the extent of change.
3. Evaluate the influence of participant mortality.

Issues

1. Takes time.
2. Demand characteristics.
3. Carry over effect.
4. Testing reactivity.
5. History.

Matched Random Assignment

	Independent Variable	Post-test
SS_{1A} SS_{2B} SS_{3C}	Treatment 1	Measure A
SS_{4A} SS_{5B} SS_{6C}	Treatment 2	Measure A

Matched Random Assignment

- Group 1
  - S1. Smartest
  - S2. 4th Smartest
  - S3. 5th Smartest
  - .
  - .
  - .
- Group 2
  - S1. 2nd Smartest
  - S2. 3rd Smartest
  - S3. 6th Smartest
  - .
  - .
  - .

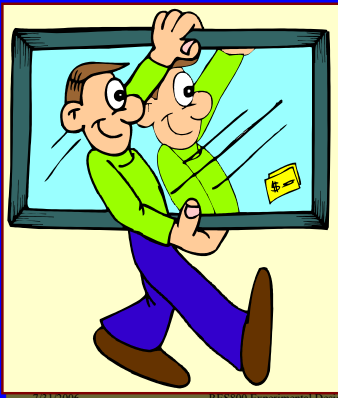
Matched Random Assignment

Benefits

1. Minimizes probability that groups will be different on a key variable.
2. Reduces random subject error.

Issues.

1. Time consuming.
2. Never sure you have controlled for all variables.
3. Complicated with multiple variables.



Within Subjects Designs

Within Subjects Design

Participants are exposed to more than one level of the experimental treatment.

– Sometimes called a repeated measures design.

Within Subjects Design

	Independent Variable	Post-test
SS_1 SS_2 SS_3	Treatment 1	Measure A
SS_1 SS_2 SS_3	Treatment 2	Measure A
SS_1 SS_2 SS_3	Treatment 3	Measure A

Example

Larry Leche was interested in chocolate preferences. He got a group of volunteers and had them eat some milk chocolate, then evaluate it. Second they all ate a piece of German chocolate and evaluate it. Finally, he had them eat dark chocolate and evaluate this.

Leche's Design

	Trial 1	Trial 2	Trial 3
S1	Milk Chocolate	German Chocolate	Dark Chocolate
S2	Milk Chocolate	German Chocolate	Dark Chocolate
S3	Milk Chocolate	German Chocolate	Dark Chocolate

Question!

What is a major problem with this design?

Benefits and Issues

Benefits.

1. Fewer participants.
2. Reduce subject variability.

Order effects.

1. Practice effect.
2. Fatigue effect.
3. Carryover effect.
4. Sensitization effect (demand characteristics).

Counterbalancing

	Trial 1	Trial 2	Trial 3
S1	Milk Chocolate	German Chocolate	Dark Chocolate
S2	Dark Chocolate	Milk Chocolate	German Chocolate
S3	German Chocolate	Dark Chocolate	Milk Chocolate

Counterbalancing

- Varying the order of the presentation of the independent variable.
- Full counterbalancing.
  - Issue here is the number of possibilities is N!.
- Randomized blocks.

Multiple Variable (Factorial) Designs

Factorial Design

A design in which each participant is exposed to two or more treatments.

Example

Dr. Albert Angst was interested in the influence of anxiety on task performance. He felt that anxiety would enhance performance on easy tasks but would be a detriment when the task was difficult.

Dr. Angst developed both an easy task and a difficult task. He then had three stress conditions: low, moderate, and high.

His prediction was that subjects would do well on both tasks when the stress level was low. He felt that the performance for the difficult task would decrease as the stress got higher but that the easy-task group's performance would get better as the stress level increased.

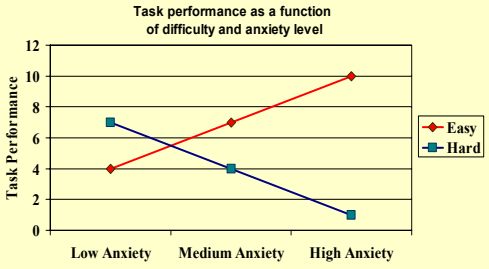
Question?

- How many independent variables are there?
- What are they?
- How many dependent variables are there?
- What are they?

Results

	Stress Level			
Task	Low	Medium	High	Mean
Hard	6.5	4.0	1.0	3.83
Easy	4.0	6.5	10.0	6.83
Mean	5.25	5.25	5.50	

Example #1



Outcomes

Main Effect

The influence that one variable alone has independently of the other variables.

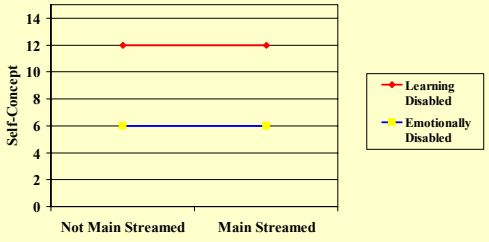
Interaction

The influence that two or more variables have on the dependent variable over and above their main effects.

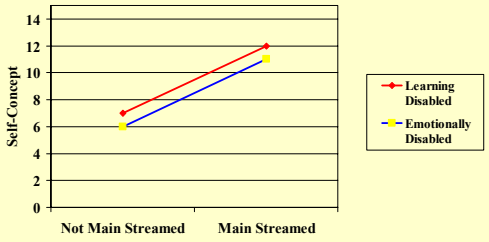
Example #2

Vera Similitude was interested in the impact of main streaming on the Self-Concept of Learning Disabled and Emotionally Disabled Students. She identified one group of Learning Disabled students and had them randomly assigned to either Main Stream condition or Non Main Stream Condition. She did the same for a group of Emotionally Disabled students.

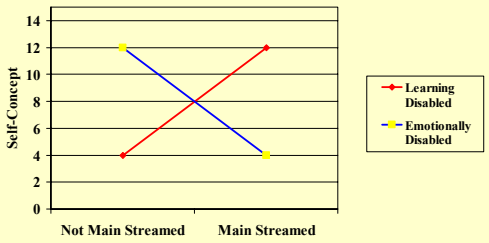
Example #2: Main Effect for Condition



Example #2: Main Effect for Class



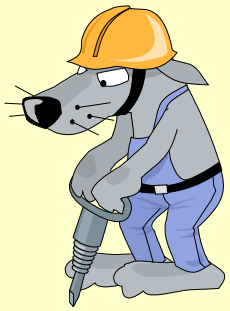
Example #2: Interaction



Uses of Factorial Designs

1. Testing for moderator effects.
2. Are there order effects.
3. Controlling extraneous variables.

Internal and External Validity



Internal Validity

- Refers to
  The accuracy of the research in determining the relationship between the independent and dependent variables.
  - Applies to experimental research.
  - Can I unambiguously conclude that the independent variable caused a change in the dependent variable.

Confounding

Any variable other than the independent variable that could reasonably have caused changes in the dependent variable.

Confounding Variable: Example

	Independent Variable	Dependent Variable
Confounded by time of day.	Given orange juice in the morning	Alertness two hours later.
	Given distilled water in the evening	

Reactivity

Demand Characteristics

- *Cues in the research setting that allow the participant to form their own opinions about the research hypothesis.*

Controlling for Demand Characteristics

1. Cue reduction.
2. Separate the dependent variable from the study (unobtrusive).

Experimenter Reactivity

1. Biased observation.
2. Influencing participants' responses.

Reducing Experimenter Effects

1. Rehearsal.
2. Monitoring.
3. Minimize experimenter influence.
4. Use double blind.
5. Minimize data snooping.

External Validity

The extent to which research results can apply to a wide range of situations.

Key Learning Point

Internal validity is a prerequisite for external validity.

Experimental Design Flowchart

Thought Problem #1

Wayne D. Back believed that people who sat in the front of busses would be more content than people who sat in back of busses. Wayne selected a number of busses at random and gave surveys to people in the front seats and surveys to people who were sitting in the rear seats.

1. **Is this a good or bad experimental design? Why?**
2. **How could this study be improved?**

Thought Problem #2

Pickup N. Dropoff wanted to evaluate the influence of Jolt on the driving habits. Dropoff had a group of people drink 12 oz of Jolt, then assessed their ability to drive through a set of traffic cones. Dropoff then waited an hour and had the people drive through the cones again. He evaluated the differences number of cones hit.

1. **What kind of design is this?**
2. **Is this a good or bad design? Why?**
3. **If bad, how could this study be improved?**

Thought Problem #3

Hugh Jass was interested in the influence of dieting plans. He selected a group of people who were considered to be extremely overweight. He randomly assigned the volunteers to one of two groups. One group participated in a diet of dried fruits, berries and sushi. The second group ate canned beets and beer.

1. **What kind of design is this?**
2. **Is this a good or bad design? Why?**
3. **How could this study be improved?**

The End