Experimental Design

Psychology 280 Lecture
Orange Coast College
3/13/2006

Confounding and Internal Validity

- Experimental method has the advantage of allowing a relatively unambiguous interpretation of the results.
  - Manipulated independent variable
    - Create groups that differ in the levels of the variable
    - Compares the groups in terms of their scores on the dependent variable
    - All other variables kept constant through direct experimental control and/or randomization

Confounding and Internal Validity (con't)

- A confounding variable...
  - Is a variable that varies along with the independent variable
  - Occurs when the effects of two independent variables are intertwined so you can't determine which variable is responsible for the observed effects!
- An experiment is said to have internal validity when the results of an experiment can confidently be attributed to the effect of the independent variable.
- A good experimental design eliminates possible confounding to reduce alternative explanations

Basic Experiments

- Simplest possible experimental design
  - Two variables – one independent variable and one dependent variable
  - One independent variable with two levels (an experimental group and a control group)
  - Randomization
  - Experimental control

Basic Experiments (con't)

- The basic, simple experimental design can take on of two forms
  1. Posttest-only design
  2. Pretest-posttest design

Basic Experiments (con't)

- The posttest-only design
  1. Obtain two equivalent groups
    - Groups must be equivalent to eliminate selection differences. Subjects must not differ in any systematic way.
  2. Introduce the independent variable
  3. Measure the effect of the independent variable on the dependent variable
Posttest-only design

- Independent variable
- Dependent variable

Participants → Experimental group → Measure

R

Control group → Measure

R

“R” = random assignment to conditions

Pretest-posttest design

- Same as a posttest-only design but adds a pretest before the experimental manipulation
- Allows the researcher to ascertain if the groups are equivalent at the beginning of the experiment
  - Not necessary if participants were randomly assigned to the two groups especially if a large sample is used
  - A large sample increases the likelihood that the groups will not differ in any systematic way prior to the manipulation of the independent variable
  - As a rule of thumb, 20 to 30 participants PER CONDITION is considered an adequate sample

Advantages and Disadvantages of the two basic designs

- Advantages of the pretest-posttest design
  1. Assess equivalency with small sample size
  2. Select the participants for the experiment
  3. Assess the effects of mortality

- Disadvantages of the pretest-posttest design
  1. Time consuming and awkward to administer
  2. Sensitize participants to what is being studied
     - Demand characteristics
     - External validity
     - Possible solutions: disguise pretest, embed the pretest in another measure, concealed observation

Assess directly the impact of the pretest by using a Solomon four-group design

- Half the participants receive only the posttest
- Half the participants receive both the pretest and posttest
- If no impact of the pretest, the posttest scores will be the same
  - In the two control groups (with and without the pretest)
  - In the two experimental groups

Solomon Four-Group Design Example
Assigning Participants to Experimental Conditions

- Independent groups design
  - Participants randomly assigned to conditions
  - Participants are in only one group

<table>
<thead>
<tr>
<th></th>
<th>Low-meaningful</th>
<th>High-meaningful</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 randomly assigned participants</td>
<td>Another 10 randomly assigned participants</td>
<td></td>
</tr>
</tbody>
</table>

Assigning Participants to Experimental Conditions (con’t)

- Repeated measures design
  - The same participants are in all of the groups

<table>
<thead>
<tr>
<th></th>
<th>Low-meaningful</th>
<th>High-meaningful</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 participants</td>
<td>The SAME 10 participants</td>
<td></td>
</tr>
</tbody>
</table>

Assigning Participants to Experimental Conditions (con’t)

- Advantages and disadvantages of repeated measures designs
  - Advantages
    1. Fewer participants
    2. Extremely sensitive to statistical differences
       (more likely to detect an effect of the IV on the DV)
       - There are individual differences among participants, usually termed random error, that are minimized with using repeated measures designs
  - Disadvantages
    1. Order effects (the order of presenting the treatments affects the dependent variable)
       - Practice effects
       - Fatigue effects
       - Exposure to the second condition is altered due to the comparison of the two conditions (less severe vs. more severe crime)

Assigning Participants to Experimental Conditions (con’t)

- Approaches to deal with order effects
  - Counterbalancing techniques
    1. Complete counterbalancing
    2. Latin square
  - Randomized blocks
  - Time interval between treatments

Assigning Participants to Experimental Conditions (con’t)

- Complete counterbalancing
Assigning Participants to Experimental Conditions (con’t)

Latin square

<table>
<thead>
<tr>
<th>Row</th>
<th>Order of conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A (60) B (100) C (50) D (120)</td>
</tr>
<tr>
<td>2</td>
<td>C (180) A (60) B (50)</td>
</tr>
<tr>
<td>3</td>
<td>D (120) A (60) C (180)</td>
</tr>
<tr>
<td>4</td>
<td>B (50) C (180) D (120)</td>
</tr>
</tbody>
</table>

Matched pairs design – ensures groups are equivalent on the matching variable prior to the IV
- Match participants on a particular characteristic (either the dependent measure or a variable strongly related to the dependent variable).
- After matching, randomly assign to experimental conditions

Developmental Research Designs

- Developmental psychologists often study the ways that individuals change as a function of age.

1. Cross-sectional method – measured at one point in time
2. Longitudinal method – same group observed at different times as they get older
3. Sequential method – combination of 1 & 2

Developmental Research Designs (con’t)

- Design considerations
  - Cohort effects
  - Mortality effects
  - Monetary costs
  - Difficulty level